How close are we to predicting trauma

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Pelvic Floor Disorders (PFDs)

Pelvic Organ Prolapse (5-10%)
Urinary incontinence (30-60%)
Anal incontinence (11-15%)

Any form of pelvic floor disorder 46%

Common problems affecting millions of women throughout the world

Negative effect on:

Quality of life and Working ability

Sporting activities and Sexual activity

Global costs high

Milsom I, Altman D, Cartwright R, Lapitan MC, Nelson R, Sillén U, Tikkanen K. Epidemiology of Urinary Incontinence (UI) and other Lower Urinary Tract Symptoms (LUTS), Pelvic Organ Prolapse (POP) and Anal (AI) Incontinence. *In:* Incontinence. Editors Abrams, Cardozo, Kouhry and Wein. Health Publications Ltd, Paris 2013

Life-time risk of POP surgery

The lifetime risk of undergoing POP surgery alone has been reported to vary between 5 and 19%.[1] The highest life time risk for POP surgery,19%, has been reported from Western Australia[2]

De Boer[3] et al. estimated that 20.2% of Dutch women would undergo POP or continence surgery before 85 years of age

Wu et al.[4] estimated a similar rate of intervention in the United States

1. Haya et al. Am J Obstet Gynecol 2015;212:755.e1-755.e27.
2. Smith et al. Obstet Gynecol 2010;116:1096-1100
3. de Boer et al. Eur J Obstet Gynecol Reprod Biol 2011;158:343-349
4. Wu et al Obstet Gynecol 2014;123:1201-1216

Numerous risk factors for PFDs have been identified

Age
Hereditary factors
Hysterectomy
Obesity
Irritable Bowel syndrome
Ethnicity
Dementia
Physical activity
Neurological illnesses

Parity
Pregnancy
Delivery mode
Anal sphincter rupture
Postmenopausal
Multiple sclerosis
Parkinsons illness
Urinary tract infections
Diabetes mellitus

Milsom I, Altman D, Cartwright R, Lapitan MC, Nelson R, Sillén U, Tikkanen K. Epidemiology of Urinary Incontinence (UI) and other Lower Urinary Tract Symptoms (LUTS), Pelvic Organ Prolapse (POP) and Anal (AI) Incontinence. *In:* Incontinence, Editors Abrams, Cardozo, Kouhry and Wein. Health Publications Ltd, Paris 2013.

For ethical and practical reasons, randomised controlled trials to evaluate the causal effects of vaginal and caesarean delivery on the pelvic floor will never be performed

We therefore have to rely on:

