PREVALENCE AND RELATION OF URINARY TRACT INFECTION BACTERIAL PATHOGENS TO SEX AND AGES AMONG PATIENTS IN THREE ARAB COUNTRIES

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ABSTRACT:

Background: urinary tract infections is one of the most prevalent bacterial infections worldwide. The present study aims to study and survey different isolates from urine specimens from different countries to assess their prevalence and their relation to urinary tract infections. One hundred and sixty-eight samples were randomly collected from three countries, Egypt, Sudan and Saudi Arabia, as follows: 43, 33 and 92, respectively. Samples were collected from private laboratories and from both sexes. The ages of the patients differed between three years and 89 years for females and from one year to 85 years for males between 4 / 2015-7 / 2016. All samples were inoculated on different selective and differential sterile culture media. After growth, isolated bacteria were identified by physiological and biochemical characteristic. Among all clinical samples, five bacterial genera were detected. The isolates were identified as **Escherichia coli** (93), **Klebseilla spp**. (32), **Pseudomonas spp**. (26), **Proteus spp**. (14), and **Staphylococcus spp**. (3). Regarding the sex of the patient, this study showed that females are more likely to be infected than males, with 53 (31.55%) of the patients being males and 115 (68.45%) of being females. The most common UTI bacterium was **Escherichia coli,** followed by **Klebseilla spp**. Majority of female infected cases were in menstruation age stage (14-44 years), while majority males were in old age stage (52-85 years). Surveys and studies of infectious factors are considered one of the most important epidemiological tools for tracking infectious diseases and predicting disease patterns, especially with regard to urinary tract infections due to their widespread prevalence and serious complications between the sexes at the global level.

Keywords: bacterial pathogens; urinary tract infections; clinical samples

Introduction:

Urinary tract infections (UTIs) are known as microbial permeation of sterile urinary tract and is one of the most prevalent bacterial infections globally. It include infections of the urethra, bladder, ureters, and kidney (Barber *et al*., 2013). It is considered as a significant cause of morbidity in infant boys and in older men and women of all ages by causing serious consequences include recurrent infection, pyelonephritis with sepsis, kidney damage in young children, and premature birth (Flores-Mireles *et al*., 2015). UTIs in pregnant women are associated with an increased risk of maternal and neonatal illness and death, even when the infection without symptoms (Gilbert *et al*., 2013).

Various bacterial pathogens are responsible for UTI including *Escherichia coli, Proteus spp., Klebsiella spp.* and *Staphylococcus spp.* (Amdekar *et al*., 2011). *Escherichia coli* have been found to be the most common causative organism of UTI in many countries (Samra *et al*., 2005). Globally, *E. coli* is the most common pathogen causing UTIs, it causes 80–85% of cases (Abraham & Miao, 2015, Tandogdu & Wagenlehner, 2016).

Klebsiella pneumonia is the species of aerobic Gram-negative bacteria, it is the most relevant human pathogen within genus *Klebsiella* spp., and it is causing many infections worldwide including urinary tract and it is the most important microorganism causes urinary tract infection, next to *Escherichia coli* (Cristea *et al*., 2017) *Peudomonas aeruginosa* is an opportunist microbe and it is one of urinary tract infection microbes (Tumbarello *et al*., 2020). It is even the third most common pathogen-related with hospital-acquired catheter-associated UTIs (Jarvis & Martone, 1992). *Proteus mirabilis* is also a frequently pathogen of the urinary tract, especially in patients undergoing long-term catheterization (Schaffer & Pearson, 2015). The most common clinical appearance of *Proteus* infection is urinary tract infections and ninety percent of *Proteus* infections occur as a result of *Proteus mirabilis* (Jamil *et al*., 2019). *Staphylococcus aureus* is significantly isolated from urine samples obtained from long-term care patients (Muder *et al*., 2006).

Consequently, it is assumed that there will be a continuous follow-up to reveal the extent of these UTI pathogens and to see whether they are increasing or not by comparing recent results with the results of previous studies and to examine their prevalence among different countries. Therefore, this study aimed to isolate, identify and characterize of UTI bacterial pathogens from Egypt and surrounding countries Sudan and Saudi Arabia to assess their prevalence.

Materials and Methods

Samples collection

One hundred and sixty-eight samples were collected randomly from three countries, Egypt, Sudan and Saudi Arabia as the following 43, 33 and 92, respectively. The samples were collected from private laboratories and from two genders. The

patients' ages were ranged from 3 years to 89 years in females and from one to 85 years in males, in the period between April 2015 to July 2016.

