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Obstetric perineal tears: risk factors, wound infection and dehiscence: a prospective cohort study

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Abstract

Purpose To assess risk factors for perineal tears, wound infection and dehiscence among primiparous women.

Methods A prospective cohort study at four Danish hospitals (Odense, Esbjerg, Aarhus and Kolding) among 603 primiparous women sampled in three groups: 203 with none/labia/1st degree, 200 with 2nd degree, and 200 with 3rd/4th degree tears included between July 2015 and January 2018. Baseline data were obtained and a clinical examination of perineal wound healing was performed 11–21 days postpartum. Main outcome measurements were as follows: degree of perineal tear, 1st to 4th, analyzed with a case–control approach, infection (purulent drainage or wound abscess), and wound dehiscence (a gap between wound edges > 0.5 cm).

Results Instrumental delivery and birthweight > 4000 g increased the risk of 3rd/4th degree tears (adjusted Odds Ratio [aOR] 13.7, 95% confidence interval [CI] 5.48–34.1 and aOR 3.27, 95% CI 1.52–7.04, respectively). BMI > 35 kg/m^2 increased the risk of wound infection and dehiscence (aOR 7.66, 95% CI 2.13–27.5 and aOR 3.46, 95% CI 1.10–10.9, respectively). Episiotomy tripled the risk of infection (aOR 2.97, 95% CI 1.05–8.41). Treatment with antibiotics during delivery and postpartum seemed to decrease the risk of dehiscence (aOR 0.32, 95% CI 0.15–0.70).

Conclusions Instrumental delivery and high birth weight increased the risk of perineal tears. Severe obesity and episiotomy increased the risk of perineal wound complications. More focus on these women may be warranted postpartum. The use of prophylactic antibiotics among women in high risk of wound complications should be further investigated in interventional studies.

Keywords Birth trauma · Perineal trauma · Perineal care · Wound infection · Wound dehiscence

Introduction

Perineal repair after spontaneous obstetric tears or episiotomies is one of the most common surgical procedures in women, with more than 90% of primiparous women sustaining injury to the labia, vagina or perineum during vaginal childbirth [1]. The type of tears can be either spontaneous or induced as an episiotomy. Spontaneous tears are classified as first- to fourth-degree depending on the severity of the tear. A first-degree tear only involves vaginal mucosa and connective tissue while second-degree also involves the underlying perineal muscles. A third-degree tear is defined by a partial or complete disruption of the anal sphincter muscles, which may involve either the external (*EAS*) and/or the internal anal sphincter (*IAS*) muscles. A fourth-degree tear is defined by a complete rupture of the anal sphincter muscles also involving the rectal mucosa. The overall prevalence of third- and fourth-degree tears is 4–5% among primiparous women [2].

Women who sustain a perineal tear may experience problems with infection and wound dehiscence. Potential morbidities after repair of perineal tears include pain [3], dyspareunia [4, 5] and incontinence [6–8]. The role

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of prophylactic antibiotics in relation to perineal tears is ambiguous [9, 10]. In Denmark, antibiotics are given perioperatively to fourth degree tears and on suspicion of contamination to third-degree tears only [11].

The present literature on perineal wound infection and dehiscence shows a large variation in prevalence ranging from 0.3 to 11% in general [3, 12, 13] and has been reported as high as 24% among women with anal sphincter ruptures [14]. The reported prevalences of dehiscence in perineal tears range from 4% to 20% [3, 10, 14, 15]. The large variation may be explained by the lack of standardized definitions of postpartum perineal wound infection and dehiscence [16]. Further, the existing studies within the field have different designs, follow-up periods (ranging from 3 days to 6 weeks postpartum) and definitions of infection and dehiscence [3, 10, 12–15, 17, 18]. In addition, women often seek treatment from multiple care providers, e.g. maternity hospitals and general practitioners who are using different definitions and measurement criteria. The objective of this study was to examine risk factors for perineal tears and the prevalence of perineal wound infection and dehiscence related to degree of perineal tear among primiparous women.

Methods

Study setting

A multi-center prospective cohort sampled in three groups stratified according to degree of rupture. The study was conducted at Odense University Hospital (OUH), Aarhus University Hospital (AUH), Esbjerg Hospital, and Kolding Hospital, Denmark from July 2015 until January 2018. The annual number of primiparous women with vaginal deliveries in 2016 was 1594 at OUH, 2051 at AUH, 611 at Esbjerg Hospital and 1059 at Kolding Hospital [19]. Based on delivery statistics, about 20% of primipara experience a first-degree perineal tear, 45% a second-degree tear, 4% a third- and 0.5–1% a fourth-degree perineal tear [11].

