

DIFFERENCES IN THE RELATIONSHIP BETWEEN PELVIC FLOOR MUSCLE ACTIVATION AND INTRAVAGINAL PRESSURE DURING COUGHING BETWEEN WOMEN WITH AND WITHOUT STRESS URINARY INCONTINENCE

Hypothesis / aims of study

Stress urinary incontinence (SUI) occurs during tasks that increase intra-abdominal pressure such as coughing, laughing and sneezing, and it is thought that pelvic floor muscle (PFM) activation failure or a loss of PFM fascial support is at least partially responsible for this condition. The literature is inconclusive as to whether women with SUI have reduced contractility of their PFM as measured by electromyography (EMG) and intravaginal pressure (IP). Most studies have been done while women with and without SUI perform maximal voluntary contractions and not while they perform tasks that are associated with urine leakage. The purpose of this study was to investigate PFM EMG activation and intravaginal pressure (IP) during coughing in women with and without SUI. It was hypothesized that the women with mild and more severe SUI would demonstrate lower PFM activation and lower peak intravaginal pressures during coughing. It was also hypothesized that the women with mild and more severe SUI would demonstrate differences in the relationship between IP and PFM EMG.

Study design, materials and methods

Continent and stress incontinent women aged 21 to 60 years who were not pregnant, had not given birth in the previous twelve months and who were in good general health were invited to participate. Women were excluded if they had a history consistent with urge urinary incontinence or pelvic organ prolapse, previous urogynecological surgery, diabetes, neurological conditions or autoimmune connective tissue disorders and if they took medications to treat or known to exacerbate urinary incontinence. Volunteers participated after providing informed consent. Potential subjects first attended a screening session conducted by a research nurse in which pelvic organ prolapse was investigated (POP-Q) and lower extremity reflex and sensation testing was performed. Subjects were invited to continue their participation only if this examination revealed no deficits. Subjects then underwent urodynamic observations to rule out other conditions such as intrinsic sphincter deficiency. Those whose urodynamic study results were consistent with SUI or with no pathology (control) were provided guided instruction by the research nurse on how to perform a PFM contraction who used digital palpation to verify proper performance before the subjects left the session. Subjects were given a three day bladder diary to fill out prior to attending the experimental session. The diary information was later used to stratify women into continent, mild SUI and moderate to severe SUI groups.

At the experimental session, the researchers were blind to subject group assignment. Each subject inserted a Femiscan™ vaginal bilateral differential EMG probe into her vagina. The probe was modified to house an air-filled balloon coupled to a pressure transducer on the posterior surface. The EMG electrodes were coupled to Delsys DE2.1 pre-amplifiers and Bagnoli-8 amplifiers with an overall gain of 1000 and a pass band of 20 to 450 Hz. The pressure transducers were coupled directly to the data acquisition card. EMG and IP data were sampled at 1000 Hz. The subjects performed 3 trials of a maximum voluntary contraction of the PFM in supine and eight women in each group performed three trials of a maximum effort cough in supine. Only the EMG data from the side that generated larger signal amplitudes were used in the analysis. All data files were smoothed using a third order dual pass Butterworth filter. Maximum EMG and IP amplitudes were obtained for each task. Each data file was then normalized to the maximum smoothed amplitude achieved during that task and an IP versus PFM EMG curve was created.

Maximum EMG and IP amplitudes recorded during each task were compared among the groups using two-way nested ANOVA models. Ensemble average IP versus PFM EMG curves were created for each group and task and the curves were compared among the groups.

Results

Twenty-nine continent women, 24 women with mild SUI and 8 women with moderate to severe SUI participated in a larger study, of which eight women per group participated in the current study on coughing. For the PFM maximum voluntary contractions in the larger group, there was no significant difference in PFM EMG amplitudes (overall mean = 41.2(±46.5)uV; p=0.491; power = 0.070), but the women with moderate to severe SUI generated significantly lower (6.51±2.50 cmH₂O) IP amplitudes than the continent (13.65±14.2 cmH₂O) and the mild SUI (16.4±10.3 cmH₂O) groups (p=0.029). The ensemble averaged IP versus PFM EMG curves were not substantively different among the groups, and are presented in Figure 1.