Cultivation of samples

The samples were transported safely into the private laboratory according to the microbial laboratory guide transfer (Cheesbrough, 2006). The samples were inoculated on various media by streaking technique; then incubated overnight at 37°C. The cultured media for bacterial isolates were Cysteine–lactose–electrolyte-deficient agar (C.L.E.D) (Sandys, 1960), Muñoz *et al*., 1992); Sheep blood agar, (Spector, 1961); MacConkey agar (MacConkey, 1900), Chocolate agar (McLeod *et al*., 1927), and Thayer martin agar (Thayer & Martin, 1964).

Isolation and identification

The obtained bacterial isolates have been secluded from pure colonies then scanned microscopically by using Gram stain method to differentiate between Gram-negative and Gram-positive bacteria (Coico, 2006). The identification experiments including the cultural, morphological, and physiological specifications of each isolate were done as previously described (Alfred & Heidi, 2015). The biochemical tests utilized for isolates definition involved the following: catalase and coagulase tests; Novobiocine susceptibility; oxidase, indole, urease and citrate tests; lactose, glucose, and mannitol fermentation; and hydrogen sulfide test (Cheesbrough, 2006).

Statistical analysis

All data involved were evaluated statistically by the statistical package, IBM SPSS version 23.

Results:

The study included 168 urine samples that were collected from different countries, gender and ages. The samples have been distributed according to several considerations as follows:

Samples distribution by countries

A total of 168 samples have been collected to be examined were distributing among three countries, Egypt, Sudan and Saudi Arabia as following: 43, 33 and 92 samples, respectively **(Fig.1).**

Distribution of samples according to gender.

Out of total samples, 115 (68.45%) were females and 53 (31.55%) were males **table (1)** and (**Fig.2**). Regarding countries distribution, in Egyptian samples, 51.16% were females and 48.84% were males. For Saudi Arabia, 84.78% of total samples were females and 15.22% were males. Whereas for Sudan samples, 45.45% were females and 54.55% were males (**Fig. 3).**

Identification and prevalence of isolates

From the total identified isolates, *E. coli* were predominant with 93 strains (55.36%), followed by *Klebseilla* spp. with 32 strains (19%), *Pseudomonas* spp. with 26 strains (15.48%), *Proteus* spp. with 14 strains (8.33%) and *Staphylococcus* spp. with 3 strains (1.79%) (**Fig.4**). The majority of isolated bacteria from Egypt were *E. coli* with 29 strains (67.44%), followed by *Pseudomonas* spp. with 8 strains (18.6%), *Klebsiella* spp. with 5 strains (11.63%) and *Staphylococcus* spp. with one strain (2.33%), while there is no *Proteus* spp. For Saudi Arabia, the most common were also *E. coli* with 48 strains (52.17%), followed by *Klebseilla* spp. with 20 strains (21.74%), *Proteus* spp. with 14 strains (15.22%), *Pseudomonas* spp. with 8 strains (8.7%) and *Staphylococcus* spp. with 2 strains (2.17%). The most common isolates obtained from Sudan were also *E. coli* with 16 strains (48.48%), followed by *Pseudomonas* spp. with 10 strains (30.3%), and *Klebsiella* spp. with 7 strains (21.21%), while *Proteus* spp. and *Staphylococcus* spp. were not detected in the examined clinical samples **(Fig.5).**

Distribution of isolates between males and females

The majority of isolates in female were *E. coli* (58.26%), followed by *Klebsiella* spp. (22.61%), *Pseudomonas* spp. (9.57%), *Proeus* spp. (7.83%) and *Staphylococcus* spp. (1.74%), while in male were *E. coli* (49.1%) followed by *Pseudomonas* spp. (28.3%), *Klebsiella* spp. (11.32%), *Proteus* spp. (9.4%) and *Staphylococcus* spp. (1.89%). **(Fig.6)**

Cases distribution with regard to age stages

According to female age stage, majority of the infected cases were in menstruation age stage (14-44 years) with 61.54%, followed by menopause age stage (49-89) at 22.12% and Childhood stage (3-13 years) at 16.35% **(Fig.7).** On the Other hand, in males, old age stage (52-85 years) showed the majority infected cases with 54.1%, followed by adult age stage (29-45) with 29.73% and Childhood stage (1-8 years) with 16.22% (**Fig. 8**).