Study population

To estimate the number of women needed for the study, a sample size calculation was performed. Based on available literature, we assumed that 20% of women with a 3rd or 4th degree tear would experience a wound infection as compared to 10% in women with a 2nd degree tears at 14–21 days postpartum [10, 14]. According to our sample size calculation, a total of 398 women, 199 with 2nd degree perineal tears and 199 women with 3rd or 4th degree perineal tears were required to detect a difference with a significance level of 0.05 and a power of 80%. To serve as a reference group, we also included a group of women with no tears, labia tears or 1st degree tears. The study thus involved three groups of women (1) 200 women with no tears, labial tears or 1st degree perineal tears, (2) 200 women with 2nd degree perineal tears and (3) 200 women with 3rd or 4th degree perineal tears. Women no tears/labial tear, 1st degree and 2nd degree tears were included at OUH while women with 3rd or 4th degree tears were included at OUH, AUH, Esbjerg Hospital, and Kolding Hospital.

Inclusion and follow-up procedure

Primiparous women with a vaginal delivery, at least 18 years old and able to read and speak Danish, were considered eligible for the study. Immediately after the delivery and before discharge from the hospital, the responsible doctor or midwife informed eligible women about the study, and if interested, further information was sent by e-mail. Subsequently the women were contacted by telephone and invited to participate in the study. Women who accepted participation filled out a baseline questionnaire and were booked for a face-to-face interview and clinical examination to assess wound infection and healing 11–21 days postpartum. Written informed consent was obtained before the clinical examination and study data were collected and managed using REDCap electronic data capture tools hosted at The University of Southern Denmark [20].

Outcome measurements

Primary outcome measurements were degree of perineal tear, perineal wound infection and perineal wound dehiscence > 0.5 cm.

Degree of perineal tears

This part of the study was analyzed using a case–control approach. Degrees of perineal tears as primary outcome measurement were defined according to the Green-top Guideline No. 29 [2]. First-degree tears were defined as injury to perineal skin and/or vaginal mucosa. Second-degree tears were defined as injury to perineum involving perineal muscles but not involving the anal sphincter. Third-degree tears were defined as injury to perineum involving the anal sphincter complex including: Grade 3a tear with less than 50% of the externals anal sphincter (EAS) thickness torn. Grade 3b tear with more than 50% of EAS thickness torn and Grade 3c tears with both EAS and internal anal sphincter (IAS) torn. Finally, fourth-degree tears were defined as an injury to perineum involving the anal sphincter complex (EAS and IAS) and anorectal mucosa [2]. Furthermore, labial tears were defined as tears isolated to the labia.

Wound infection

Wound infection was defined as either the presence of purulent discharge or a wound abscess according to the Center for Disease Control (CDC) definition for episiotomy site infection [21].

Wound dehiscence

Examination for wound dehiscence was performed with the woman placed in the lithotomy position. The definition for wound dehiscence was a gap of > 0.5 cm between wound edges [3, 16].

Exposure variables and covariates

Baseline questionnaire

At baseline and before the clinical examination, a questionnaire was completed providing information about age in years, height in centimeters, pregestational weight in kilograms and smoking status as yes or no. Age was categorized into 3 categories, ≤ 25, 26–30 and > 30 years or into 2 categories, ≤ 34 and > 34 years. BMI was calculated (kg/m^2), and categorized into three categories, < 25, 25–29.9 and > 29.9 or into 2 categories, ≤ 35 and > 35 kg/m^2.

Obstetric information

Information about pregnancy, birth and the postpartum period was obtained from the obstetric journal and included vaginal group B streptococcus colonization (yes/no), diabetes mellitus (yes/no), length of active birth categorized into 4 categories, < 220, 220–340, 341–570 and > 570 min. or 2 categories, ≤ 340 and > 340 min., length of the second stage of labor categorized into 4 categories, < 16, 16–30, 31–45 and > 45 min. or 2 categories, ≤ 30 and > 30 min., use of episiotomy (yes/no), operative delivery (yes/no) and treatment with any antibiotics during the birth or postpartum (yes/no). Birthweight was categorized into 4 categories, < 3000, 3000–3499, 3500–3999 and ≥ 4000 g or 2 categories, ≤ 3500 and > 3500 g, and head circumference was categorized into 4 categories, < 34, 34, 35 and > 35 cm or 2 categories, < 35 and ≥ 35 cm.