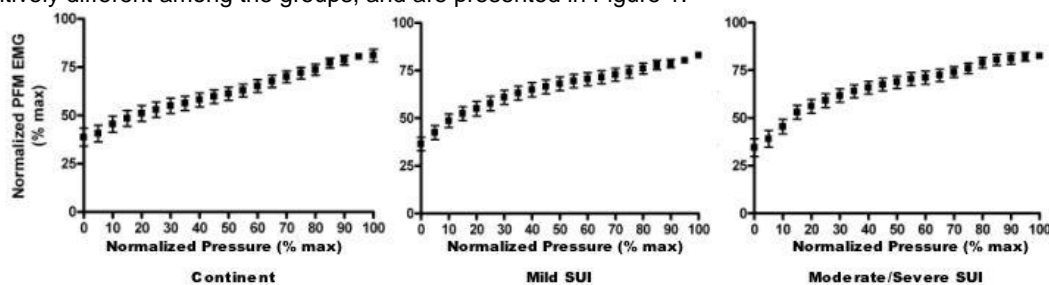


Figure 1: Intravaginal pressure versus pelvic floor muscle EMG during voluntary PFM contractions. (Continent n=29, mild SUI n=24, moderate to severe SUI n=8). 95% confidence intervals for the predicted values at each pressure increment are presented.

During coughing, there were no differences in maximum EMG amplitude (overall mean = 46.3 (±070.5) uV; p=0.63, power = 0.063) or maximum IP (overall mean = 22.9(±21.7) cmH₂O; p=0.88, power = 0.073) among the groups. The shapes of the ensemble average curves were not substantively different among the groups, however the intercept was higher (p<0.05) in the women with moderate to severe SUI than in the women with mild SUI, and tended (p=0.08) to be higher in the women with moderate to severe SUI than in the continent women. There also appeared to be two distinct curve shapes for each group, as indicated in Figure 2.

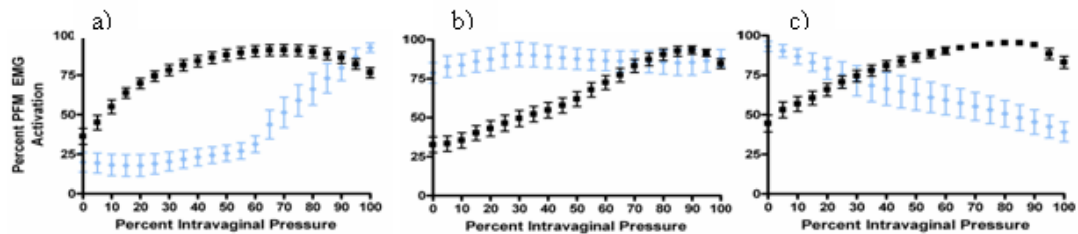


Figure 2: Intravaginal pressure versus pelvic floor muscle EMG during coughing for the (a) continent, (b) mild SUI, and (c) moderate to severe SUI groups. The black curves indicate the primary ensemble average curves for each group, with 95% confidence intervals for the fitted points. There was a small number of trials (6 of 24 trials in the continent group, 4 of 24 trials in the mild SUI group, and 3 of 24 trials in the moderate to severe SUI group) that did not fit the general pattern and curves for these data are plotted in blue.

Interpretation of results

Based on the results of this study, there does not appear to be a difference in PFM EMG activation amplitude during voluntary contractions or during coughing between women with and without SUI. The differences noted in the intercept of the IP versus EMG curves during coughing may indicate delays in the transmission of the forces induced by PFM contraction in women with SUI. Such delays in transmission might be the result of fascial damage within the pelvic floor, and not specifically due to contractile deficits. A slight delay in the generation of urethral closure pressure at the initiation of a cough is consistent with the leakage of a small amount of urine at the initiation of coughing, sneezing or laughing as described by women with SUI.

Concluding message

Through the results of this work it appears that women with SUI may demonstrate delays in the transmission of forces generated through PFM contraction during activities such as coughing. During coughing the total amount of PFM EMG amplitude or intravaginal pressure generated by women with SUI is not different from women without SUI.

<i>Specify source of funding or grant</i>	Funding was provided by the Physician's Services Incorporated Foundation, and the Canadian Institutes for Health Research
<i>Is this a clinical trial?</i>	No
<i>What were the subjects in the study?</i>	HUMAN
<i>Was this study approved by an ethics committee?</i>	Yes
<i>Specify Name of Ethics Committee</i>	Queen's University Health Sciences Research Ethics Board
<i>Was the Declaration of Helsinki followed?</i>	Yes
<i>Was informed consent obtained from the patients?</i>	Yes