Objective Pathophysiological data

Epidemiological data

Objective Pathophysiological data

Magnetic resonance imaging

Ultrasound

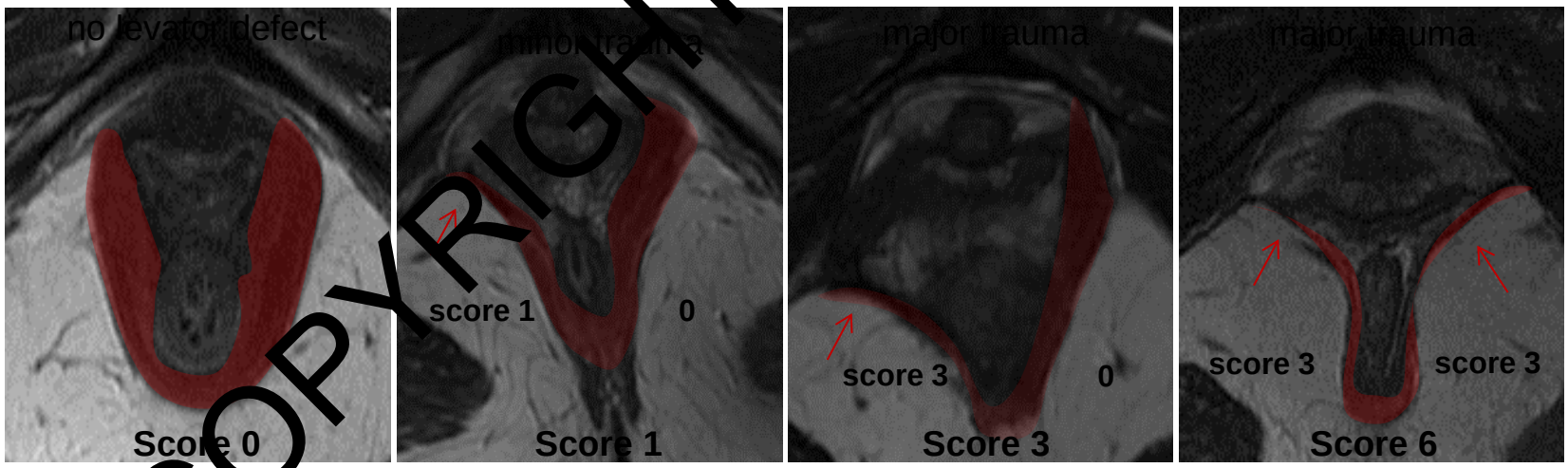
Electrophysiological data

MRI Levator ani injury postpartum

6-10% after spontaneous vaginal delivery
17-33% after vacuum extraction
67-71% after forceps delivery

but was not identified in nulliparous women or after caesarean section

Kearney R, Fitzpatrick M, Brennan S, Behan M, Miller J, Keane D, O'Herlihy C, DeLancey JO. Int J Gynaecol Obstet. 2010