Statistical analyses

To investigate the association between risk factors and degree of perineal tear, nominal logistic regression was performed with estimates reported as odds ratios (OR) with 95% confidence intervals (CI). The analysis of perineal tears were adjusted for operative delivery as a categorical variable, age, duration of the second stage of labor and duration of active birth, fetal birthweight and fetal head circumference, all as continuous variables.

The analysis of perineal wound infection and wound separation was restricted to women with ≥ 2nd degree perineal tears. Risk of wound infection and dehiscence according to demographic and obstetric risk factors were examined using logistic regression and reported as odds ratios with 95% CI. The analyses of wound infection and dehiscence were adjusted for diabetes, episiotomy and operative delivery, all as categorical variables, and BMI and duration af the second stage of labour both as continuous variables acknowledging the limited amount of cases in the study population.

Potential confounders were chosen a priori based on directed acyclic graphs generated for each outcome variable using DAGitty v2.3 as graphical tool for analyzing the causal diagrams [22].

All statistical test were two-tailed, and P values < 0.05 were considered statistically significant. The analyses were carried out using STATA statistical software version 15.0 [23].

Results

Participants

A total of 832 women were invited to participate in the study. Of these, 81 declined and 138 of the women, who agreed to be contacted for further information, could not be reached by phone. This left 613 women who filled out a written consent and a baseline questionnaire and were booked for a clinical examination at 11–1 days postpartum. Of these, 10 women withdrew their consent. The study population thus comprised 603 women (72.5%) as depicted in Fig. 1.

Risk factors associated with degree of tear

Age ≤ 25 years was significantly associated with reduced risk of 3rd and 4th degree perineal tears (aOR 0.38, 95% CI 0.22–0.66) (Table 1). A higher degree of tear was seen with higher head circumference, longer second stage of labour, and longer active birth, but these associations were not statistically significant after adjustment for other obstetric factors.

Comparing women with no perineal tears to women with 2nd degree tears, we found birthweight < 3000 g to decrease the risk of 2nd degree tears (aOR 0.42, 95% CI 0.22–0.80). A duration of active birth < 220 min also decreased the risk of 2nd degree tears (aOR 0.56, 95% CI 0.33–0.97) while having a 2nd stage of labor < 16 min increased the risk (aOR 1.75, 95% CI 1.02–2.99).

Comparing women with 3rd or 4th degree tears with women with no tears, we observed decreased risks with

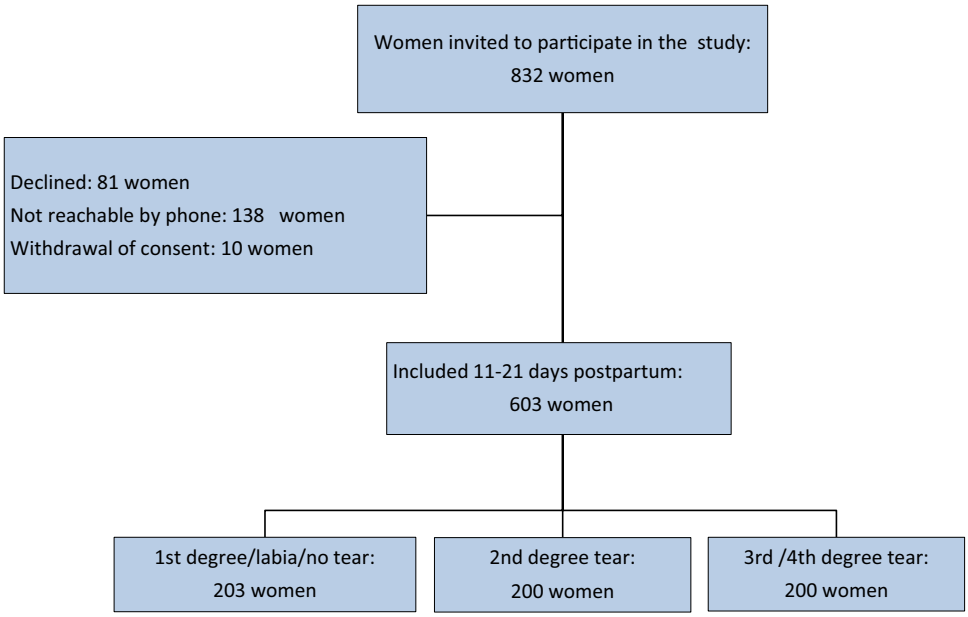

Fig. 1 Flowchart of inclusion

age ≤ 25 years (aOR 0.38, 95% CI 0.22–0.66), birthweight < 3000 g (aOR 0.45, 95% CI 0.21–0.99) and duration of active birth < 220 min (aOR 0.45, 95% CI 0.24–0.84) while birthweight of ≥ 3500–4000 g and > 4000 g increased the risk of 3rd or 4th degree tears, aOR 1.77, 95% CI 1.03–3.03 and aOR 3.27, 95% CI 1.52–7.04, respectively. Instrumental delivery increased the risk of both 2nd degree (aOR 5.69, 95% CI 2.26–14.4) and 3rd or 4th degree tears (aOR 13.7, 95% CI 5.48–34.1).

