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PREDICTING STRESS URINARY INCONTINENCE IN PRIMIPAROUS WOMEN WHO UNDERWENT VAGINAL DELIVERY USING A CLASSIFICATION TREE APPROACH.

Hypothesis / aims of study
Vaginal delivery (VD) has been recognized as potentially traumatic to the pelvic floor (PF) and may lead to stress urinary incontinence (SUI) [1]. Studies have been conducted to identify factors that predict SUI after VD. Important to note is that these factors do not occur in isolation, therefore the investigation of the association between them offers results with higher external validity, giving support to the clinical decision making process. The aim of this study was to investigate predictive factors for SUI in primiparous women who underwent VD using a statistical approach relevant to the clinical practice.

Study design, materials and methods
Between May/2007 and January/2010, primiparous women aged 18 to 35 years who underwent a singleton vertex presentation VD at a Brazilian birthing centre were invited to participate in this prospective observational study. All the procedures were approved by the ethical committee and in accordance with the Declaration of Helsink. All participants signed the consent form. Potential predictive variables were collected from the birth center's records as well as through physical exam at 5 to 7 months postpartum: newborn weight, maternal position and duration of the 2nd stage of labor, oxytocin use, episiotomy, occurrence of perineal lacerations that required suturing; overweight/obesity (body mass index-BMI $\geq$ 25 kg/m^2), vaginal squeeze pressure (VSP), and history of SUI defined as presence of at least one episode of SUI per month before pregnancy. The occurrence of SUI postpartum (outcome variable) was based on the report of at least one episode of SUI in the last month, in accordance to the definition from the ICS. Classification and regression tree (CART), a non parametric approach [2], was applied to hierarchically classify predictors according to the outcome (occurrence or nonoccurrence of SUI postpartum). Predictions from this procedure are at the level of an individual rather than a group, and thus can be of great clinical usefulness. The goodness of the classifications was determined by the sensitivity and the specificity of the predictive models as well as by the cross-validation risk estimate, a gauge of the predictive ability of the tree for an independent data set.

Results
A total of 192 women with median age 22 years (range 18-34) were evaluated at 189.3±12.1 (mean ± SD) days postpartum. Further descriptive information of the sample is summarized in Table 1. SUI symptoms were reported by 32 (16.7%) women (Figure 1-node 1). The resulting classification tree used 5 of the 9 predictors tested, as follows (Figure 1): VSP was the strongest predictive variable for nonoccurrence of SUI postpartum with 96.4% of the women with VSP>35.5cmH$_2$0 not presenting SUI, followed by the history of SUI, newborn weight, duration of the 2nd stage of labor and overweight/obesity (Table 2). Important to note is that the CART classified each individual according to cutoff values/categories for each of the 5 predictive variables, creating decision rules that discriminate women with and without SUI (Table 2). The sensitivity and specificity of the classification were respectively 71.3% and 84.4%. The cross-validation risk estimate was 33% indicating that 67% of the incontinent women of an independent data set would be correctly classified using this model.

Interpretation of results
The prevalence of SUI postpartum was low, indicating the high quality of obstetric care offered to this sample. The predictive models generated by this study can be generalized to services that provide similar obstetric assistance with 67% of accuracy. From the 5 predictors determined, 3 are modifiable by preventative approaches, mainly with physical therapy, which should be target at VSP>35.5cmH20, prevention of SUI before pregnancy and women weight gain control. Also, obstetric interventions such as adoption of vertical positions and use of ocytocin aimed at reducing the duration of the 2nd stage of labor so that it does not exceed 26 min, should be considered in continent women with history of newborn weighted >2988g.

Concluding message
The combination of factors that predicted SUI postpartum in this cohort indicated the need to adopt strategies to achieve VSP>35.5cmH20, to prevent SUI before pregnancy, to control maternal weight postpartum and to avoid duration of 2nd stage of labour > 26 min in continent women with history of newborn >2988g.
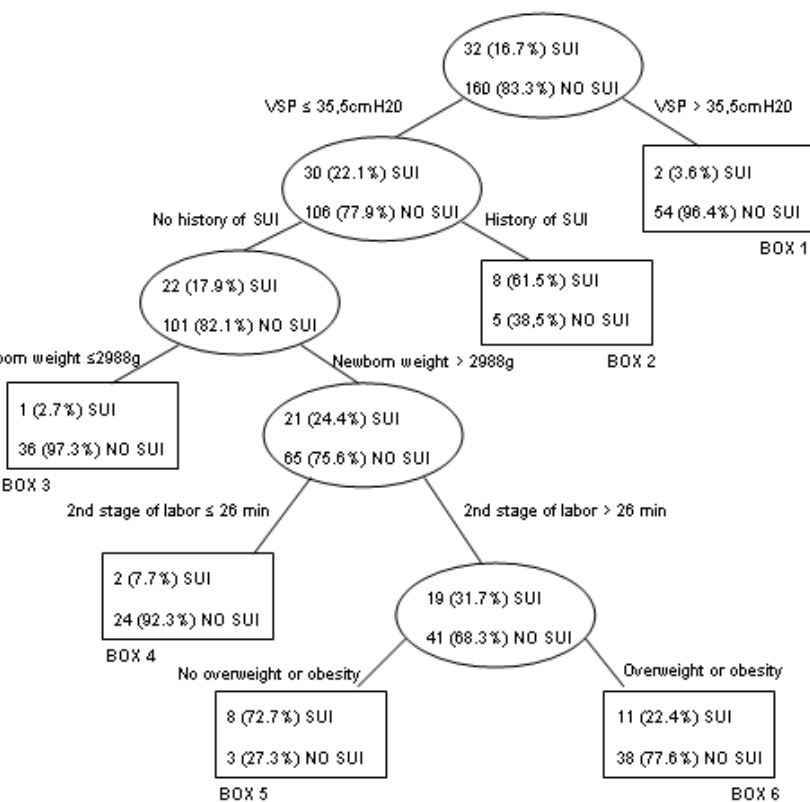
TABLE 1: Descriptive information of the sample (N=192)

