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Breaking news in the prediction of pelvic floor disorders

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A B S T R A C T

Urinary incontinence (UI) and fecal incontinence (FI) together with pelvic organ prolapse (POP) constitute a huge global health problem affecting millions of women throughout the world. These pelvic floor disorders (PFDs) can have a negative influence on a woman's well-being, quality of life, and sexual function and prevent many women from participating in recreational and sporting activities. The global costs of PFDs to health care systems and society are enormous and approximately one in five women will undergo surgery for genital prolapse or UI by the age of 85 years.

Despite the fact that obstetric events are clinically recognized as important predictors, it is difficult to counsel women and intervene around the time of childbirth because of an inability to accurately convey an individual woman's risk. Little progress has been made in preventing PFDs despite their significant health and economic impact. Identifying women at risk remains a key element in targeting prevention and planning health resource allocation strategies.

A hypothesis (UR-CHOICE) has been put forward, based on the available scientific evidence, that the physical features of the mother and baby can be scored, and this score can be used to determine the most suitable route of delivery to avoid pelvic floor dysfunction in the future. Models capable of predicting the development of PFDs 12 and 20 years after delivery using data have recently been

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constructed and validated from two large, independent, international cohort studies. The models provide individualized prediction of the risk of developing PFDs 12 and 20 years after delivery using maternal and obstetrical variables available before childbirth (available at http://riskcalc.org/UR_CHOICE/).

Pelvic floor disorders (PFDs) such as urinary incontinence (UI) and fecal incontinence (FI) together with pelvic organ prolapse (POP) constitute a huge global health problem affecting millions of women throughout the world [1]. PFD can have a negative influence on a woman's well-being, quality of life, and sexual function and prevent many women from participating in recreational and sporting activities [1–4]. Millions of women throughout the world are afflicted [1,5,6], and there has been an increasing interest in these symptoms in recent years as a consequence of the increased awareness of the human and social implications for the individual sufferer.

Prevalence of PFDs

UI is a common condition and its prevalence increases with age. The prevalence of UI in adult women has been reported to vary between 30% and 60% according to different studies [1]. The prevalence of POP and anal incontinence has been reported to vary between 5% and 10% and 11% and 15%, respectively [1]. The prevalence of one or more PFD has been reported to be 46%, and many women have a combination of conditions [1].

Economic and health care burden of PFD

The global costs of PFDs to health care systems and society are enormous [7,8]. In Sweden, the annual cost of UI alone has been reported to account for approximately 2% of the total health care budget [7]. Approximately, one in five women will undergo surgery for genital prolapse or UI by the age of 85 years [9–12]. The highest lifetime risk for POP surgery, 19%, has been reported from Western Australia [9]. De Boer et al. [11] estimated that 20.2% of Dutch women undergo POP or continence surgery before 85 years of age, and Wu et al. [12] estimated a similar rate of interventions in the United States. Current treatments, often surgical, carry risks and relatively high rates of recurrence [13–15].

Risk factors for PFD

The etiology of PFD is known to be multifactorial, but obstetric trauma during childbirth has been reported to be one of the most important risk factors. Other important factors (Table 1) that have been implicated in the etiology of PFD are obesity, family history of PFD, and aging (1). Many of these risk factors are shared by two or more forms of PFD. Childbirth is one of the most important risk factors in the etiology of PFD and may contribute to the occurrence of some or all types of PFDs (1). Numerous epidemiological studies indicate an increased prevalence of PFDs

Table 1
Numerous risk factors for pelvic floor disorders have been identified [1].

Age	Pregnancy
Hereditary factors	Parity
Hysterectomy	Delivery mode
Concurrent prolapse	Anal sphincter rupture
Irritable bowel syndrome	Postmenopausal
Ethnicity	Multiple sclerosis
Dementia	Parkinson's disease
Obesity	Physical activity
Neurological illnesses	Diabetes mellitus
Urinary tract infections	Dementia

with increasing parity, and the greatest increase in risk is attributed to the birth of the first child [16–21].

During the second stage of labor, damage to the pelvic floor, its muscles and nerves, and to the endopelvic fascia may occur because of stretch, compression, and ischemia. Studies utilizing magnetic resonance imaging (MRI), ultrasound, and electrophysiological techniques have provided us information regarding the occurrence of levator ani and nerve injuries following vaginal delivery [22–28]. DeLancey et al. [22] reported on the occurrence of levator ani damage following spontaneous vaginal delivery (6–10%) and also found a much higher occurrence following forceps delivery (60–70%). Levator ani damage was not observed in nulliparous women or after cesarean section. In an ultrasound study by Dietz et al. [23] it was found that the detachment of the levator ani muscle was present in 14 of 39 examined women after vaginal delivery (VD), which was associated with stress UI 3 months postpartum.