Table (1): Urine samples distribution according to gender.

Gender	Male	Female
Sample count	53	115
Sample percent	31.55%	68.45%

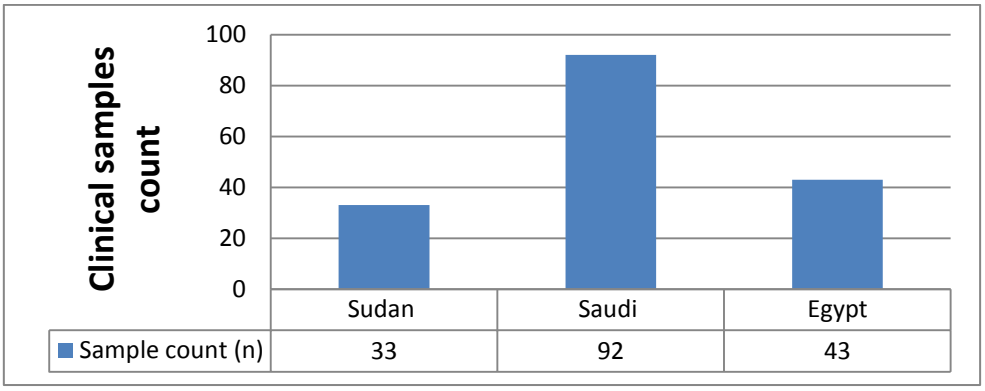


Fig (1): Total of samples distribution according to countries.

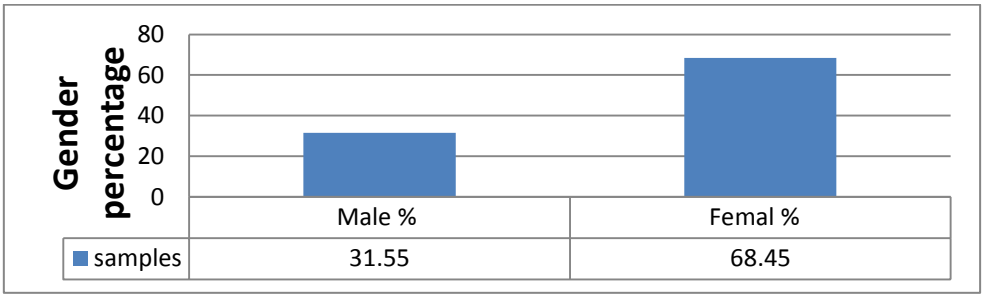


Fig (2): Total distribution of Samples according to gender.

