Peer review

Assessment of pelvic floor muscle contraction ability in healthy males following brief verbal instruction

Abstract

This study assessed the ability of healthy men to contract their pelvic floor muscles on request, following standardised, brief, verbal instruction. Associations between self-reported lower urinary tract symptoms and the ability to contract the pelvic floor muscles on request were explored since there is currently no available data related to these topics. The study group, 52 healthy men (mean age of 22.6 years, SD 4.42), received brief, standardised instructions. Each man's starting position was randomised to standing or crook lying. Bladder base elevation was observed and recorded using real-time transabdominal ultrasound imaging to determine muscle activation. Participants then completed a questionnaire recording age, body mass index, presence of chronic respiratory conditions, acute lower back pain and any lower urinary tract symptoms. Univariate logistic regression was applied to assess associations between ability to contract the pelvic floor muscles in each position, participant characteristics and study variables likely to impact upon lower urinary tract symptoms. Six participants (11.5%) were unable to perform the muscle contraction in either standing or crook lying, 17 (32.7%) men could not contract the muscles in crook lying and 14 (26.9%) could not contract the muscles when standing. While results suggest there is no optimal starting position in which to achieve pelvic floor muscle contraction in men, no assumptions should be made that an ability to contract those muscles is present or effective in young, asymptomatic men. This may have implications for interventions aimed at pelvic floor muscle rehabilitation following treatment for management of prostate cancer.

Keywords: Physiotherapy, urinary continence, muscle contraction, men's health.

Introduction

The male pelvic floor forms a supportive muscular sling around the urethra and the anus. It aids bladder and bowel continence[1-3], and erectile function[4] in healthy men. While lower urinary tract symptoms (LUTS) in men are known to be associated with ageing[5], they also emerge as sequelae of surgical and radiation treatment protocols used for prostate cancer, in part attributed to trauma of the pelvic floor muscles (PFMs) and/or urethral sphincters[6,7].

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Competing interest statement
No relevant competing interests.

Physiotherapy has an increasing role in PFM rehabilitation in men and there is emerging evidence to support the use of non-invasive therapies such as PFM training and bladder training in the management of bladder and bowel symptoms in this population. A systematic review of available studies supports the efficacy of PFM rehabilitation following radical prostatectomy[8].

While it has been demonstrated that PFM training can be used as a treatment option for men to help regain continence by improving PFM function[4,8,9], in the clinical setting, digital rectal assessment of PFM contraction is often not undertaken and the assumption is made that all men are capable of performing an effective PFM contraction on request. The veracity of this assumption is questionable, particularly in light of evidence suggesting this is not true of women[10].

To maximise the effect of conservative therapies, a clear understanding of the ability to perform PFM contraction in the healthy male population is essential. This cross-sectional study explored the ability of healthy males to effectively perform a PFM contraction on request, following brief verbal instruction. This was observed using real-time transabdominal ultrasound (US) imaging, which has been shown to reliably depict elevation of the bladder base during an effective PFM contraction in women[10,11] and has also been used to compare male PFM function in two different starting positions[12]. A secondary aim of this study was to explore the relationship between the ability to contract the PFM on request and the presence of self-reported LUTS in healthy, young men as there is little known of these associations.

Methods

Ethical approval for this study was granted by The University of Newcastle Human Research Ethics Committee, Newcastle, Australia.

Participants were 52 healthy, male, undergraduate physiotherapy students. To be eligible to participate, volunteers had to be aged over 18 years and not currently seeking care for bladder problems.

Participants were asked to "squeeze up as though trying to stop yourself passing wind and/or urine". The use of the stimulus instruction recruiting the external anal sphincter (EAS) as part of the PFM activation is considered valid and justified since the EAS has been established to be functionally an anatomical component of the pelvic floor[13]. PFM contraction was assessed using real-time transabdominal US imaging (Mindray DP-6600 digital ultrasonic imaging system, Shenzen Mindray Bio-medical Electronics Co., Ltd. China). Participants were requested to consume one to two cups (250–500 ml) of water and refrain from voiding one hour prior to the appointment to allow optimal imaging of the bladder. A 3.5 MHz curved array US transducer head was placed in the transverse plane just superior to the pubic rami as described and validated by Sherburn *et al*.[14]. The US head was angled in a posterior/caudal direction. The specific angle was adjusted to optimise imaging of the bladder base (Figure 1). The mid-point of the bladder base was marked in its relaxed position. The verbal instruction previously detailed was then given. Displacement of the bladder base was observed and recorded.