Predictor Variables	Incontinent (n=32)	Continent (n=160)
Oxytocin use*	13 (40.6%)	66 (41.3%)
Episiotomy	3 (9.4%)	20 (12.5%)
Maternal birth position		
Sited/semi-recumbent	6 (18.8%)	40 (25.0%)
Lithotomic	9 (28.1%)	56 (35.0%)
Squatting	8 (25.0%)	28 (17.5%)
All fours	1 (3.1%)	6 (3.8%)
Lateral recumbent	3 (9.4%)	7 (4.4)
Sited in Water	4 (12.5%)	22 (13.8%)
Perineal lacerations with suture	19 (59.4%)	102 (63.8%)
Newborn weight[†] (g)	3206.4 (364.8)	3124.46 (370.8)
Duration of the 2nd stage of labour (min)	36.77 (20.9)	41.05 (29.3)
History of SUI	9 (28.1%)	6 (3.8%)
Overweight/obesity	9 (28.1%)	30 (18.8%)
VSP (cmH$_2$0)	19.3 (13,1)	30.4 (18.9)
There was no occurrence of instrumental VD or of anesthesia.		

TABLE 2: Classification tree rules for predicting occurrence and nonoccurrence of SUI postpartum

*When frequencies are presented, corresponding percentages are in parenthesis

[†]When means are presented, standard deviations are in parenthesis

FIGURE 1: Classification tree of predictor factors according to occurrence and nonoccurrence of SUI after VD

I- Decision rules for SUI
BOX 2: VSP ≤ 35.5cmH20 and history of   SUI
BOX 5: VSP ≤ 35.5cmH20 and no history of SUI and newborn weight>2988g and duration of the 2nd stage of labor > 26 min and overweight/obesity
BOX 6: VSP ≤ 35.5cmH20 and no history of SUI and newborn weight >2988g and duration of the 2nd stage of labor > 26 min and no overweight/obesity
II- Decision rules for continence
BOX 1: VSP > 35.5cmH20
BOX 3: VSP ≤ 35.5cmH20 and no history of SUI and newborn weight ≤2988g
BOX 4: VSP ≤ 35.5cmH20 and no history of SUI and newborn weight > 2988g and duration of the 2nd stage of labor ≤ 26 minutes

32 (16.7%) SUI
160 (83.3%) NO SUI

VSP ≤ 35,5cmH20   VSP > 35,5cmH20

30 (22.1%) SUI
106 (77.9%) NO SUI

No history of SUI   History of SUI

2 (3.6%) SUI
54 (96.4%) NO SUI
BOX 1

22 (17.9%) SUI
101 (82.1%) NO SUI

8 (61.5%) SUI
5 (38,5%) NO SUI
BOX 2

Newborn weight ≤2988g   Newborn weight > 2988g

1 (2.7%) SUI
36 (97.3%) NO SUI
BOX 3

21 (24.4%) SUI
65 (75.6%) NO SUI

2nd stage of labor ≤ 26 min   2nd stage of labor > 26 min

2 (7.7%) SUI
24 (92.3%) NO SUI
BOX 4

19 (31.7%) SUI
41 (68.3%) NO SUI

No overweight or obesity   Overweight or obesity

8 (72.7%) SUI
3 (27.3%) NO SUI
BOX 5

11 (22.4%) SUI
38 (77.6%) NO SUI
BOX 6

References

1. . Koel BL, Nitti V, Baessler K, Salvatore S, Sultan A, Yamaguchi O. Pathophysiology of urinary incontinence, faecal incontinence and pelvic organ prolapse.: Health Publication; 2009 p. 255-330.
2. Breiman L, Friedman J, Olshen RA, Stone CJ. Classification and regression trees. Belmont, California: Wadsworth; 1984.

Specify source of funding or grant	**None**
Is this a clinical trial?	**Yes**
Is this study registered in a public clinical trials registry?	**No**
Is this a Randomised Controlled Trial (RCT)?	**No**
What were the subjects in the study?	**HUMAN**
Was this study approved by an ethics committee?	**Yes**
Specify Name of Ethics Committee	**Sofia Feldman Hospital Ethical Committee**
Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**