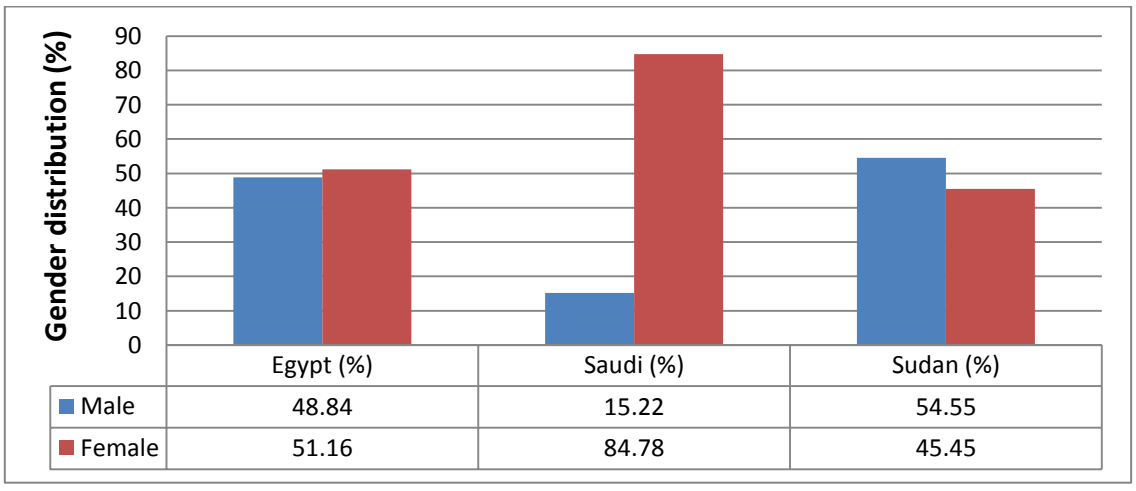
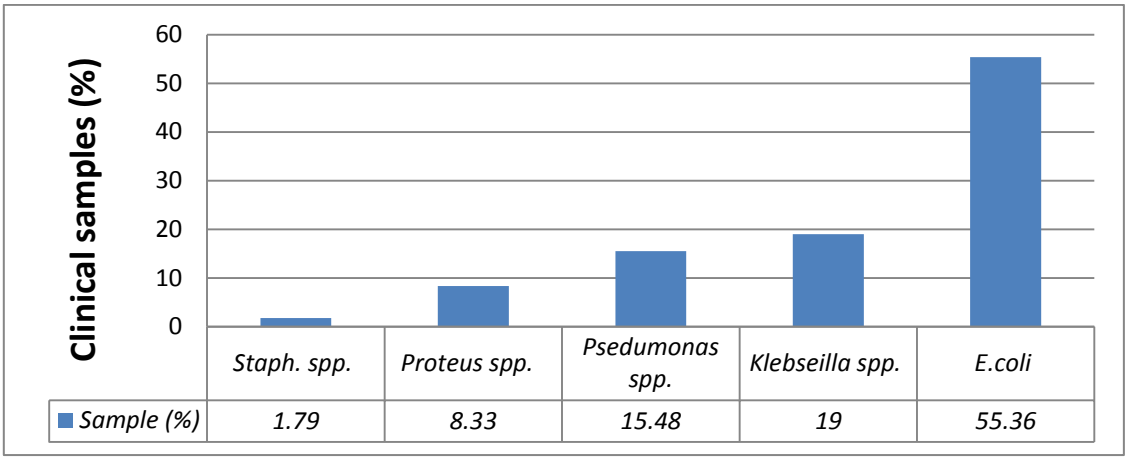
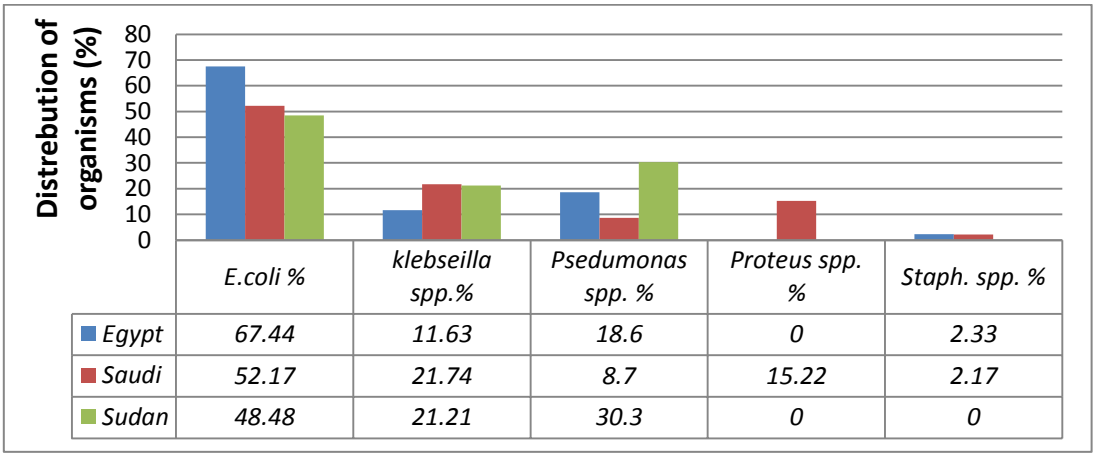


Fig (3): Percentage of samples distribution in three countries according to gender.