Inability to perform an individual risk assessment

Despite the fact that obstetric events are clinically recognized as important predictors, it is difficult to counsel women and intervene around the time of childbirth owing to an inability to accurately convey an individual woman's risk. The presence of multiple risk factors and the long time lapse between obstetric events and the onset of PFDs later in life have inhibited counseling on an individual basis. Little progress has been made in preventing PFDs despite their significant health and economic impact [29]. To identify women at risk remains a key element in targeting prevention and planning health resource allocation strategies.

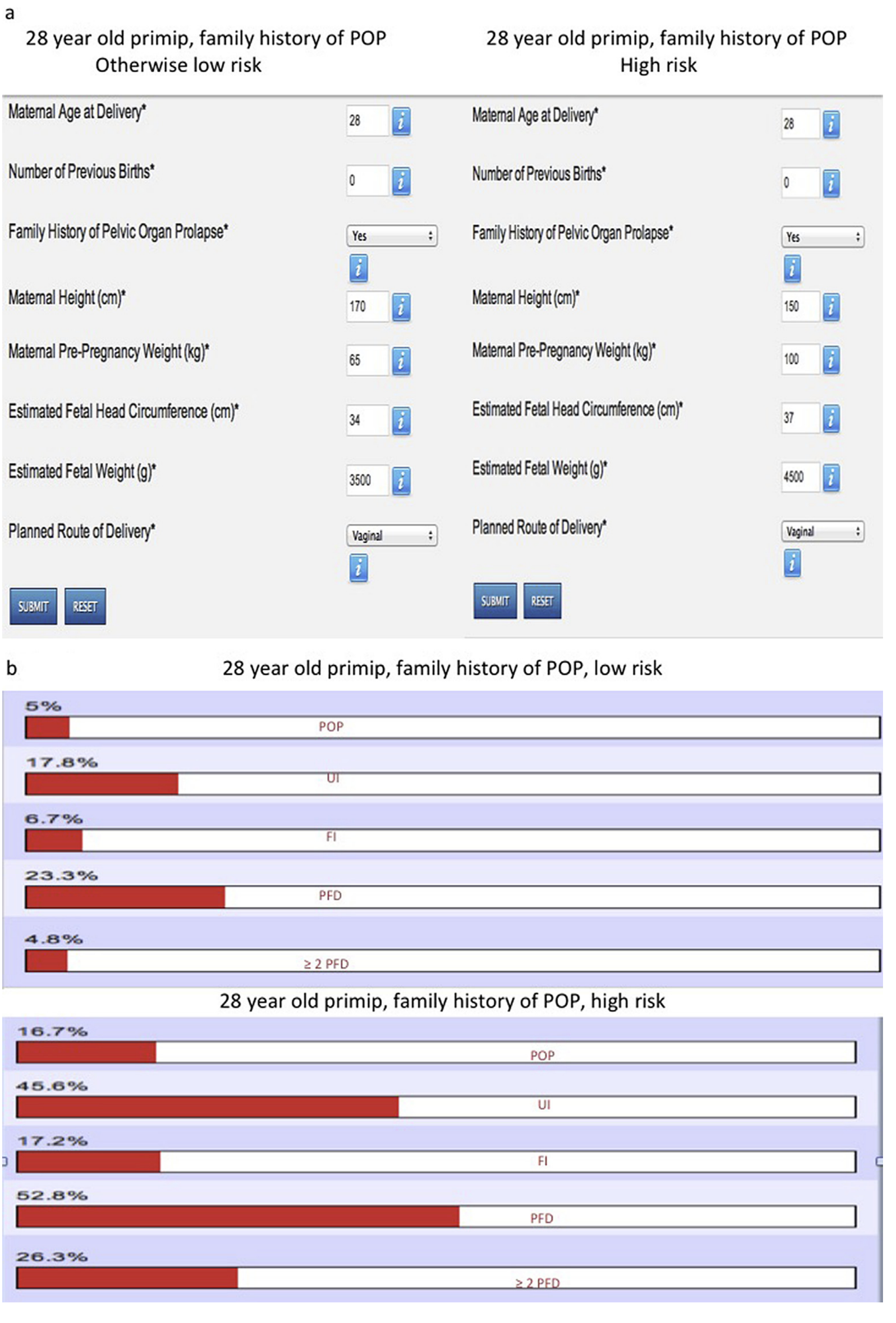
Prediction modeling

Scoring systems and prediction models have been used in other fields of medicine to identify patients at risk for chronic diseases [30–33]. Others have proposed or developed models for female PFDs shortly after delivery [34,35].

