

WOMEN WITH AND WITHOUT STRESS URINARY INCONTINENCE SHOW AGE-RELATED CHANGES IN THE RISE TIME AND THE PEAK OF THE INTRAVAGINAL PRESSURE PRODUCED DURING COUGHING.

Hypothesis / aims of study

The purpose of this study was to determine (1) if, compared to continent women, women with stress urinary incontinence (SUI) generate lower intravaginal pressure (IVP) during voluntary pelvic floor muscle (PFM) contractions or coughing, slower contraction times or less ability to sustain IVP generated by a PFM contraction, and (2) if there are reductions in the ability to generate IVP during these tasks associated with increasing age.

Study design, materials and methods:

Ethics approval from the appropriate institutional research ethics board was obtained before initiating this cross-sectional observational study. Women with and without stress urinary incontinence (SUI) with ages ranging from 20 to 70 years were recruited from the community, and provided written informed consent. All volunteers were first screened by telephone interview to exclude women with urge or mixed urinary incontinence, women with connective tissue or neurologic disorders and women with a history of gynecological surgery. Volunteers were then screened by a research nurse to ensure that they had no evidence of prolapse (POP-Q >stage 1) and that they could perform a proper pelvic floor muscle (PFM) contraction. Eligible volunteers completed a three day bladder diary to determine the type and severity of their incontinence symptoms, and women with evidence of urge incontinence on the bladder diary were excluded. Severity of SUI was rated by the number of leakage episodes over the three days and the lowest intensity task that provoked urine leakage, and women were stratified into three groups: no SUI, mild SUI and severe SUI. Women with mild and severe SUI underwent urodynamic studies to rule out detrusor instability and those with such evidence were excluded from the study. The participants attended one session in which intravaginal pressure (IVP) was recorded by a researcher blind to group assignment during a series of maximal effort voluntary PFM contractions and maximal effort coughs. IVP data were acquired using a custom air-filled pressure transducer mounted on an intravaginal probe. The participants each performed three maximum voluntary PFM contractions and one sustained PFM contraction in supine, and three maximum effort coughs in standing. Pressure data were acquired at a sampling rate of 1000Hz and smoothed using a moving root mean square (RMS) filter of 200ms and 199ms overlap. The baseline pressure was removed from the peak pressure obtained during each task. The maximum IVP amplitudes measured during the maximum voluntary contractions and the coughs, the time for IVP to reach a peak during the coughs, and the time for the IVP to drop by 50% during the sustained PFM contraction were compared among the groups using separate analysis of covariance models, with age included as a covariate and the interaction between group and age included in the model ($\alpha=0.05$).

Results

Thirty-five continent women, 35 women with mild SUI and 17 women with severe SUI participated. All groups produced higher IVPs during coughing than during voluntary contractions. There were no group by age interactions and no difference in maximum IVP generated during voluntary PFM contractions among the groups or associated with age. During coughing there was no group by age interaction in the peak IVP recorded. The women with mild SUI produced higher IVP amplitudes during coughing than did the continent women and the women with severe SUI, and older age was associated with a reduction in IVP, with a slope of -3.58 (± 0.94)cmH₂O per decade. See Figure 1 for details. The time to reach peak intravaginal pressure was not different among the groups, but was longer in the older women, where the rise time lengthened by 97.2 (± 30.3)ms per decade. See Figure 2 for details. For the sustained contraction, many women in all groups were able to hold their "maximum" PFM contraction for more than 60 seconds which resulted in a ceiling effect in the data. As such, non-parametric statistics were used to analyze the contraction time data, and no difference in contraction time was found among the groups. Spearman's correlations revealed that there was a very small positive correlation between older age and endurance time ($r_s=0.05$).