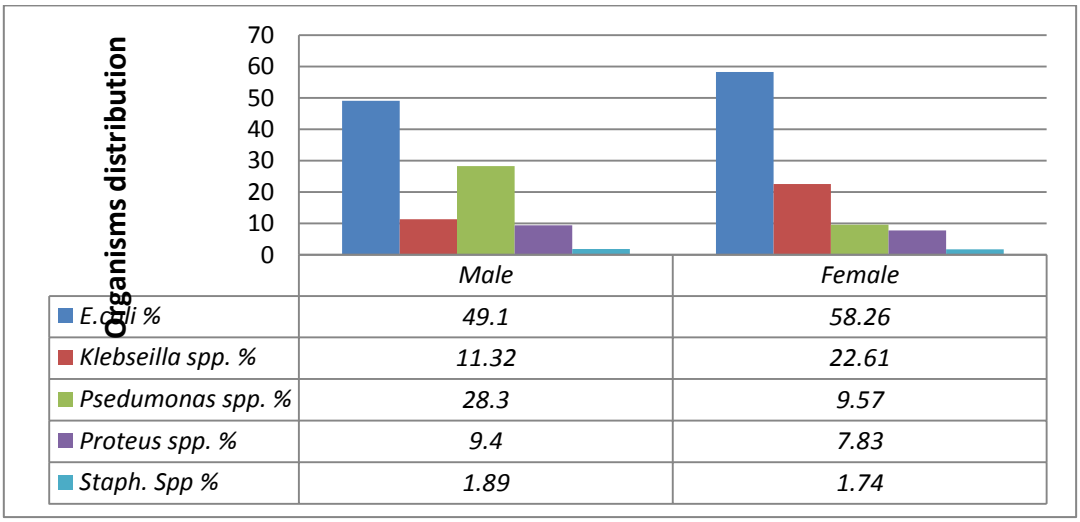
	Staph. spp.	Proteus spp.	Psedumonas spp.	Klebseilla spp.	E.coli
Sample (%)	1.79	8.33	15.48	19	55.36

Fig (4): Total samples distribution according to organisms.



	E.coli %	klebseilla spp.%	Psedumonas spp. %	Proteus spp. %	Staph. spp. %
Egypt	67.44	11.63	18.6	0	2.33
Saudi	52.17	21.74	8.7	15.22	2.17
Sudan	48.48	21.21	30.3	0	0

Fig (5): Organisms distribution among the three countries.



	Male	Female
E.Coli %	49.1	58.26
Klebseilla spp. %	11.32	22.61
Psedumonas spp. %	28.3	9.57
Proteus spp. %	9.4	7.83
Staph. Spp %	1.89	1.74

Fig (6): Organisms distribution among two genders.

