

# **Birth complications, overweight and physical inactivity**

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Birth complications and life style

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## **Birth complications, overweight and physical inactivity**

**Abstract.** Maternal life style factors are potential predictors of pregnancy complications.

We examined relationships between modifiable factors and delivery complications.

Methods: A cohort of 553 women was followed through pregnancy and delivery. Main outcomes were pre-specified birth complications. Univariate and multiple logistic regression analysis were performed. Besides high birth weight ( $\geq 4200\text{g}$ ), modifiable predictors (high body mass index (BMI), fasting glucose and physical inactivity) and non-modifiable predictors (parity, high maternal age, gestational age and gender) were considered.

Results: High birth weight and high BMI were overrepresented among cesarean deliveries (CD). Acute CD was associated with birth weight, parity, high maternal age and induction of labor OR (95% CI) = 3.7 (1.7-8.1), 3.5 (1.7-7.2), 2.6 (1.3- 5.3) and 4.8 (2.6- 9.1), all p-values  $< 0.01$ . Excluding CD, parity and gender were associated with operative vaginal delivery OR (95% CI) = 8.7 (3.8- 20) and 2.2 (1.2- 4.1), p-values  $< 0.01$  and  $< 0.01$ . The risk for perineal lacerations of 3<sup>rd</sup> and 4<sup>th</sup> degree was associated with pregestational physical inactivity and operative vaginal delivery OR (95% CI) = 6.1 (1.6- 22.9) and 5.1, (1.5-17.6), p-values  $< 0.01$  and  $0.01$ . Severe haemorrhage ( $\geq 1000\text{ ml}$ ) was associated with high birth weight ( $\geq 4200\text{ g}$ ) and BMI  $\geq 30$ , OR = (95% CI) 4.2 (1.2- 4.7) and 4.6 (1.2-17.7), p-values 0.02 and 0.03.

Conclusions: We found that boys are more frequently subjected to operative vaginal deliveries and that pregestational physical inactivity increased the risk of perineal lacerations of 3<sup>rd</sup> and 4<sup>th</sup> degree.

Key words: Birth complications, physical activity, perineal lacerations

**Abbreviations:**

BMI; body mass index (kg/m<sup>2</sup>)

CD; cesarean delivery

VD; vaginal delivery

## **Birth complications, overweight and physical inactivity**

### **Introduction**

The change of lifestyle in many parts of the world with increasing prevalence of overweight and obesity also affects women of childbearing age. It is well documented that overweight and obesity are associated with increased risk of a variety of pregnancy and delivery complications. Pregnancy complications include pre-eclampsia, gestational diabetes and macrosomia (1-3). Delivery complications include increased use of cesarean deliveries (CD), induction and augmentation of labor, operative vaginal deliveries and fetal and maternal injuries (4-8). Many of the delivery complications are closely related to fetal macrosomia. The major cause of overweight is too high intake of energy relative to energy consumption. The relative contribution of high energy intake and physical inactivity may vary between populations (9). Among women in fertile age, it is not known to which extent physical inactivity may contribute to fetal macrosomia independent of maternal weight. However, we have recently reported that physical inactivity before pregnancy may contribute to fetal macrosomia, independent of maternal body mass index (10). Physical activity in the year before pregnancy seems to be inversely related to the risk of pre-eclampsia (11) as well as to lower prevalence of gestational diabetes (12). Furthermore, it can not be ruled out that physical inactivity may contribute to delivery complications independent of maternal BMI and the size of the baby. From a practical point of view, maternal dietary intake, physical inactivity, overweight and gestational weight gain are all factors that are modifiable and may be subjected to intervention, in contrast to non-modifiable determinants of macrosomia like genes, imprinting, gestational age, parity, maternal age and infant gender.

The aim of the present work was to study the relation between both modifiable and non-modifiable factors, and delivery complications. Our previous finding that pre-gestational

physical inactivity independently predicted fetal macrosomia lead us to pay particular attention to the impact of physical exercise before and during pregnancy on delivery complications.

### **Material and methods**

The study followed a prospective cohort design with inclusion period from 2002 to 2005.

After inviting women with singleton pregnancies and without diabetes or other severe diseases, 588 agreed to participate in the study. Of these were 35 lost to follow up. The cohort consisted of 553 pregnant women and their newborns. More details of the cohort is published elsewhere (10). Most of the information was collected during a prospective follow-up, where the pregnant women met with the same midwife four times during pregnancy. Anthropometric measures of the women were obtained at all visits, the first visit between gestational weeks 14-16 and at the last visit at gestational weeks 36-38.

Information on physical activity and exercise level was obtained retrospectively at the end of pregnancy in a physical activity questionnaire handed out at week 30-32. Physical activity was defined as any bodily movement produced by skeletal muscles resulting in energy expenditure. Physical exercise was defined as repetitive bouts of physical activity conducted over a longer period. By combining the answers of the questions 1) *How often do you exercise (times per week)*, and 2) *For how long do you usually exercise (minutes)?* information of the mean time spent on physical exercise weekly was obtained (13). Women exercising less than one hour per week were defined as physically inactive (14). Details of the delivery were obtained from the hospital records of each patient. Gestational age was based on routine ultrasound at weeks 17-19. Birth weight, head circumference and length of the baby were measured within two hours by the midwife attending the delivery.