The prevalence of infection was 17/200 (9%) among women with 2nd degree tears and 3/203 (3%) among women with 3rd or 4th degree tears (Table 2). Women with BMI > 35 kg/m^2 had a more than sevenfold risk of wound infection (aOR of 7.66, 95% CI 2.13–27.5) compared to women with BMI ≤ 35 kg/m^2. Also women with a mediolateral episiotomy had an almost threefold risk of wound infection compared to women with no episiotomy (aOR 2.97; 95% CI 1.05–8.41). Having suffered from a 3rd or 4th degree tear was associated with a 65% reduced risk of wound infection compared to a 2nd degree tear (aOR 0.35, 95% CI 0.13–0.95). However, more women with 3rd or 4th degree tears received preventive treatment with antibiotics (18.5%) compared to 2.5% of women with 2nd degree tears. Any treatment with antibiotics during delivery and until the clinical examination also indicated a protective association with wound infection (aOR 0.52, 95% CI 0.18–1.50).

In total, 36/200 (18%) women with 2nd degree tears and 25/200 (13%) women with 3rd or 4th degree tears had wound dehiscence (Table 3). Women with BMI > 35 kg/m^2 faced a more than threefold risk (aOR 3.46, 95% CI 1.10–10.9). Every time the duration of the second stage of labour increased with 10 min, the risk of dehiscence increased with 10%, aOR 1.10, 95% CI 1.00–1.21. Treatment with antibiotics during delivery or in the period from birth and until the clinical examination decreased the risk of dehiscence significantly (aOR 0.32, 95% CI 0.15–0.70). There was a tendency of less wound dehiscence in 3rd–4th degree tears compared to 2nd degree tears (aOR 0.64, 95% CI 0.36–1.15), however, not after adjusting for use of antibiotics (aOR 8.82, 95% CI 0.45–1.50).

Discussion

Main findings

In this clinical study of 603 primiparous women, young age ≤ 25 years seemed to protect against 3rd/4th degree tears, while instrumental delivery and high birth weight increased the risk. BMI > 35 kg/m^2 was associated with a sevenfold risk of wound infection while episiotomy was associated with a threefold risk. Treatment with antibiotics during delivery and postpartum decreased the risk of dehiscence significantly.

Interpretation (in light of other evidence)

Other studies have shown similar findings but only few studies focused on primiparous women and most studies focused on the risk of 3rd or 4th degree tears. An Australian retrospective cohort study among 4405 primiparous women found instrumental delivery to increase the risk of severe tears while age < 20 years seemed to protect against 3rd and 4th degree tears. No association was observed for birth weight [24]. Results from a recently published prospective cohort study among 448 primiparous women found that

Table 1 Risk factors according to degree of tear ($n=603$)[a]

