

## IS IT WHAT YOU DO OR THE WAY YOU DO IT?

### Hypothesis / aims of study

It is widely believed that women at risk of pelvic floor disorders (PFDs) should avoid certain exercises and activities, on the assumption that they generate high abdominal pressures ( $P_{AB}$ ). However, there is no evidence to underpin these beliefs. Advice given to patients is to avoid many household activities<sup>1</sup>, and Pelvic Floor First<sup>2</sup> advises women to avoid certain exercises, some of which can be unnecessarily restrictive. Yet, few studies have adequately investigated this issue due to the practical difficulties of measuring  $P_{AB}$  and deficiencies in analysing the data that comprises several parameters. Most analyses use only one parameter such as mean or maximal pressure but it is not clear which component is the most important. This study uses multivariate statistical methods and a novel wireless intravaginal pressure sensor (IVPS)<sup>3</sup> to analyse pressure measurements.

The aim of this study is to measure  $P_{AB}$  generated during a series of pelvic floor safe and conventional exercises<sup>2</sup> to provide preliminary evidence for or against clinical guidelines.

### Study design, materials and methods

All participants were volunteers recruited through advertisements at the University of Auckland. Inclusion criteria were > 18 years, had no symptoms of PFDs and could comfortably perform exercises with no contraindications. All women attended a gym once where a clinical exercise practitioner guided them through 10 types of exercises (including planks, stepups and ball rotations) with safe and conventional versions, as well as several activities that occur during daily living. Analysis was performed on the paired exercises. Each participant had their own IVPS which was self-administered and recorded  $P_{AB}$  in real-time. LabChart 7 was used to extract components from the  $P_{AB}$  trace (Fig. 1A).

Multivariate analysis of variance (MANOVA) and canonical discriminant analysis (CDA) were performed on the data using R version 3.2.2.

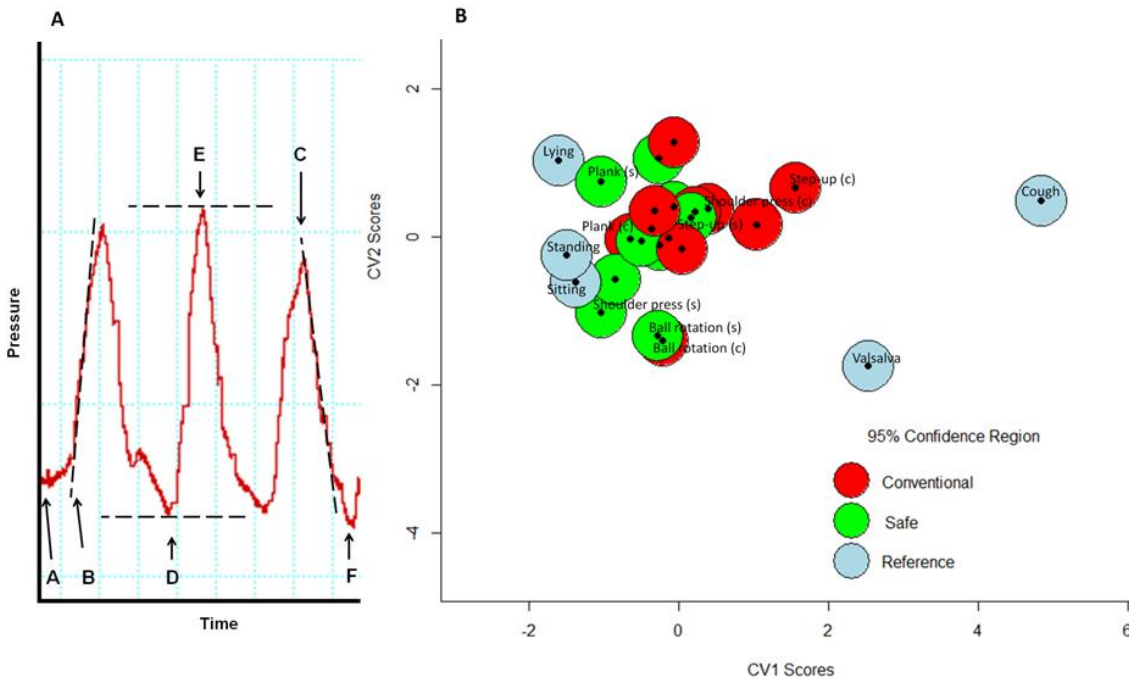
### Results

51 women were recruited with a median age 42 years (22 to 58), mean BMI 25.9 kg/m<sup>2</sup> (SD=6.2) and median parity 1 (0 to 4). After adjusting for age, BMI and parity, the MANOVA suggested there is very strong evidence to indicate that the effect of the version (safe or conventional) is not the same for all exercise types ( $p < 0.01$ ).

The dimension reduction technique, CDA, was used to visualise the multivariate data. The CDA showed approximately 89 % of the variation between the group centroids (20 exercise versions and 5 reference groups) can be accounted for by the first two canonical variates (CVs).

The first canonical variate (CV1) is positively correlated with larger maximum amplitudes, higher mean pressure, steeper rates of increase and decrease in pressure. CV2 is negatively correlated with higher mean pressure. Not all pelvic floor safe exercises generate less  $P_{AB}$  than their conventional counterpart (Fig. 1B). For example, there is no evidence to suggest that the safe and conventional versions of ball rotation generate different  $P_{AB}$ .

$P_{AB}$  generated during valsalva and cough is distinctly different to the pressure generated during all other exercises (Fig. 1B).



**Fig. 1A:** A typical recording from wall push ups. A and F are the manually selected start and end of activity, respectively. D and E are the minimum and maximum activity pressures, respectively. Maximum pressure amplitude is the maximum minus the minimum (E–D) within the interval A to F. Mean is the average pressure within the interval A to F. **B:** Representative plot of different exercises and reference groups presented in the first two dimensions of a CDA. CV scores are canonical variate scores. s=safe, c=conventional.

There is also evidence that BMI is correlated with mean lying IAP ( $r=0.34$ ,  $p=0.02$ ), sitting IAP ( $r=0.48$ ,  $p<0.01$ ), and standing IAP ( $r=0.27$ ,  $p=0.05$ ).

#### Interpretation of results

Based on this study, not only is there no evidence of a difference between safe and conventional versions for some exercise types (in terms of  $P_{AB}$  development) but some safe exercises of one type can generate higher pressure than conventional exercises of another type such as the safe version of stepups vs. the conventional version of a plank. Cough and Valsalva generate pressures which have larger maximum amplitudes and higher mean pressures than any of the exercises tested in this study.

#### Concluding message

Preliminary results suggest that the advice given to women needs to be evidence-based as current recommendations may be needlessly restrictive. Using multivariate techniques that take into account more pressure components appears to be more informative as the  $P_{AB}$  generated is dynamic and not the same for all exercises.

#### References

1. IUGA ([goo.gl/MXV4zn](http://goo.gl/MXV4zn))
2. Continence Foundation of Australia ([goo.gl/s2GkCL](http://goo.gl/s2GkCL))
3. Int Urogynecol J, 2013. 24(10):1715-21

#### Disclosures

**Funding:** J Kruger - Aotearoa Postdoctoral Fellowship **Clinical Trial:** No **Subjects:** HUMAN **Ethics Committee:** University of Auckland Human Participants Ethics Committee Ref no:010994 **Helsinki:** Yes **Informed Consent:** Yes