There is thus a wealth of evidence (MRI, ultrasound, electrophysiological data, and epidemiological data), thus indicating an increased risk of PFD following vaginal delivery compared to delivery by cesarean section. However, there are also many women who have a vaginal delivery and do not subsequently develop a PFD. Objective pathophysiological data [22–28], epidemiological data [1], and, in particular, the long-term data from the SWEPOP [18–21] and PROLONG [16,17] studies have indicated that there are a number of factors important for the future development of PFD. A hypothesis (UR-CHOICE) has been put forward, based on the available scientific evidence, that the physical features of the mother and baby can be scored, and this score can be used to determine the most suitable route of delivery to avoid pelvic floor dysfunction in the future [35]. Wilson et al. [35] proposed a scoring system (RU-CHOSE(N)) to predict the risk of future PFD based on several factors (UI before pregnancy, ethnicity, age at first birth, BMI, family history (mother and sisters) of PFD, baby's weight and maternal height (if less than 160 cm and the baby >4 kg) identified as major risk factors for subsequent PFD (see Table 2).

Table 2
The UR-CHOICE scoring system as proposed by Wilson et al. [35].

UR-CHOICE
U – Presence or absence of antenatal UI
R – Race/Ethnicity
C – Childbearing started at what age
H – Height of mother
O – Overweight? (mother's BMI)
I – Inheritance (family history)
C – Children (number of children desired)
E – Estimated fetal weight


a
28 year old primip, family history of POP
Otherwise low risk
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)*
170
Maternal Pre-Pregnancy Weight (kg)*
65
Estimated Fetal Head Circumference (cm)*
34
Estimated Fetal Weight (g)*
3500
Planned Route of Delivery*
Vaginal
SUBMIT
RESET
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
b
28 year old primip, family history of POP, low risk
5%
POP
17.8%
UI
6.7%
FI
23.3%
PFD
4.8%
≥ 2 PFD
28 year old primip, family history of POP, high risk
16.7%
POP
45.6%
UI
17.2%
FI
52.8%
PFD
26.3%
≥ 2 PFD

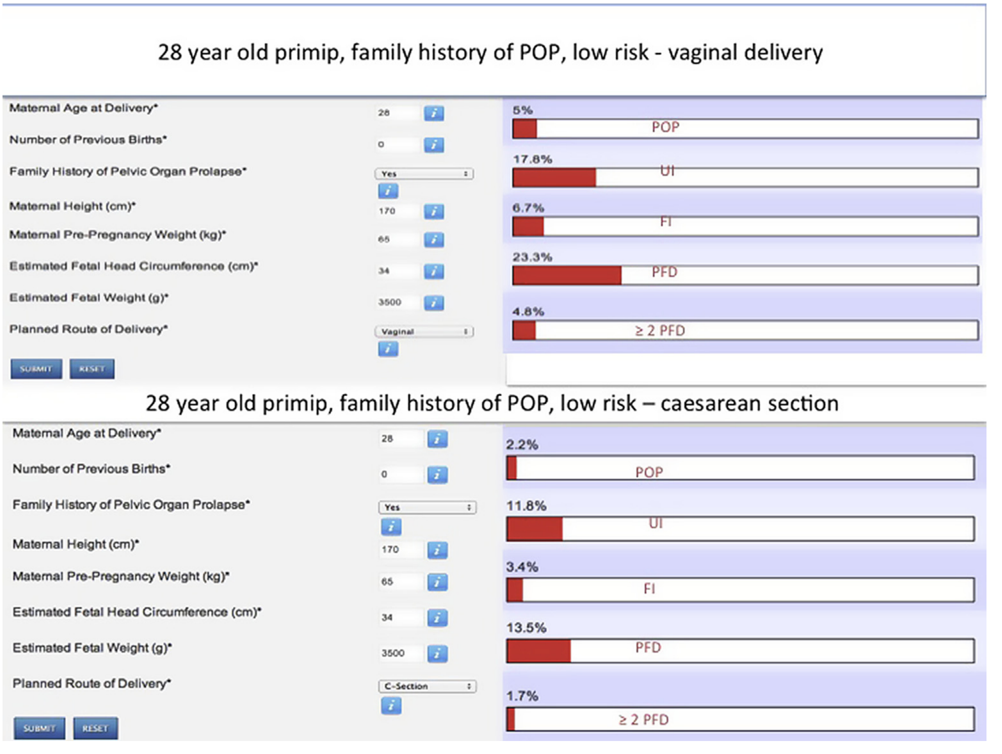


Fig. 2. An example of the prediction modeling system comparing a vaginal delivery and a cesarean section in a 28-year-old primiparous women. Clinical details and results of the prediction modeling system.