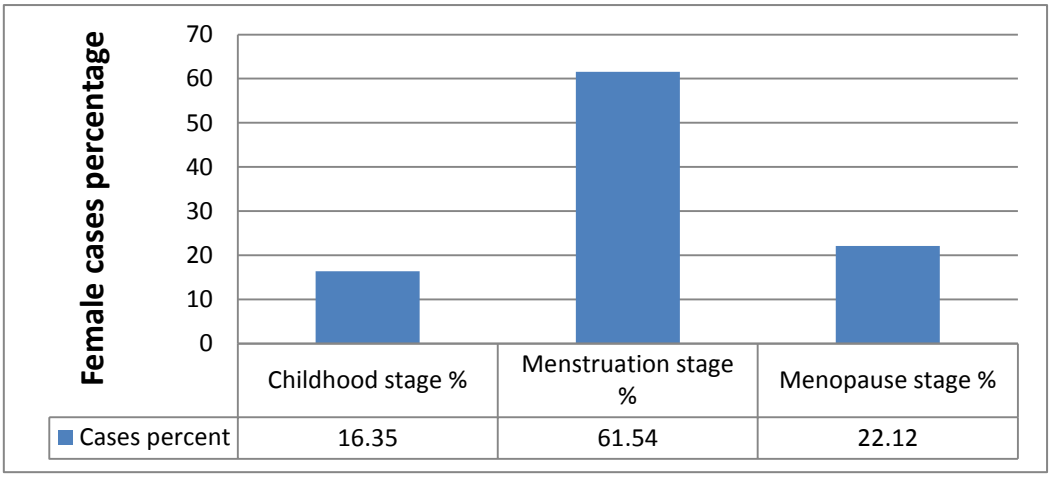


Fig (7): Female cases distribution according to age stage

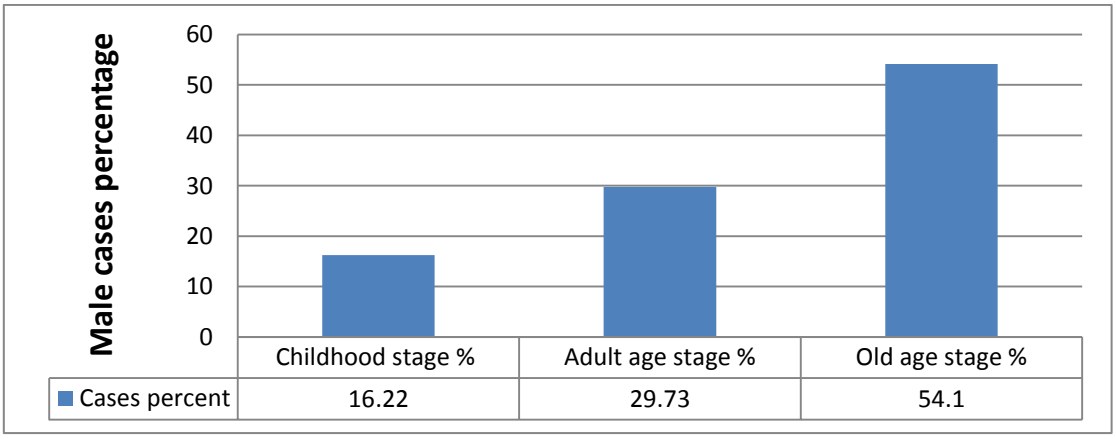


Fig (8): Male cases distribution according to age stage

Discussion.

Urinary tract infections (UTIs) are between the most common bacterial infections acquired in the community and in hospitals. In persons without anatomical or functional anomalies, UTIs are generally limited, but they tend to recur. Uropathogens have specialized properties, such as the production of binders and toxins that enable them to colonize and foray the urinary tract, and are transmitted between persons through personal contact and probably through food or water (Foxman, 2010) . Recurring and untreated UTIs lead to serious complications such as, urosepsis (Porat & Kesler, 2020), early hypertension, weaken glomerular function, proteinuria and lastly, renal failure (Baghiani *et al*., 2013), Therefore, early detection and treatment of infection prevents these complications from occurring. In the present study, we reported that the number of women suffering from urinary tract infections are more than doubled the number of men affected. Generally, the biological as well as social differences

between men and women have an effective role in the fact that women are more susceptible to microbial infection than men (Julie, 2004). As for urinary tract infection in particular, women are also more affected than men due to several factors, including that the urethra in women is much closer to the anus, as well as the low level of the estrogen hormone during menopause increases the risk of urinary tract infections due to the lack of protective vaginal flora (Griebling, 2007, Dielubanza & Schaeffer, 2011). In addition, there is a relationship between urinary tract infections and vaginal atrophy that sometimes occurs after menopause (Goldstein *et al*., 2013). So studies reported that around 50-60% of women may experience a UTI in their lifetime (Rahn, 2008), and repetition of around 25–30% is noted in affected women (Finer & Landau, 2004).

The previous studies have indicated that Gram-negative intestinal flora is the well-identified cause of most urinary tract infections worldwide (Flores-Mireles *et al*., 2015); this explains the greater percentage of both *Escherichia* and *Klebsiella* in women than men due to the proximity of their anus to the vaginal opening.

In our study all bacterial isolates were *E. coli*, *Klebseilla* spp., *Pesudomonas* spp., *Proteus* spp., and *Staphylococcus* spp. Studies reported that bacterial pathogens isolated from urine were *Escherichia coli, Klebsiella pneumonia* (Ronald, 2002, Amdekar *et al*., 2011, Stefaniuk *et al*., 2016, Beyene & Tsegaye, 2011), *Proteus* spp. (Ronald, 2002, Amdekar *et al*., 2011, Schaffer & Pearson 2015, Stefaniuk *et al*., 2016,), *Staphylococcus* spp. (Ronald, 2002, Beyene & Tsegaye, 2011, Amdekar *et al*., 2011) and *Pseudomonas aeruginosa* (Ronald, 2002, Todar, 2006, Tumbarello *et al*., 2020). The study refer to the majority of isolates were *Escherichia coli*, followed by *Klebsiella* spp. and *Pseudomonas spp.*, and three species were isolated from three countries unlike other species. In the world, the most common pathogen causing urinary tract infection is *Escherichia coli* (Samra *et al*., 2005 , Abraham & Miao, 2015, Tandogdu & Wagenlehner, 2016**)**, followed by *Klebsiella pneumonia* **(** Cristea *et al.*, 2017) *Pseudomonas aeruginosa* is the third most common pathogen-linked with hospital-acquired catheter-associated UTIs (Jarvis & Martone, 1992, Sabharwal *et al*., 2014**).** In this study, *Proteus* spp. was isolated only from Saudi specimens. Other studies indicated that in a healthy people, *Proteus* accounts for 1% to 2% of all UTIs, while in hospital-acquired UTIs, *Proteus* accounts for 5% (Jamil *et al*., 2019).

