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PELVIC FLOOR MUSCLES ACTIVITY DURING IMPACT LOADS IN CONTINENT AND INCONTINENT WOMEN: A SYSTEMATIC REVIEW

Hypothesis / aims of study

Investigations of muscle activity of female pelvic floor muscles (PFMs) during impact loads help us to better understand the pathophysiology of stress urinary incontinence (SUI) and to improve rehabilitation strategies. This systematic review (PROSPERO:2016:CRD42016035624) summarises current evidence for PFMs activity, detected through electromyography (EMG), during impact loads in both continent and incontinent women.

Study design, materials and methods

We systematically searched Pubmed, EMBASE, Cochrane, and SPORTDiscus databases for literature published between January 1990 and December 2016. The PICO approach (Patient, Intervention, Comparison, Outcome) was applied in order to construct the search query. We included original articles that investigated PFMs activity during impact loads if they included terms related to muscle activity and measurement methods, test positions, activities performed, and continence status. Two reviewers screened titles and abstracts independently to ascertain if included papers fulfilled the inclusion criteria. Data on outcome parameters have been extracted.

Results

Twenty-eight studies fulfilled inclusion criteria; 26 were cross-sectional studies. Ten studies compared continent to incontinent women. Studies used wide range of PFMs EMG measurement methods, including vaginal probes, surface, needle, and wire EMG. They also contained a wide array of EMG calculations and comparisons for several reflex tasks, like coughing, running, rapid arm movements, load-catching tasks, and horseback riding, in different test positions. Continent women contracted their PFMs before other trunk and arm muscles. Incontinent women performed the PFMs activity later than continent women during impact loads. This was observed during coughing and rapid arm movements. Time interval in relation to the onset of other trunk muscles seemed to be important, and so did time interval from the onset of PFMs activity in comparison to the onset of intra-abdominal-, urethral- and posterior vaginal wall pressure rise. Coughing significantly increased PFMs EMG activity, which correlated with the intensity of coughing. Gradual adaptation of PFMs activity was also evident for running speeds and pace of horseback riding. As for other muscles, PFMs activity during impact loads is greater than activity during maximal voluntary contraction (MVC). While running, the maximal PFMs activity varied from 98.6 to 238.7 %EMG (MVC-normalised); pre-activity (activation before heel strike; -30 to 0 ms) varied from 72.1 to 136.9 %EMG (1, 2). Posture did not influence timing, but in a neutral pelvis position PFMs activity was higher than in hypo- or hyperlordosis posture, suggesting that posture should be considered in rehabilitation. Parous SUI women showed asymmetrical and uncoordinated levator ani muscle activation patterns, and revealed behavioural abnormalities.

Interpretation of results

The initial phase of intravaginal pressure increase seen during abdominal contraction was caused by PFMs contraction. Our findings support the “subvesicular hammock” theory of Delancey *et al.* (3). They suggest that compression of the urethra closes the lumen through its lateral attachment to the arcus tendineus fascia pelvis and levator ani muscle. This endopelvic fascia tissue stiffens under the influence of a reflex contraction of PFMs because intra-abdominal pressure increases. Therefore the stiffness of fascia is of consideration. This finding supports the thesis that the time interval between the onset of PFMs activity and the onset of intra-abdominal pressure rise are important for continence. Our review confirmed the significance of timing during impact activities; specifically SUI women had delayed PFMs activation.

PFMs reflex activity during coughing is not a univocal response but a modulated reflex; it gradually adapts to the impact tasks. An alteration of the modulation of cough anal reflex showed a no graded PFMs response during impact activities in SUI women. This alteration may contribute to the pathophysiology of SUI.

During impact loads incontinent women had more PFMs activity than continent women, this supports the idea that incontinence might not be caused by morphological changes of PFMs, but by altered muscle activation patterns. PFMs may maintain basal tonus with slow twitch muscle fibres, while fast twitch muscle fibres are recruited for rapid contractions. We found behavioural abnormalities in muscle activation patterns for SUI women. These findings should be integrated into a PFMs rehabilitation program for SUI women that include training control and coordinating abdominal muscle activity, and integrating impact loads to exercise and activate fast twitch muscle fibres and, first of all, their involuntary function.

Concluding message

We summarise current knowledge of PFMs activity during impact loads. Time interval between the onsets of PFMs activity in relation to the onset of trunk muscles and relation to the onset of abdominal and bladder pressure rise, which is a result of abdominal strain, seems to be crucial for the maintenance of continence. Our results suggest that impact activities should be included in rehabilitation programs, because of their intensive involuntary PFMs activation, although we still do not clearly understand the pathomechanism of PFMs activity during impact loads. Future research should focus on dynamic PFMs activities during impact loads and could integrate the influence of stiffness from the endopelvic fascia tissue and PFMs tone into research question.

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