	Total	Group 1 (none/labia/1st degree)	Group 2 (2nd degree)	Group 3 (3rd/4th degree)	Group 2 vs. Group 1	Group 2 vs. Group 1	Group 3 vs. Group 1	Group 3 vs. Group 1
	($n=603$)	($n=203$)	($n=200$)	($n=200$)	Crude OR (95% CI)	Adjusted OR (95% CI)[b]	Crude OR (95% CI)	Adjusted OR (95% CI)[b]
	n	%	%	%				
Age at inclusion (years)								
≤25	152	44.1	36.2	19.7	0.88 (0.56–1.40)	0.87 (0.55–1.40)	0.39 (0.23–0.65)	0.38 (0.22–0.66)
26–30	299	32.4	30.1	37.5	1	1	1	1
>30	152	25.7	36.2	38.1	1.52 (0.92–2.51)	1.39 (0.83–2.33)	1.29 (0.79–2.10)	1.03 (0.59–1.77)
Per 1 year older					1.03 (0.98–1.08)	1.02 (0.97–1.07)	1.08 (1.03–1.14)	1.05 (1.00–1.12)
BMI (kg/m^2)								
<25	388	35.1	32.0	33.0	0.85 (0.53–1.37)	0.82 (0.50–1.34)	0.94 (0.58–1.52)	0.92 (0.54–1.58)
25–29.9	138	32.6	34.8	32.6	1	1	1	1
>29.9	76	29.0	35.5	35.5	1.15 (0.57–2.30)	1.06 (0.52–2.14)	1.23 (0.61–2.47)	1.08 (0.51–2.31)
Per BMI unit increase					1.02 (0.98–1.06)	1.02 (0.97–1.06)	1.00 (0.96–1.05)	0.99 (0.95–1.04)
Birthweight (g)								
<3000	85	52.9	28.2	18.8	0.45 (0.25–0.81)	0.42 (0.22–0.80)	0.52 (0.26–1.01)	0.45 (0.21–0.99)
3000–3499	212	34.9	41.0	24.1	1	1	1	1
3500–3999	224	29.0	30.4	40.6	0.89 (0.56–1.41)	0.88 (0.54–1.43)	2.03 (1.26–3.28)	1.77 (1.03–3.03)
≥4000	80	23.8	26.3	50.0	0.94 (0.47–1.88)	1.01 (0.47–2.19)	3.05 (1.59–5.87)	3.27 (1.52–7.04)
Per 100 gr. increase					1.04 (1.00–1.08)	1.04 (0.99–1.10)	1.14 (1.09–1.19)	1.14 (1.08–1.21)
Head circumference (cm)								
<34	153	41.8	34.6	23.5	0.99 (0.57–1.73)	1.25 (0.96–2.25)	0.71 (0.39–1.28)	1.39 (0.71–2.70)
34	126	38.1	31.8	30.2	1	1	1	1
35	140	26.4	38.6	35.0	1.75 (0.97–3.17)	1.59 (0.86–2.92)	1.67 (0.92–3.06)	1.23 (0.63–2.40)
>35	180	29.4	28.9	41.7	1.18 (0.67–2.08)	0.95 (0.52–1.77)	1.79 (1.03–3.11)	0.90 (0.47–1.74)
Per cm increase					1.09 (0.97–1.24)	0.99 (0.84–1.16)	1.33 (1.17–1.51)	0.96 (0.81–1.14)
Length of 2nd stage of labour (min)								
<16	119	37.0	42.9	20.2	1.57 (0.93–2.64)	1.75 (1.02–2.99)	0.78 (0.43–1.41)	1.05 (0.55–2.00)
16–30	205	41.0	30.2	28.8	1	1	1	1
31–45	98	35.7	28.6	35.7	1.08 (0.60–1.97)	0.96 (0.52–1.77)	1.42 (0.80–2.53)	1.14 (0.61–2.14)
>45	181	22.1	32.6	45.3	2.00 (1.19–3.36)	1.60 (0.94–2.76)	2.92 (1.76–4.83)	1.57 (0.89–2.76)
Per 10 min. increase					1.06 (0.97–1.15)	1.00 (0.92–1.09)	1.20 (1.11–1.29)	1.06 (0.97–1.15)
Length of active birth (min)								
<220	153	50.3	31.4	18.3	0.51 (0.30–0.87)	0.56 (0.33–0.97)	0.35 (0.19–0.63)	0.45 (0.24–0.84)

Table 1 (continued)

	Total	Group 1 (none/labia/1st degree)	Group 2 (2nd degree)	Group 3 (3rd/4th degree)	Group 2 vs. Group 1	Group 2 vs. Group 1	Group 3 vs. Group 1	Group 3 vs. Group 1
	(*n* = 603)	(*n* = 203)	(*n* = 200)	(*n* = 200)	Crude OR (95% CI)	Adjusted OR (95% CI)[b]	Crude OR (95% CI)	Adjusted OR (95% CI)[b]
	n	%	%	%				
221–340	150	30.7	37.3	32.0	1	1	1	1
341–570	155	33.6	33.6	32.9	0.82 (0.48–1.42)	0.74 (0.42–1.29)	0.94 (0.54–1.64)	0.72 (0.40–1.32)
>570	145	19.3	30.3	50.3	1.29 (0.70–2.38)	0.99 (0.53–1.88)	2.50 (1.38–4.53)	1.28 (0.66–2.45)
Per 60 min. increase					1.08 (1.02–1.13)	1.04 (0.98–1.10)	1.18 (1.12–1.24)	1.08 (1.03–1.15)
GBS colonization								
No	578	94.1	96.5	97.5	1	1	1	1
Yes	24	5.9	3.5	2.5	0.58 (0.22–1.50)	0.49 (0.18–1.32)	0.41 (0.14–1.19)	0.34 (0.11–1.06)
Smoker								
No	576	95.6	95.5	96.0	1	1	1	1
Yes	26	4.4	4.5	4.0	1.02 (0.40–2.61)	1.30 (0.49–3.42)	0.90 (0.34–2.39)	1.78 (0.62–5.18)
Diabetes mellitus								
No	583	97.5	96.0	96.5	1	1	1	1
Yes	20	2.5	4.0	3.5	1.65 (0.53–5.13)	1.53 (0.48–4.88)	1.44 (0.45–4.60)	1.16 (0.32–4.14)
Operative delivery								
No	499	96.5	84.5	67.0	1	1	1	1
Yes	104	3.5	15.5	33.0	5.14 (2.21–12.0)	5.69 (2.26–14.4)	13.8 (6.14–31.0)	13.7 (5.48–34.1)