DeLancey JO et al. Obstet Gynecol 2003;209:295-302

Epidemiological data

Urinary Incontinence after Vaginal Delivery or Caesarean Section

Rortveit G et al. N Engl J Med 2003;348: 900-907

EPINCONT study - community based cohort (n = 15 307), younger than 35 years

Prevalence of UI

Nulliparous 10.1%

Vaginal delivery group 21.0%

Cesarean section group 15.9%

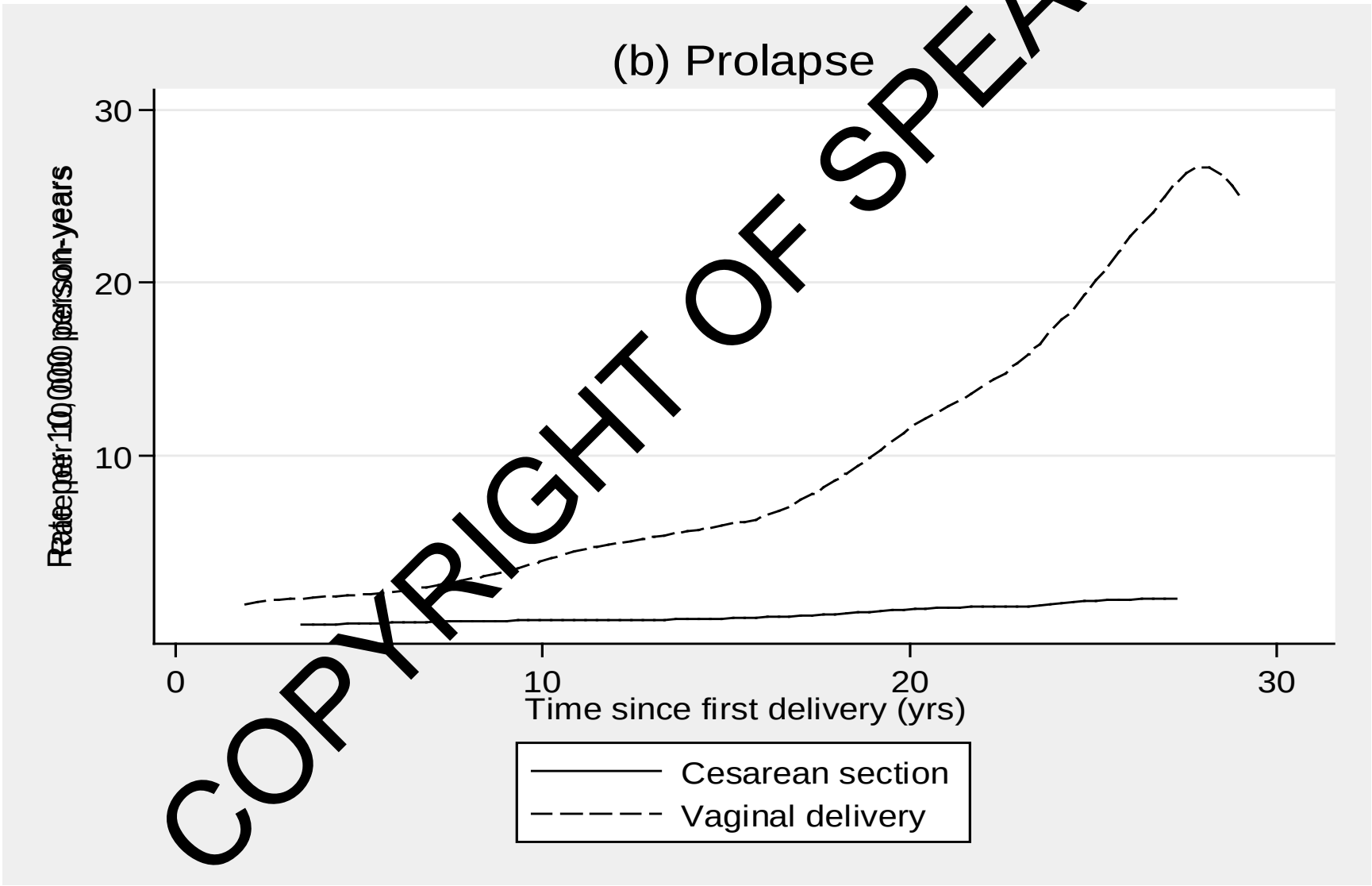
Odds ratio UI

Nulliparous - CS 1.5 (95% CI 1.2-1.9)

VD - CS 1.7 (95% CI 1.3-2.1)

Rate of pelvic organ prolapse surgery in relation to mode of delivery and time from first childbirth

(Leijonhufvud et al. Am J Obstet Gynecol 2011;204(1):70.e1-7)



Effect of delivery history on pelvic organ prolapse

Mode of delivery (N)	% with prolapse ≥ 2b	OR* [95% CI]	P value
Only SVD (343)	29%	Reference	
Only CS (53)	6%	0.12 [0.04 to 0.41]	0.001
SVD + CS (52)	21%	0.51 [0.25 to 1.05]	0.067

* OR adjusted for age at first child, parity and BMI at index birth

C Glazener et al, BJOG, 120:161–168 (2013)

SWEPOP-study

SWEdish Pregnancy, Obesity and Pelvic floor study

- **The risk increase after VD compared to CS was 67% for UI and 275% for UI>10 years**
- **The prevalence of sPOP was 14.6% after vaginal delivery and 6.3% after caesarean section and the risk increase associated with VD was 255% compared to CS**
- **Vaginally delivered women had a more than tripled prevalence and risk of having the combination sPOP and UI compared to CS**
- **The prevalence of UI, UI>10 years and sPOP did not differ between elective CS and acute CS**

Gyhagen et al. BJOG. 2013 Jan;120(2):144-51.
Gyhagen et al. BJOG. 2013 Jan;120(2):152-60.

Prevalence of sPOP in relation to mode of delivery stratified for BMI and infant birth weight

	VD (%)	CS (%)	OR (95% CI)
BMI			
< 25	12.1	5.1	2.57 (1.73-3.83)
25-29	15.5	7.8	2.18 (1.44-3.30)
≥ 30	19.4	7.4	3.04 (1.82-5.08)
Birth weight			
<3000	11.8	7.9	1.57 (0.97-2.56)
3000-3499	14.2	5.0	3.17 (1.95-5.15)
3500-3999	14.6	5.9	2.73 (1.55-4.80)
4000-4499	15.8	3.7	4.85 (2.10-11.17)
≥ 4500	23.8	7.8	3.67 (1.22-11.03)

Adjusted for current BMI, maternal age, infant birth weight and head circumference.

Gyhagen et al. BJOG. 2013 Jan;120(2):152-60. Prevalence and risk factors for pelvic organ prolapse 20 years after childbirth: a national cohort study in singleton primiparae after vaginal or caesarean delivery

UR-CHOICE – Can we provide mothers-to-be with information about the risk of future pelvic floor dysfunction?

Don Wilson, James Dornan, Ian Milsom, Robert Freeman
Int Urogynecol J 2014; 25: 1449 – 1452

A hypothesis was proposed that the following physical features of the Mother and the Baby can be scored and used to determine the most suitable route of delivery

U - Presence or absence of antenatal UI

R - Race/Ethnicity

C - Childbearing started at what age

H - Height of mother

O - Overweight? (mothers BMI)

I - Inheritance (family history)