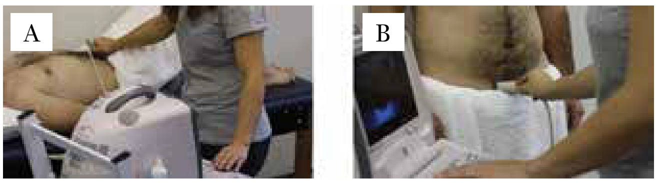

Figure 1. Pelvic floor muscles contraction testing positions: (A) crook-lying (B) standing.

The starting position for imaging each participant was randomised to either crook lying (lying supine with knees bent to 90° with feet on the bed) or standing (unsupported with feet shoulder-width apart). Imaging was then repeated in the alternative position. The anal sphincter component of the PFMs has been demonstrated to fatigue quickly[15]; therefore, participants were allowed only one or two PFM contraction attempts in each position. Participants were unable to view the US image while performing the contraction to eliminate any biofeedback response. To ensure consistency of measurement, the same trained operator conducted all examinations. At the conclusion of the evaluation of PFM function, demographic data and responses to questions relevant to current or past LUTS[16] were recorded with no identifying information on the survey.

Ability to contract PFM was recorded as a dichotomous outcome. Contraction was recorded as occurring if the base of the bladder was seen to move upward as the PFM contraction elevated the prostate gland, which, in turn, elevated the bladder base (Figure 2). If the bladder base moved downward during an attempted contraction, the displacement was judged to be ineffective. Likewise, if the bladder moved upward then descended during a contraction due to abdominal muscle recruitment, ability to contract the PFM was recorded as "no" as an effective bladder base elevation was not observed. The distance through which the bladder base moved was not used in analysis. While transabdominal US measurements have good intra-rater reliability, normative displacement values are not able to be obtained using two-dimensional US as the measurement cannot be taken due to the absence of fixed bony landmarks in this plane[11,14].

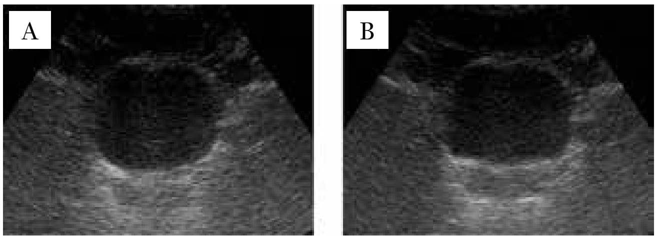

Figure 2. Images of the bladder and prostate using real-time transabdominal ultrasound during (A) relaxed pelvic floor muscle position and (B) contraction of pelvic floor muscles position.

Observable upward movement of the bladder base was separately validated as a measure of actual PFM function in seven of the study participants using external surface electromyography (EMG) (Neuro Trac ETS Verity Medical Ltd, Chilbolton UK). This was used to demonstrate concurrent EAS and, therefore, PFM activity[3]. While the gold standard for assessing PFM function in men might be considered to be either digital palpation[17] or needle EMG[18], the unacceptability of these methods to study participants meant that surface EMG was preferred in this case.

The survey instrument was comprised of 15 items including items related to past history of back pain, respiratory problems or bed wetting past the age of five years. Eleven items related specifically to the assessment of LUTS using a validated adjectival scale with response options; "never, rarely, sometimes, often". One item relating to LUTS (nocturia) was measured numerically from zero to six times per night. Demographic information including age, body weight, height and any previous instruction in PFM contraction was recorded.

All data were analysed using STATA 11.0 (Statacorp, Texas). Self-reported presence of LUTS was summarised by frequency and severity of the condition. Univariate logistic regression was applied to assess the associations between ability to contract in each position, and participant characteristics and variables thought likely to impact upon LUTS. Variables with p-values obtained from univariate analysis less than 0.2 were then simultaneously included in a multivariate logistic regression model for each position. A p-value of less than 0.05 was considered to be statistically significant.

Results

Fifty-two healthy, young men participated in this study. The characteristics of this sample are described in Table 1. The starting position for PFM contraction was randomised to crook lying (n=23) and standing (n=29). In 38 participants (73.1%) there was no observable elevation of the bladder base in standing compared to 35 (67.3%) in crook lying. In 27 (51.9%) there was observable elevation of the bladder base in both standing and crook lying. Eleven (21.2%) had observable elevation of their bladder base in standing but not crook lying, in eight (15.4%) there was no observable elevation of the bladder base in crook lying but not standing, and in six (11.5%) participants there was no observable elevation of the bladder base in either position.

Table 1. Characteristics of the study participants.

Variable	Mean (SD)
Age (years)	22.6 (4.42)
Body mass index (kg/m^2)	24.21 (2.08)
	N/N
Previous instruction in PFM contraction	23/52
Acute lower back pain in past 6 months	8/52
Chronic respiratory condition	1/52
Bed wetting past age of 5 years	8/52

SD = standard deviation, kg = kilograms, m^2 = metres squared

The presence of LUTS within the sample is given in Table 2. The International Continence Society (ICS) definition of nocturia is the "complaint of interruption of sleep one or more times because of the need to void. Each void is preceded and followed by sleep"[13]. Of our sample, 24 of 52 (46.2%) participants reported nocturia according to this definition.