OR odds ratio, *CI* confidence interval, *BMI* body mass index, *GBS* group B streptococcus

[a]A sum of less than the one given in total is the expression of missing values not included in the analyses

[b]Adjusted for age, length of the 2nd stage of labour, length of active birth, operative delivery, fetal birthweight, fetal head circumference (length of the 2nd stage of labour and length of active birth are not mutually adjusted for each other)

women having tears > 1st degree were older, had longer 2nd stages of labour and gave birth to children with higher birth weight compared to women with no tears or only 1st degree tears [25]. Similar results were reported from a cohort of 52.211 Swedish women where they also found instrumental delivery to increase the risk of 3rd or 4th degree tears [26].

Regarding infection and dehiscence, other studies have found different prevalence estimates compared to our study. The explanation could be different definitions, sampling and study methods used. A prospective telephone audit among 341 women based on self-assessment of the wound 21 days postpartum showed that 11% experienced signs of infection [17], while 25% of women with 3rd or 4th degree tears in another prospective cohort study was found to have infection at 1 week postpartum [14]. However, our results are in accordance with a randomized trial published in 2008 where a dehiscence prevalence of 15–20% among women with 2nd degree tears was observed.

Intrapartum antibiotics administered for any indication have been shown to protect against perineal wound complications such as infection or wound dehiscence following 3rd and 4th degree tears [10, 14, 15]. Although our results indicate a similar effect of antibiotics, the low number of infections in our study did not allow reliable statistical calculations on this association. However, we found 3rd and 4th degree tears to be protective against infection, which could be related to the use of antibiotic treatment in this group.

Women with BMI > 35 were found to have a more than sevenfold risk of wound infection and a more than threefold risk of dehiscence. Obesity is one of the most common health problems in women of reproductive age and maternal obesity has become highly prevalent worldwide leading to a major concern in obstetrics [27]. Studies of obesity-associated inflammation have found vascular dysfunction to occur in adipose tissue, leading to a local hypoxia response in adipose tissue [28]. Hypoxia itself

Table 2 Risk of perineal wound infection 11–21 days postpartum ($n=400$)[a]

	Total ($n=400$)	Infection ($n=23$)	Crude OR (95% CI)	Adjusted OR[b] (95% CI)
	n	*n* (%)		
Age at inclusion (years)				
≤34 years	380	29 (5)	1	1
>34 years	20	4 (20)	4.75 (1.45–15.6)	1.57 (0.24–10.3)
Per 1 year older			1.00 (0.90–1.11)	1.00 (0.90–1.11)
BMI (kg/m^2)				
≤35 (kg/m^2)	385	19 (5)	1	1
>35 (kg/m^2)	14	4 (29)	7.71 (2.21–26.8)	7.66 (2.13–27.5)
Per BMI unit increase			1.11 (1.03–1.20)	1.12 (1.04–1.22)
Birthweight (g)				
≤3500 g	181	14 (8)	1	1
>3500 g	217	9 (4)	0.52 (0.22–1.22)	0.37 (0.15–0.96)
Per 100 g increase			0.95 (0.86–1.04)	0.91 (0.82–1.01)
Head circumference (cm)				
<35	167	9 (5)	1	1
≥35	230	14 (6)	1.14 (0.48–2.69)	1.10 (0.45–2.67)
Per cm increase			1.06 (0.82–1.39)	1.02 (0.78–1.35)
Length of 2nd stage of labour (min)				
≤30 min.	196	13 (7)	1	1
>30 min.	204	10 (5)	0.73 (0.31–1.70)	0.89 (0.35–2.27)
Per 10 min. increase			0.99 (0.85–1.15)	1.01 (0.86–1.18)
Length of active birth (min)				
≤340	180	10 (6)	1	1
>340	220	13 (6)	1.07 (0.46–2.50)	1.16 (0.47–2.86)
Per 60 min. increase			1.00 (0.92–1.10)	1.00 (0.91–1.10)
GBS colonization				
No	387	22 (6)	1	1
Yes	12	1 (8)	1.51 (0.19–12.2)	1.37 (0.16–11.5)
Smoker				
No	382	22 (6)	1	1
Yes	17	1 (6)	1.02 (0.13–8.07)	1.07 (0.13–8.94)
Diabetes mellitus				
No	385	22 (6)	1	1
Yes	15	1 (7)	1.18 (0.15–9.38)	0.70 (0.08–5.91)
Any antibiotics				
No	274	18 (7)	1	1
Yes	116	5 (4)	0.64 (0.23–1.77)	0.52 (0.18–1.50)
Episiotomy				
No	344	17 (5)	1	1
Yes	56	6 (11)	2.31 (0.87–6.13)	2.97 (1.05–8.41)
Operative delivery				
No	303	18 (6)	1	1
Yes	97	5 (5)	0.86 (0.31–2.38)	0.83 (0.28–2.51)
Degree of tear				
2nd	200	17 (9)	1	1
3rd/4th	200	6 (3)	0.33 (0.13–0.86)	0.35 (0.13–0.95)