C - Children (number of children desired

E - Estimated fetal weight

Predictive Modelling Cooperation

SWEPOP Study Group

Sahlgrenska Academy, Gothenburg

Maria Gyhagen, Jwan Othman, Ida Nilsson, Björn Areskoug, Ian Milsom

PROLONG Study Group

Aberdeen, Glasgow and Otago

Don Wilson, Suzanne Hagen, Andrew Elders

CLEVELAND CLINIC Group

Cleveland

Matt Barber, Eric Jelovsek, Michael Kattan, Kevin Chagin

Study Populations

Data from 2 longitudinal, prospective cohorts

1. **Swedish Pregnancy, Obesity and Pelvic Floor Study (SwePOP)**
   - **Only Primiparous women delivered 1985-1988 (n = 9423)**
   - **Swedish Medical Birth Register data**
   - **Follow-up 20 years after delivery**
2. **ProLong study from UK/New Zealand**
   - **All deliveries w/in 12 months (1993-94)**
   - **7883 participated 3 months after index birth**
   - **Aberdeen (UK), Birmingham (UK), Dunedin (New Zealand)**
   - **Followed up 12 years after delivery**

Gyhagen M, Bullarbo M, Nielsen T, Milsom I. BJOG 2013
MacArthur C, Glazener C, Lancashire R, Herbison P, Wilson D, BJOG 2011

Hypotheses

- Models can be developed to predict the likelihood of developing PFDs (outcomes) 12-20 years after delivery that:
  - Discriminate better than chance (i.e. concordance index=0.5)
  - Reasonable to calibrate and are internally and externally validated
  - Can be used in an ***on-line calculator*** to permit prediction on an individual basis

Prediction modelling- methodology

The cohorts were split so that data during the first half of the cohort's time period were used to fit prediction models and validation was performed using data from the second half (temporal validation).

Multiple logistic models were fit to the data and reduced using backwards elimination.

Model internal validation was assessed using 1000 bootstrap samples generating a bias-corrected concordance index.

Prediction modelling - Results

Models were able to discriminate between women who developed bothersome symptoms or received treatment, at 12 (PROLONG) and 20 years (SWEPOP) respectively, for:

- Pelvic organ prolapse (concordance indices 0.570, 0.627)
- Urinary incontinence (concordance indices 0.653, 0.689)
- Fecal incontinence (concordance indices 0.618, 0.676)
- One or more pelvic floor disorders (concordance indices 0.639, 0.675)
- Two or more pelvic floor disorders (concordance indices 0.635, 0.619)

28 year old primip, family history of POP
Otherwise low risk

Maternal Age at Delivery*	28
Number of Previous Births*	0
Family History of Pelvic Organ Prolapse*	Yes
Maternal Height (cm)*	170
Maternal Pre-Pregnancy Weight (kg)*	65
Estimated Fetal Head Circumference (cm)*	3[illegible]
Estimated Fetal Weight (g)*	3500
Planned Route of Delivery*	Vaginal