Jelovsek et al. [36] have recently constructed and validated models capable of predicting the development of PFDs 12 and 20 years after delivery using data from two large independent international cohort studies [17,18]. Predictors were examined from 8629 primiparous and multiparous women in two longitudinal, prospective cohorts from Sweden (the SwePOP cohort, N = 4991)[17] and Scotland/New Zealand (ProLong cohort, N = 3638) [18]. Baseline data on maternal and obstetric risk factors had been collected at the time of delivery, and outcomes related to PFD were noted 12 or 20 years after the index birth. The cohorts were split so that data during the first half of the cohort's period were used to fit prediction models, and validation was performed from the second half (temporal validation).

Models were able to discriminate between women who developed bothersome symptoms and those who received treatment at 12 and 20 years, respectively, for the following: POP (concordance indices 0.570, 0.627), UI (concordance indices 0.653, 0.689), FI (concordance indices 0.618, 0.676), ≥1 PFDs (concordance indices 0.639, 0.675), and ≥2 PFDs (concordance indices 0.635, 0.619) [36]. Route of delivery and family history of each PFD were strong predictors in most models. UI before and during the index pregnancy was a strong predictor for developing all PFDs in most models 12 years after delivery [36].

A major barrier for effective prevention of PFDs is the inability to identify "at risk" women to target prevention programs. Childbirth is among the most important and consistent risk factor for PFDs;

Fig. 1. a. An example of the prediction modeling system comparing a vaginal delivery in two 28-year-old primiparous women with regard to pelvic floor dysfunction in the future. Clinical details of a woman with low risk and a woman with high risk. b. An example of the prediction modeling system comparing a vaginal delivery in two 28-year-old primiparous women with regard to pelvic floor dysfunction in the future. Results of the prediction modeling system.

however, in most women, clinically relevant symptoms and treatment occur after decades in life [37]. The models presented by Jelovsek et al. [36], although not perfect, predict better than chance and are able to discriminate 51–75% of the time between those with and without PFDs. Traditionally, when estimates of risk are provided to women during pregnancy, they are based on a clinician's knowledge and experience by quoting overall average population risk to all women or by heuristically assigning individuals into crude categories such as low- or high-risk groups [36]. Even when high-level evidence exists, estimates are typically provided without accurately accounting for the specifics of a woman's unique characteristics such as her age, parity, comorbidities, and family history. The development and implementation of accurate clinical tools that go beyond clinical judgment and predict an individual woman's future risk of developing PFDs will be an essential component of any primary prevention strategy and will help reassure the majority of mothers when serious pelvic floor damage is not strongly predicted [36].

An example of the modeling system in use is provided in Figs. 1a,b, and 2. Fig. 1a describes relevant clinical data available before delivery in a 28-year-old primip who had a family history of POP but who was otherwise of low risk (normal BMI and estimated fetal weight of 3500 g), whereas Fig. 1b describes a primip of the same age with a family history of POP but who also had additional risk factors (high BMI and estimated fetal weight of 4500 g). A comparison of the estimated risks for POP, FI, any PFD, and $\geq$2 PFDs is shown in Fig. 1b based on the information provided in Fig. 1a. Fig. 2 compares the risks for POP, UI, FI, PFD, and $\geq$2 PFDs in the low-risk woman grouped according to the mode of delivery (i.e., a comparison between vaginal delivery and cesarean section; Fig. 1a,b).

The models presented by Jelovsek et al. [36] provide similar discrimination to other predictive models currently used in clinical practice whose concordance indices generally range from 0.6 to 0.8 including widely used models such as the National Cancer Institute Gail model for the prediction of Breast Cancer risk (concordance index 0.59) and the Framingham Cardiovascular Risk Model (concordance index 0.72) [30,38].

In summary, these models provide individualized prediction of the risk of developing PFDs 12 and 20 years after delivery using maternal and obstetrical variables available before childbirth. The models (available at http://riskcalc.org/UR_CHOICE/) should help identify high-risk women in whom prevention strategies such as pelvic floor muscle training and weight control or elective cesarean section might be targeted.

Practice points

A hypothesis (UR-CHOICE) has been put forward, based on the available scientific evidence, that the physical features of the mother and baby can be scored, and this score can be used to determine the most suitable route of delivery to avoid pelvic floor dysfunction in the future. Models have currently been constructed and validated, and these models can provide individualized prediction of the risk of developing pelvic floor disorders 12 and 20 years after delivery using maternal and obstetrical variables available before childbirth.

Research Agenda

Professor Milsom and Dr Maria Gyhagen are the authors and/or co-authors of numerous publications within the field of urogynecology. Their research team has explored the etiology of pelvic floor dysfunction with the aim of creating preventive strategies. They have devoted particular interest toward the epidemiological aspects of these common conditions.

Conflict of interest statement

Dr Milsom received a grant (National LUA/ALF grant no. 11315) and honoraria for lectures from SCA/Essity, Astellas Pharma, and Allergan. Dr Gyhagen received an honorarium from Astellas Pharma for speaker participation.

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