OR odds ratio, *CI* confidence interval, *BMI* body mass index, *GBS* group B streptococcus

[a]A sum of less than the one given in total is the expression of missing values not included in the analyses

[b]Adjusted for BMI, diabetes, episiotomy, length of the 2nd stage of labour and operative delivery (length of active birth is not adjusted for length of the 2nd stage of labour)

Table 3 Risk of perineal wound dehiscence 11–21 days postpartum ($n=400$)[a]

	Total ($n=400$)	Dehiscence ($n=61$)	Crude OR (95% CI)	Adjusted OR[b] (95% CI)
	n	*n* (%)		
Age at inclusion (years)				
≤ 34 years	380	55 (15)	1	1
> 34 years	20	6 (30)	2.53 (0.93–6.87)	3.36 (0.79–14.3)
Per 1 year older			0.99 (0.92–1.06)	0.99 (0.92–1.06)
BMI (kg/m^2)				
≤ 35 (kg/m^2)	385	56 (15)	1	1
> 35 (kg/m^2)	14	5 (36)	3.26 (1.06–10.1)	3.46 (1.10–10.9)
Per BMI unit increase			1.02 (0.97–1.08)	1.03 (0.97–1.09)
Birthweight (g)				
≤ 3500 g	181	32 (18)	1	
> 3500 g	217	28 (13)	0.69 (0.40–1.20)	0.59 (0.33–1.05)
Per 100 gr. increase			0.98 (0.92–1.04)	0.98 (0.93–1.04)
Head circumference (cm)				
< 35	167	22 (13)	1	1
≥ 35	230	38 (17)	1.31 (0.74–2.30)	1.26 (0.71–2.25)
Per cm increase			1.04 (0.87–1.24)	1.02 (0.85–1.21)
Length of 2nd stage (min)				
≤ 30 min.	196	26 (13)	1	1
> 30 min.	204	35 (17)	1.35 (0.78–2.35)	1.53 (0.85–2.76)
Per 10 min. increase			1.07 (0.98–1.17)	1.10 (1.00–1.21)
Length of active birth (min)				
≤ 340	180	29 (16)	1	1
> 340	220	32 (15)	0.89 (0.51–1.53)	0.94 (0.53–1.66)
Per 60 min. increase			0.95 (0.89–1.01)	0.95 (0.89–1.02)
GBS colonization				
No	387	58 (15)	1	1
Yes	12	3 (25)	1.89 (0.50–7.19)	1.98 (0.51–7.68)
Smoker				
No	382	60 (16)	1	1
Yes	17	1 (6)	0.34 (0.04–2.58)	0.34 (0.04–2.69)
Diabetes mellitus				
No	385	58 (15)	1	1
Yes	15	3 (20)	1.41 (0.39–5.15)	1.32 (0.35–5.01)
Any antibiotics				
No	274	52 (19)	1	1
Yes	116	9 (8)	0.35 (0.17–0.76)	0.32 (0.15–0.70)
Episiotomy				
No	344	49 (14)	1	1
Yes	56	12 (21)	1.64 (0.81–3.33)	1.64 (0.79–3.43)
Operative delivery				
No	303	49 (16)	1	1
Yes	97	12 (12)	0.73 (0.37–1.44)	0.56 (0.27–1.17)
Degree of tear:				
2nd	200	36 (18)	1	1
3rd/4th	200	25 (13)	0.65 (0.37–1.13)	0.64 (0.36–1.15)