According to female age stages, in our study the menstruation age stage (from puberty until menopause) was involving the majority of cases, followed by post-menopausal stage, while cases in childhood stage were the least. In young sexually active women, sexual activity is the reason of 75–90% of bladder infections, with the jeopardy of infection regarding to the frequency of sex. On the other hand, in post-menopausal women, sexual activity does not impact the risk of developing a UTI (Nicolle, 2008), with consideration that the mean age at menarche in girls is 13.9 years (FH & RM, 2008, Al Alwan *et al*., 2015, Ali *et al*., 2011), and the mean age at menopause is 48 years (Sallam *et al*. 2006, AlDughaither *et al*., 2015, , Abdelwahed 2018, Saad *et al*., 2019). In contrast, this study showed that adult men older than 45 of age who suffer from UTIs were the majority, followed by adult men under the age of 45, while the incidence of male children were the lowest. Other studies have reported that the incidence of UTIs in adult men is younger than 45 years of ages is low and

uncommon (Abarbanel *et al*., 2003, Tan & Chlebicki, 2016,]. In elderly men, prostate disease causes urinary tract symptoms and urinary retention (Beveridge *et al*., 2011).

Conclusion.

Surveys and studies on infectious factors are considered as one of the most important epidemiological tools for tracking infectious diseases and predicting disease patterns, especially with regard to urinary tract infections for their wide spread and serious complications between the sexes at the global level. Therefore, the authors recommend following up on groups in which the infection rate was higher than others, such as non-childhood females, as well as men over the age of fifty, and taking necessary measures to limit the spread of infection among these. As well as limiting its repetition or neglect to avoid complications that may kill the patient.

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معدل انتشار عدوى المسالك البولية وعلاقة مسببات الأمراض البكتيرية بالجنس والأعمار بين المرضى في ثلاث دول عربية

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الملخص:

يهدف هذا البحث إلى مسح دراسة وتوصيف عزلات مختلفة من عينات بول تم جمعها من دول مختلفة لتقييم انتشارها وعلاقتها بالتهابات المسالك البولية. تم جمع مائة وثمانية وستين عينة بشكل عشوائي من ثلاث دول هي مصر (٤٣ عينة) والسودان (٣٣ عينة) والمملكة العربية السعودية (٩٢ عينة). تم جمع العينات من مختبرات طبية خاصة في الفترة ما بين إبريل ٢٠١٥ ويوليو ٢٠١٦ من كلا الجنسين. اختلفت أعمار المرضى بين ثلاث سنوات و ٨٩ سنة للإناث ومن سنة واحدة إلى ٨٥ سنة للذكور. تم حقن وزراعة جميع العينات على أوساط استنبات انتقائية وتفاضلية مختلفة. بعد النمو ، تم التعرف على البكتيريا المعزولة من خلال الخصائص الفسيولوجية والبيوكيميائية. من بين جميع العينات السريرية ، تم اكتشاف خمسة أجناس بكتيرية والتي كانت ٩٣ عزلة من الإيشريشيا كولاى (*Escherichia coli*)، ٣٢ عزلة من سلالات الكليبسيلا (*Klebsiella* spp.) ، ١٤ عزلة من سلالات بروتياس (*Proteus* spp.) ، ٢٦ عزلة من سلالات السيدوموناس (*Pseudomonas* spp.) ، ٣ عزلات من المكورات العنقودية الذهبية (*Staphylococcus* spp.). فيما يتعلق بجنس المريض ، أظهرت هذه الدراسة أن الإناث أكثر عرضة للإصابة من الذكور ، حيث أن ٥٣ (٣١.٥٥٪) من المرضى كانوا ذكورًا بينما ١١٥ (٦٨.٤٥٪) كانوا من الإناث. كانت بكتيريا المسالك البولية الأكثر شيوعًا هي الإيشريشيا كولاى (*Escherichia coli*)، تليها الكليبسيلا (*Klebsiella* spp.)، وكانت غالبية الحالات المصابة في الإناث في سن الدورة الشهرية (١٤-٤٤ سنة) ، بينما كانت غالبية الحالات المصابة في الذكور في مرحلة الشيخوخة (٥٢-٨٥ سنة).

الكلمات المفتاحية :- البكتريا الممرضة ، التهاب المسالك البولية ، عينات طبية