The relationship between the ability to elevate the bladder neck in the crook lying and standing positions, and the variables of age, body mass index (BMI), previous instruction in PFM contraction, acute lower back pain (LBP), bed wetting past the age of five and LUTS are compared in Table 3. In this sample, those men who reported LBP within the last six months had observable elevation of the bladder base in standing, while in lying, six could effectively elevate their bladder base and two could not. No apparent association was found between self-reported experience of respiratory conditions and a participant's ability to demonstrate an effective PFM contraction.

The validity of observed upward movement of the bladder base as an indication of anal sphincter contraction is supported by a dynamic MRI study showing bladder base elevation concurrent with anal contraction in men[1] and was confirmed in seven out of seven study subjects using two small, self-adhesive electrodes placed onto the anal verge. An eleven µV mean increase in external EMG activity was recorded concurrently with the observed upward movement of the bladder base.

Discussion

While the study aimed to be representative of healthy, young men in the population, this specific population might arguably be healthier and more "body aware", given their undergraduate studies and, therefore, some generalisations may be limited to this specific population. However, the fact that some students reported being previously taught PFM contraction via verbal instruction was taken into account. Some students reported receiving prior verbal PFM contraction instruction yet this did not appear to be a predictor of ability to contract PFM. This adds strength to the study findings, suggesting that verbal instruction alone cannot be relied upon to produce a PFM contraction able to elevate the bladder base. The results of this study suggest that the standing position may be slightly more effective as a position for eliciting a PFM contraction able to elevate the bladder base. Greater measured distance of bladder base elevation in the standing position has also been found in women[12]. It is suggested that this may be due to the effect of gravity on the pelvic floor and, perhaps, because this is the most usual position in which the pelvic floor functions. This position is more likely to enhance such effects as gravity, length-tension relationship of muscle fibres and proprioceptive feedback.

In saying this, the study results suggest no definitive optimal starting position in which to achieve PFM contraction strong enough to elevate the bladder base in men. Of this sample, 32.7% of the men could not elevate the bladder base in lying, 26.9% could not demonstrate bladder base elevation in standing and 11.5% were unable to effectively demonstrate elevation of their bladder base in either position. This suggests no assumptions

Table 2. Prevalence of self-reported LUTS in the study sample.

LUTS	Question	Never	Rarely	Sometimes	Often
Urinary frequency	In your opinion, do you feel that you urinate too often during the day?	17 (32.7%)	13 (25.0%)	18 (34.6%)	4 (7.7%)
Urinary urgency	Do you experience a sudden, compelling desire to urinate which is difficult to put off? What I mean is a sudden intense feeling of urgency where you feel you must urinate immediately?	27 (51.9%)	16 (30.8%)	6 (11.5%)	3 (5.8%)
Urinary incontinence	How often do you experience urinary leakage?	37 (71.2%)	12 (23.1%)	3 (5.8%)	0
Urgency urinary incontinence	Do you leak urine in connection with a sudden intense feeling of urgency?	47 (90.4%)	2 (3.85%)	3 (5.8%)	0
Stress urinary incontinence	Do you leak urine in connection with sneezing, coughing, or when doing physical activity such as lifting?	51 (98.1%)	1 (1.92%)	0	0
Intermittency	Over the past month, how often have you found you stopped and started again several times when you urinated?	34 (65.4%)	14 (26.9%)	3 (5.8%)	1 (1.9%)
Slow stream	Over the past month, how often have you had a weak urinary stream?	37 (71.2%)	12 (23.1%)	2 (3.9%)	1 (1.9%)
Straining	Over the past month, how often have you had to push or strain to begin urination?	34 (65.4%)	12 (23.1%)	6 (11.5%)	0
Terminal dribble	Do you experience prolonged dribble at the end of your urine flow?	20 (38.5%)	20 (38.5%)	12 (23.1%)	0
Incomplete emptying of bladder	Over the past month, how often have you had a sensation of not emptying your bladder completely after you finish urinating?	28 (53.8%)	19 (36.5%)	5 (9.6%)	0
Post-micturition dribble	Do you experience urine leakage almost immediately after you have finished urinating and walked away from the toilet?	22 (42.3%)	22 (42.3%)	6 (11.5%)	2 (3.9%)

should be made about whether the ability to contract PFM or the ability to elevate the bladder base is present and/or effective in either position in men. Verbal instruction alone appeared insufficient for the men to consistently elicit a PFM contraction able to elevate the bladder base. Since the study results indicate no optimal starting position, it seems useful to assess and teach PFM contraction in both positions, and using adjuncts to verbal instruction.