OR odds ratio, *CI* confidence interval, *BMI* body mass index, *GBS* group B streptococcus

[a]A sum of less than the one given in total is the expression of missing values not included in analyses

[b]Adjusted for BMI, diabetes, episiotomy, length of second stage of labor and operative delivery (length of active birth is not adjusted for length of the 2nd stage of labour)

has also been found to play a role in the risk of surgical wound infection [29–31]. Moreover, adipose tissue can put pressure on the wound edges and reduce the blood flow further, increasing the tissue forces in the wound line [32]. Prophylactic antibiotic treatment could be provided to obese women sustaining a 3rd or 4th degree tear after birth.

Strengths and limitations

This study used a prospective design and a thorough clinical examination postpartum to examine the prevalence of and risk factors associated with perineal wound infection and dehiscence among primiparous women. The prospective design is a major advantage as it eliminates the risk of recall bias. Risk factors for perineal tears were analyzed using a case–control approach theoretically leaving a risk of recall bias; however, values of the potential risk factors were all obtained from the medical records and the risk of recall bias thereby has to be considered not present.

The study achieved an inclusion rate of more than 70%. Non-participants were on average found to be younger than participants, but otherwise no differences were found between participants and non-participants across the three perineal tear groups.

Both wound infection and dehiscence were diagnosed on basis of a thorough clinical examination according to the CDC definition, which is a major strength. All the clinical examinations were carried out between 11 and 21 days postpartum, and different levels of healing could have affected the results, but no differences in time from birth to examination were seen across the perineal tear groups. All examinations were performed by research midwives, and the main part by the primary investigator who was situated at Odense University Hospital, where most of the study population was included (500 women). Different investigators leave a risk of inconsistency in the evaluation of the wound healing process. To reduce this risk, photos of the tears were discussed with the primary investigator. Also, the risk of infection and dehiscence was not affected by place of inclusion.

Our findings are restricted to our definitions of perineal wound infection and dehiscence. Different definitions of perineal wound infection have been used in other studies, which may explain a variance in prevalence statistics, and it is debatable whether purulent secretion or the presence of an abscess covers the prevalence of infection sufficiently. Another limitation of the study is the small number of perineal wound infections only allowing us to adjust for two parameters.

Clinical implications

To date, there are no standard guidelines for the follow-up of women who sustain a perineal tear during vaginal childbirth. Postpartum management of tears including the prevention of infection and assessment of wound healing is considered core component of routine maternity care [33, 34]. Our results showed that women with 2nd degree tear were at higher risk of wound complications compared to women with sphincter tears. This was an unexpected finding which might reflect the benefits of the more thorough follow-up routine, including preventive treatment with antibiotics, given to women with 3rd or 4th degree tears in Denmark. This may suggest that women who in general sustain perineal tears could benefit from routines inspired by those provided to women with 3rd and 4th degree tears. Based on our results women with BMI > 35 are at increased risk of complications and, therefore, comprise a group who might benefit most from a clinical assessment of their tear postpartum. Furthermore, our results indicate that treatment with antibiotics prevents wound dehiscence and perhaps also infection. We, therefore, suggest that antibiotic treatment, according to the degree of perineal tears, is considered for women at increased risk of wound complications, including severely obese women. Nevertheless, interventional studies providing information on the effect of antibiotic treatment on the risk of postpartum perineal wound infection and dehiscence would provide important information before the implementation of routine antibiotic treatment.

Conclusion

This study found maternal age, fetal birthweight and operative delivery to be associated with degree of perineal tear while episiotomy increased the risk of infection. Furthermore, we found severely obese women to comprise a group at risk of perineal wound complications. We, therefore, suggest an increased postpartum focus on obese women and women who had an episiotomy performed. This could include prophylactic antibiotic treatment in case of 3rd or 4th degree tears, but interventional studies on this subject are warranted.

Author contributions DG, VR, HD, NQ and EAN contributed to the design of this study. DG performed the data collection and conducted the analyses and DG, VR, NQ and EAN contributed to the interpretation of data. DG drafted the manuscript and DG, VR, HD, NQ and EAN critically revised the manuscript and approved the version to be published.

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Compliance with ethical standards

Ethical approval All procedures performed involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments. The study was approved by the Scientific Ethics Committee for the Region of Southern Denmark (S-20120213, 14.5.2013) and by the Danish Data Protection Agency (ID-2008-58-0035, 14.1.2015).

Informed consent Informed consent was obtained from all individual participants in the study.

Conflict of interest The authors report no conflict of interests.

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