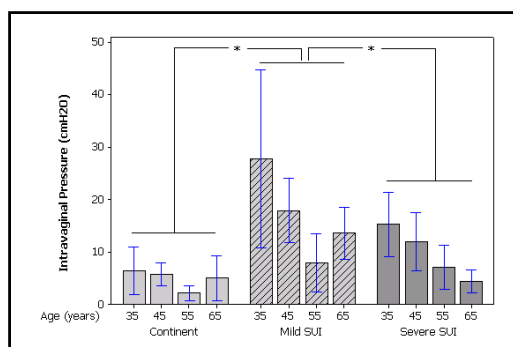


Figure 1: Maximum intravaginal pressure amplitudes during coughing plotted by group and age. The bars indicate the mean values and the whiskers indicate the 95% confidence intervals for the mean. The age by group interaction was not significant, but there were significant main effects for both group and age. The group with mild SUI generated more IVP during coughing than did the continent group and the group with severe SUI.

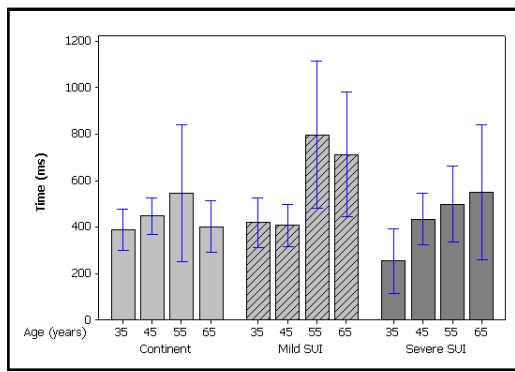


Figure 2. Intravaginal pressure rise times during coughing in standing. The bars indicate the mean values and the whiskers indicate the 95% confidence intervals for the mean. The age by group interaction and the group main effect were not significant, but there was a significant main effect for age. Older women took longer to generate peak IVP than did younger women.

Interpretation of results

The participants generated higher IVP during coughing than they were able to generate during MVCs. The women with mild SUI generated more IVP during coughing than did women without SUI, which is consistent with previous research [1] and suggests that, at least in the case of mild SUI, PFM contraction is not impaired and may actually be higher than normal to compensate for other defects in the extrinsic continence system. As such, the higher pressures seen in the women with mild SUI may be the result of a training effect. Older women did not generate as much IVP during coughing as did younger women, with a reduction in peak pressure equivalent to approximately 40% per decade. This reduction in IVP may reflect age-related changes in the extrinsic continence system, particularly the pelvic floor muscles. The related finding that older women generate IVP more slowly than younger women is also consistent with age related changes seen in other skeletal muscles. Specifically, there is selective loss of type II muscle fibers and a conversion of fast-twitch (type II) to slow-twitch (type I) fibers with increasing age[2]. Although no association between age and the duration of the sustained maximal PFM contraction was found, the contraction time data were contaminated by a ceiling effect and the fact that the women in the different groups contracted at different force levels during this task. Since most age-related changes in skeletal muscle occur after the age of 60, a future study should investigate the impact of aging on PFM function in women older than those included in the current study. Longitudinal studies are required to confirm that the changes in IVP generated during voluntary contractions and during coughing are truly related to age and not confounding variables such as reduced levels of physical activity.

Concluding message:

The data suggest that PFM weakness may not be an important a factor in the pathophysiology of SUI, particularly in younger women. The IVP generated during coughing and the rise time of the IVP during coughing are, however, lower with in older women. These changes might be associated with reappearance of or *denovo* appearance of SUI symptoms in older women.

References

1. Smith, M. D., M. W. Coppieters, et al. (2007). Postural response of the pelvic floor and abdominal muscles in women with and without incontinence. *Neurourology and Urodynamics* 26: 377-385
2. Faulkner JA, Larkin LM, Clafflin DR, Brooks SV. Age-related changes in the structure and function of skeletal muscles. (2007) *Clin Exp Pharmacol Physiol.* 34:1091-6

Specify source of funding or grant	Canadian Institutes for Health Research (CIHR)
Is this a clinical trial?	No
What were the subjects in the study?	HUMAN
Was this study approved by an ethics committee?	Yes
Specify Name of Ethics Committee	Queen's University Health Sciences Research Ethics Board
Was the Declaration of Helsinki followed?	Yes
Was informed consent obtained from the patients?	Yes