Urinary incontinence is a common, bothersome problem that is often not reported, especially in women. The estimated prevalence is up to 51%. Urinary incontinence is a well-known cause of impaired quality of life, including impairments in physical, social, and role functioning, mental health, and general health perception. Several characterizations of urinary incontinence and associated lower urinary tract symptoms have been described, including pelvic floor dysfunction, neuro-urologic pathologies, age-related causes, medications and cognitive impairment.

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standardized. Although they are not always specific for certain pathologies, they are important to determine possible etiologies and to act as a guide for appropriate investigations and management plans.\(^1\) These characterizations include stress urinary incontinence (SUI), urge urinary incontinence, mixed urinary incontinence, enuresis and continuous urinary incontinence.\(^1\)

For an objective clinical assessment of urinary incontinence, many questionnaires have been developed to enable an appropriate evaluation of symptoms, degree of distress, and quality of life. The Urogenital Distress Inventory-6 (UDI-6) questionnaire is a short form of the 19-item Urogenital Distress Inventory questionnaire that has been widely used to assess types of urinary incontinence and its effect on quality of life. The UDI-6 has been validated in many languages, including Arabic,\(^9\) and it correlated well with the original 19-item questionnaire.\(^10\) The correlation between the patient symptoms and urodynamic findings, however, has been questioned by some investigators.\(^11,12\) Although urodynamic studies (UDS) provide accurate, objective measures of various aspects of urine storage and evacuation,\(^13-15\) they are invasive and carry a risk of urinary tract infection of up to 15%.\(^16\) The studies are accompanied by significant physical and psychological impact on patients, namely, embarrassment, pain and distress.\(^17\) These caveats prompted a search for a less invasive method to predict UDS findings in women with urinary incontinence. Several investigators have studied the correlation between urodynamic findings and different questionnaires with mixed results.\(^16,18-21\) The UDI-6 might predict urodynamic findings.\(^16\) Our aim in this study was to correlate the validated Arabic version of the UDI-6 with urodynamic findings in Saudi Arabian women presenting with urinary incontinence, as there is no previous study in our population.

**METHODS**

In this prospective study we included all women with a history of urinary incontinence who presented to our tertiary referral urology clinic between July 2013 to March 2014. All women completed the Arabic UDI-6 and had a urine culture prior to urodynamic evaluation. Women with a urinary tract infection at the time of the UDS appointment did not proceed to UDS and were treated and rescheduled after being determined to be infection-free. As stated all women with urinary incontinence were included. Exclusion included only women with UTI. The project was approved by the IRB (The Impact of Renal Angiomyolipoma on Estimated Glomerular Filtration Rate in Patients with Tuberous Sclerosis Complex. RAC Proposal # 2041011) (Relationship between urinary incontinence symptoms and urodynamic findings using a validated Arabic questionnaire. RAC Proposal #2161046). There was no funding. All women were investigated using Laborie Urodynamics, Aquarius system, (Laborie, Canada). UDS was performed with the woman in a supine position using a 6Fr urethral catheter and 9Fr rectal catheter. The bladder was filled with room temperature normal saline at 60 mL/min. Filling was stopped when the patient developed a strong desire to urinate or 600 mL had been infused into the bladder. The women were asked to cough once every minute to ensure subtraction and to test for stress incontinence. Provocative maneuvers were employed with the women standing, such as coughing up to five times or listening to running water. At the end of filling, women were seated for a pressure flow study and post-void residual measurement. A urodynamic diagnosis of urodynamic SUI, detrusor overactivity (DO) and mixed urinary incontinence was made according to the International Continence Society definition.\(^1\)

The required sample size was calculated with different levels of accuracies and marginal errors with a 95% confidence level for estimating various effect sizes with 80% power. A correlation analysis was carried out between individual items on the UDI-6 questionnaire and UDS findings. Statistical analysis using the Pearson correlation coefficient and chi-square test were performed with SPSS 11.0 software (SPSS, Inc, Chicago, IL).

**RESULTS**

Eighty-seven women with a mean age of 57 (range 22-72) years completed the Arabic UDI-6 and underwent UDS. All women presented with the chief complaint of urinary incontinence. The majority had mixed incontinence followed by stress incontinence (Table 1). The most common urodynamic diagnosis was SUI followed by DO, mixed incontinence and negative study findings (Table 2). Sixty-seven patients had SUI symptoms based on question 3 of the UDI-6 (both mixed and pure SUI) (Table 3). Upon UDS, 53 of these patients (79%) had a positive SUI, while 23 (30%) did not leak during the test (P<.001). This is in contrast to 28 patients with pure SUI on question 3 of whom 24 (86%) had a positive UDS diagnosis of SUI.