While the gold standard for measuring PFM function in men includes single, fine-wire EMG or digital rectal examination, in a clinical setting these have poor acceptability from the patient perspective. Clinicians might also prefer non-invasive methods of PFM assessment. This study suggests real-time transabdominal US is a useful tool to measure PFM contraction to elevate the bladder neck in men. However, where such equipment is unavailable, it should not be assumed that men are able to contract their PFM to elevate the bladder neck on request following brief verbal instruction alone, and visual observation of anal sphincter movement may provide a useful indication of some PFM activity[1,3]. External palpation of PFM has not been tested for its validity or reliability to detect either deep or superficial PFM function.

While some factors did show a correlation between their presence and the ability to elevate the bladder neck by requesting a PFM contraction, the variance was not well accounted for in standing (39.5%) and less so in crook lying (14.9%). Some of the study variables may have been predictors of PFM contraction ability but the low prevalence of these factors in this sample indicates that a larger sample size would be required to provide enough power to indicate that these variables are associated factors.

Table 3. Relationship between self-reported LUTS and ability to contract the PFM on request in crook lying and standing.

Variables	Crook lying		Standing	
	Univariate association	**Multivariate association**	**Univariate association**	**Multivariate association**
	Odds ratio (95% CI)	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**
Age	1.16 (0.94 to 1.43)		1.02 (0.88 to 1.18)	
Body mass index	1.1 (40.85 to 1.53)		1.28 (0.91 to 1.80)	1.83 (1.04 to 3.21)
Previous instruction in PFM contraction	1.83 (0.55 to 6.09)		2.64 (0.70 to 9.94)	
Acute low back pain in previous 6 months	1.55	(0.28 to 8.64)		**
Chronic respiratory condition	N/A		1.03 (0.10 to 10.85)	
Bed wetting past age of 5 years	0.84 (0.39 to 1.79)		1.09 (0.47 to 2.51)	
Urinary frequency	0.99 (0.55 to 1.80		0.43 (0.21 to 0.88)	
Nocturia	0.90 (0.60 to 1.35)		0.71 (0.46 to 1.08)	
Urinary urgency	0.91 (0.47 to 1.73)		0.78 (0.40 to 1.53)	
Urinary incontinence	0.97 (0.36 to 2.61)		0.33 (0.12 to 0.94)	
Urgency urinary incontinence	2.17 (0.40 to 11.80)		0.38 (0.12 to 1.23)	
Stress urinary incontinence	N/A		**	
Intermittency	0.65 (0.29 to 1.47)		1.04 (0.42 to 2.55)	
Slow stream	1.31 (0.50 to 3.43)		0.44 (0.17 to 1.12)	
Straining	0.81 (0.36 to 1.85)		0.90 (0.38 to 2.14)	
Terminal dribble	0.42 (0.19 to 0.95)	0.33 (0.13 to 0.81)	0.50 (0.22 to 1.14)	
Incomplete emptying of bladder	0.61 (0.26 to 1.45)		1.20 (0.47 to 3.11)	
Post-micturition dribble	0.88 (0.43 to 1.81)		0.32 (0.13 to 0.77)	0.21 (0.05 to 0.95)

* indicates values that were not able to be obtained due to low symptom prevalence. CI = confidence interval

Also of relevance is the fact that transperineal US is the gold standard for functional PFM imaging in women. It is recognised that transabdominal US imaging does not provide accurate information about bladder base movement in all of the cases compared to transperineal US imaging. This fact should also be considered when questioning why some men were apparently unable to elevate their bladder base during this study.

While results of the current study cannot be extrapolated to older men, in which this skill becomes relevant to rehabilitation post-prostate surgery, future research might explore the ability of other cohorts to contract the PFM on command following brief verbal instruction. While there is a correlation between increasing age and increasing prostate cancer risk, the same correlation exists in relation to decreasing striated muscle strength[19,20] and would presume to be related to a decrease in PFM strength. This study highlights the need to ensure an ability to contract PFM is present before PFM rehabilitation programmes are instituted.

Conclusion

Anecdotally, clinicians commonly assume that all men can contract their PFM on request. This study suggests this might be erroneous. Transabdominal US may be a useful tool to assess PFM contraction and an individual's ability to elevate the bladder neck. It also provides a non-invasive alternative to other methods. Since there is currently no available evidence of associations between LUTS and PFM function in healthy, young men, this exploratory study is novel, and highlights the need and a possible direction for future research. It might also underpin and improve development of PFM exercise and continence promotion protocols in men following treatments for prostate cancer.

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