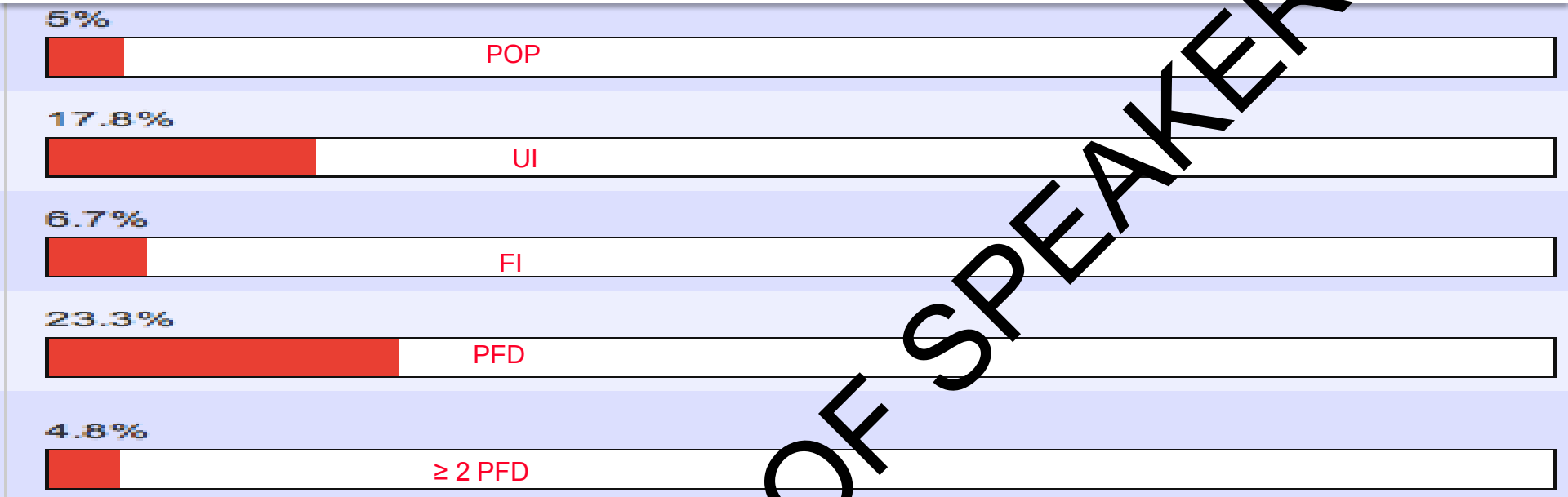
SUBMIT RESET

28 year old primip, family history of POP
High risk

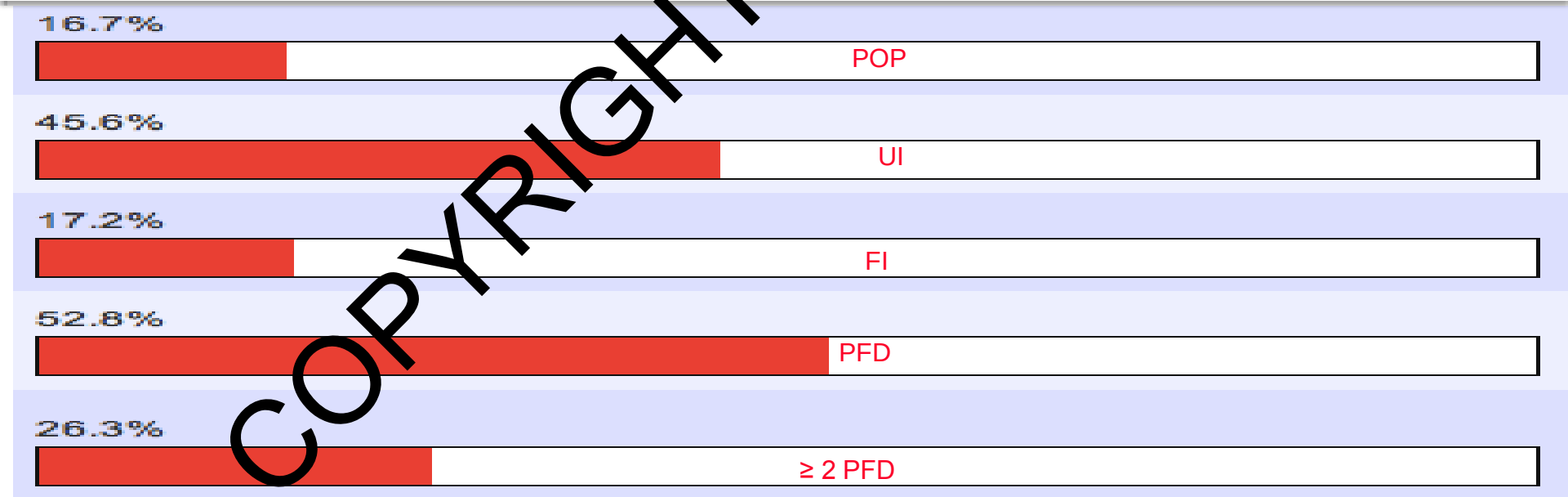
Maternal Age at Delivery*	28
Number of Previous Births*	0
Family History of Pelvic Organ Prolapse*	Yes
Maternal Height (cm)*	150
Maternal Pre-Pregnancy Weight (kg)*	100
Estimated Fetal Head Circumference (cm)*	37
Estimated Fetal Weight (g)*	4500
Planned Route of Delivery*	Vaginal

SUBMIT RESET

28 year old primip, family history of POP, low risk



28 year old primip, family history of POP, high risk



Conclusions

- **Models provide individualized risk estimates for the development of PFDs 12-20 years after delivery.**
- **Models provide an opportunity before birth to identify women at low risk of developing pelvic floor disorders and institute prevention strategies for women at higher risk.**
- **These models provide similar discrimination to predictive models currently used in clinical practice such as the National Cancer Institute Gail model for prediction of Breast Cancer risk (concordance index 0.59) and the Framingham Cardiovascular Risk Model (concordance index 0.72).**