We evaluated the relationship between urge incontinence questions 1 and 2 in the UDI-6 versus a UDS diagnosis of DO. Fifty-nine patients had symptoms of pure and mixed urge incontinence. Of these patients, 27/59, (45.8%) showed DO in the UDS (P<.001). In contrast, 11/20 (55%) of patients with a history of pure urge incontinence demonstrated UDS evidence of DO. Patients with mixed incontinence symptoms had
a lower rate of UDS diagnosis of SUI and DO (Table 3). Interestingly, 14% of patients had a negative UDS diagnosis. The correlation between question 3 and UDS was moderate, whereas the correlation was fair for questions 1 and 2 (Table 4).

**DISCUSSION**

The UDI-6 is a questionnaire with six questions used to assess the symptoms of urinary incontinence. It correlates with the original 19-item UDI.\(^9\) Arabic validation was performed by Altaweel et al.\(^8\) We evaluated the correlation between the Arabic UDI-6 and UDS findings. Lemack and Zimmern have evaluated this correlation using the English version of the UDI-6.\(^8\) Our sample population has a high rate of mixed urinary incontinence, probably due to the nature of our tertiary referral center. This might be different than the true prevalence of incontinence in the general population.

The UDS finding of SUI was the most common, possibly due to the high fertility rate in Saudi Arabia. DO was found to be the second most common, which might be explained by the high prevalence of diabetes mellitus in Saudi Arabia.\(^2\,^23\)

The Arabic UDI-6 was found to correlate well with UDS findings related to SUI, with 86% of pure SUI patients having positive UDS results. This finding was also similar to the results of Lemack and Zimmern (85%).\(^8\) However, 10% of our patients did not leak during UDS, which might be explained by either mild SUI or due to positioning and non-physiologic maneuvers, such as the Valsalva maneuver during the urodynamic study.

Fifty-five percent of our patients with pure urge incontinence symptoms demonstrated DO, which can be considered a good correlation, with findings similar to the Lemack and Zimmern study (46%).\(^8\) This percentage might be altered if we stratified the severity of the symptoms, which we could not do because of our limited sample size.

In patients with mixed urinary incontinence symptoms, 51% and 35% had a urodynamic diagnosis of SUI and DO, respectively. Lemack and Zimmern reported similar findings (50% and 35.2% for SUI and DO, respectively).\(^8\) This finding reflects the multiplicity of factors playing a major role in the pathophysiology of mixed urinary incontinence.\(^2\,^23\) In this group of patients, we did not stratify the severity of each question to indicate the dominant symptom and correlate it with UDS findings.

### Table 1. Patient symptoms and percentages based on the Urogenital Distress Inventory 6 (N=87).

| Symptoms                | n (%)   |
|-------------------------|---------|
| Mixed Incontinence      | 39 (44.8) |
| Stress incontinence     | 28 (32.2) |
| Urge incontinence       | 20 (23)  |

### Table 2. Urodynamic findings (N=87).

| Urodynamic finding    | (n) %   |
|-----------------------|---------|
| Stress incontinence   | 37 (42.5) |
| Urge incontinence     | 26 (29.9) |
| Mixed incontinence    | 16 (18.4) |
| No finding            | 8 (9.2)  |

### Table 3. Incontinence symptoms and urodynamic findings (N=87).

| Symptoms of urinary incontinence | n  | UDS findings (%) |
|----------------------------------|----|------------------|
|                                   |    | SUI              | DO              |
| Stress incontinence              | 28 | 86               | 12              |
| Urge incontinence                | 20 | 9                | 55              |
| Mixed incontinence               | 39 | 51               | 35              |

SUI: stress urinary incontinence, DO: detrusor overactivity

### Table 4. Sensitivity and specificity of the UDI-6 for predicting urodynamic findings.

| UDI-6                              | Finding          | Sensitivity % | Specificity % | Positive predictive value % | Correlation coefficient | P      |
|------------------------------------|------------------|---------------|---------------|----------------------------|------------------------|--------|
| Stress urinary incontinence Question* | SUI              | 74            | 70            | 70                         | 0.65                   | <.01   |
| Urge incontinence/frequency Questions* | DO               | 87            | 72            | 60                         | 0.38                   | <.01   |

*Statistical analysis using the Pearson correlation coefficient and chi-square test were performed.*
In conclusion, the short form of the Urogenital Distress Inventory (UDI-6) is an easily completed questionnaire, validated in Arabic, and positively correlated with urodynamic findings with good specificity and sensitivity for stress urinary and urge incontinence. This questionnaire can be used for diagnosis and conservative management without the need for urodynamic evaluation, which is particularly true in patients with SUI.

Conflict of interest
The authors report no conflict of interest.

REFERENCES
1. Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. Neurourol Urodyn. 2002; 21:167-78. [PMID: 11857671]
2. Branch LG, Walker LA, Wette TT, DuBeau CE, Resnick NM. Urinary incontinence knowledge among community-dwelling people 65 years of age and older. J Am Geriatr Soc. 1994; 42:1257-62. [PMID: 7983288]
3. Markland AD, Richter HE, Fuw CW, Eggers P, Kusek JW. Prevalence and trends of urinary incontinence in adults in the United States, 2001 to 2008. J Urol. 2011; 186:589-94. [PMID: 21684555]
4. Greiner KS, Sexton CC, Irwin DE, Kopp ZS, Kelleher CJ, Milsom I. The impact of overactive bladder, incontinence and other lower urinary tract symptoms on quality of life, work productivity, sexuality and emotional well-being in men and women: results from the EPIC study. BJU Int. 2008; 101:1388-95. [PMID: 18454794]
5. DuBeau CE, Levy B, Mangione CM, Resnick NM. The impact of urge urinary incontinence on quality of life: importance of patients’ perspective and explanatory style. J Am Geriatr Soc. 1998; 46:683-92. [PMID: 9625182]
6. Brown JS, Vittinghoff E, Wyman JF, Stone KL, Nevitt MC, Ensrud KE, et al. Urinary incontinence: does it increase risk for falls and fractures? Study of Osteoporotic Fractures Research Group. J Am Geriatr Soc. 2000; 48:721-5. [PMID: 10894308]
7. DuBeau CE, Kuchel GA, Johnson T 2nd, Palmer MH, Wagg A; Fourth International Consultation on Incontinence. Incontinence in the frail elderly: report from the 4th International Consultation on Incontinence. Neurourol Urodyn. 2010; 29:165-78. [PMID: 20025027]
8. Wein AJ. Pathophysiology and Classification of Lower Urinary Tract Dysfunction: Overview. In: Wein AJ, Kavoussi LR, Novick AC, Partin AW, Peters CA (eds.), Campbell-Waltish Urology, 10th edition. Philadelphia, Elsevier Saunders. 2012; pp. 1834-46.
9. Al滔ewel W, Søyem R, Mokhtar A, Kumar P, Hanash K. Arabic validation of the short form of Urogenital Distress Inventory (UDI-6) questionnaire. Neurourol Urodyn. 2009; 28:330-4. [PMID: 19229949]
10. Uebersax JS, Wyman JF, Shumaker SA, McCLish DK, Fanti JA. Short forms to assess life quality and symptom distress for urinary incontinence in women: the Incontinence Impact Questionnaire and the Urogenital Distress Inventory. Continence Program for Women Research Group. Neurourol Urodyn. 1995; 14:131-9. [PMID: 7780440]
11. Blaivas JG. The bladder is an unreliable witness. Neurourol Urodyn. 1996; 15:443-6. [PMID: 8857612]
12. Ding YY, Lieu PK, Choo PW. Is the bladder “an unreliable witness” in elderly males with persistent lower urinary tract symptoms? Geriatr Nephrol Urol. 1997; 7:17-21. [PMID: 9422435]
13. OuSLander J, Staskin D, Rau S, Su HL, Hepps K. Clinical versus urodynamic diagnosis in an incontinent geriatric female population. J Urol. 1997; 137:68-71. [PMID: 3795368]
14. Byrne DJ, Stewart PA, Gray BK. The role of urodynamics in female urinary stress incontinence. Br J Urol. 1987; 59:228-9. [PMID: 3567483]
15. Cantor TJ, Bates CP. A comparative study of symptoms and objective urodynamic findings in 214 incontinent women. Br J Obstet Gynaecol. 1980; 87:889-92. [PMID: 7191720]
16. Böthig R, Fließb K, Thietje R, Faschburgm B, Hirschfeld S. Morbidity of urinary tract infection after urodynamic examination of hospitalized SCI patients: the impact of bladder management. Spinal Cord. 2013; 51:70-3. [PMID: 22964752]
17. Gorton E, Stanton S. Women’s attitudes to urodynamics: a questionnaire survey. Br J Obstet Gynaecol. 1999; 106:851-6. [PMID: 10453837]
18. Lemack GE, Zimmern PE. Predictability of urodynamic findings based on the Urogenital Distress Inventory-6 questionnaire. Urology. 1999; 54:461-6. [PMID: 10475355]
19. Espuña-Pons M, Dilla T, Castro D, Carriuol C, Casarijo J, Puric-Clota M. Analy- sis of the value of the ICIQ-UI SF questionnaire and stress test in the differential diagnostic of the type of urinary incontinence. Neurourol Urodyn. 2007; 26:836-41. [PMID: 17330896]
20. Rotor M, Trainar B, Kliner K, Barbic M, Sedlar A, Gruden J, et al. Correlations between the ICIQ-UI short form and urodynamic diagnosis. Neurourol Urodyn. 2009; 28:501-5. [PMID: 19260080]
21. FitzGerald MP, Brubaker L. Urinary incontinence symptom scores and urodynamic diagnoses. Neurourol Urodyn. 2002; 21:30-5. [PMID: 11835421]
22. Altaweel W, Alharbi M. Urinary incontinence: prevalence, risk factors, and impact on health-related quality of life in Saudi women. Neurourol Urodyn. 2012; 31:642-5. [PMID: 22415626]
23. Golabek T, Kielty E, O’Reilly B. Detrusor overactivity in diabetic and non-diabetic patients: is there a difference? Int Braz J Urol. 2012; 38:652-9. [PMID: 23131522]