#### *Delivery complications*

The following delivery complications were subjected to analyses: acute CD, operative vaginal deliveries (forceps or vacuum extraction combined), perineal lacerations of third or fourth degree and severe haemorrhage of 1000 ml or more (7;8;15;16). The estimation of blood loss was done by visual inspection, which is an inherently inaccurate method (17). By choosing 1000 ml as a cut-off, we considered it likely that the women had undergone a pathological haemorrhage, which usually is defined as above 500 ml. Perineal lacerations of third or fourth degree were defined as laceration involving anal sphincter or anal or rectal mucosa, and was diagnosed by a senior gynaecologist (18).

After excluding those who delivered by elective cesarean, 508 women had a planned vaginal delivery. Prevalence of acute CD were analysed among these 508 women. Perineal injuries and operative vaginal deliveries were analysed among the remaining 442 women who had a vaginal delivery (Fig. 1).

#### *Statistical methods*

Univariate and multiple logistic regression analyses were done to determine predictors of delivery complications. Also, relations between different types of complications were investigated by logistic regression. In the different multiple regression models, subsets of predictors were selected based on plausibility and clinical relevance. In multiple analyses, both forward and backwards variable selection procedures were used to explore stability of the results, but the final model from backwards variable selection procedure was chosen for presentation. All multiple analyses where information on physical activity was relevant were repeated with imputed values for missing data on physical activity. The imputation was done by replacing missing values of physical activity with the mode (the most frequent registration) of the registrations. All statistical models were checked for possible violations of assumptions of the logistic model (19).

All analyses were done by the statistical software program SPSS 13.0 (SPSS Inc., Chicago, IL). A p-value less than .05 was considered statistically significant.

## **Results**

Description of the cohort and birth outcomes is shown in Fig. 1. Of the 553 women in the cohort, 385 (70 %) delivered vaginally without any of the four complications as previously defined. Both elective and acute CDs caused a selection in the cohort, with respect to the different factors potentially predictive of delivery complications (Table 1). Women with a high BMI, especially those with a BMI above 30, had a high rate of CDs, both elective and acute. The combined percentage of CDs in this group was 36, as compared to 21 in the total cohort. A similar increase in proportion of CDs was seen when the birth weight was above 4200g.

### *Risk of induction or acute cesarean delivery*

Among the 508 women not delivered by elective CD, 122 underwent induction of labor. Forty-one of these (33.6%) had an acute CD subsequent to the induction, as compared to 6.7% of the women planning a vaginal delivery without induction. In univariate analysis, several factors seemed to be predictive of induction: birth weight above 4200g, parity, high maternal age, high gestational age, infant gender, high fasting glucose at week 30-32, and BMI above 30 (Table 2a). Multiple regression analysis showed that significant predictors for induction were parity, maternal age, gestational age and BMI above 30 (Table 3). The crude risk of acute CD was associated with the same variables as risk of induction except for gestational age. In addition, acute CD was strongly associated with preceding induction of labor. Multiple analyses showed that parity, maternal age and birth weight above 4200g were significant predictors and BMI above 30 borderline significant, of acute CD, after adjusting for induction (Table 4).

### *Risk of operative vaginal delivery or perineal lacerations of third and fourth degree*



Among the 442 women having a vaginal delivery, 57 had a delivery with use of forceps or vacuum extraction. Nineteen women (4.3 %) had a perineal laceration of third or fourth degree and seven of these occurred subsequent to an operative delivery. Of the 19 women with a severe perineal laceration, twelve returned the physical activity questionnaire. None of the seven women not returning the questionnaire were delivered by the use of vacuum or forceps.

Analysis of possible risk factors of operative vaginal delivery or perineal lacerations was done after excluding all CDs from the cohort. This excluded 29 of the 84 (35%) infants with birth weight above 4200g, and 21 of the 59 (36%) women with a BMI above 30 (Table 1).

Unadjusted analyses indicated that the risk of operative vaginal deliveries was associated with parity, high maternal and gestational age, infant gender, and weight gain above median (Table 2a). After adjustment, the only significant predictors of vaginal operative delivery were parity and infant gender, with a borderline significant contribution of high gestational age (Table 5). The gender differences and the effect of parity remained significant after adjusting for head circumference (data not shown).

The risk of perineal lacerations of third or fourth degree showed univariate associations with birth weight above 4200g, parity, pre-gestational physical inactivity and operative vaginal delivery (Table 2a). After adjustment, the only significant predictors were pre-gestational physical inactivity and operative vaginal delivery, whereas birth weight and parity was non-significant (Table 6). The analysis was repeated with imputed values for physical activity. This analysis gave similar results for physical inactivity ( $p=0.02$ ) and operative delivery ( $p=0.05$ ), and an additional effect of birth weight above 4200 ( $p=0.04$ ), and a possible contribution of parity ( $p=0.08$ ) (data not shown).

*Severe haemorrhage above 1000 ml*

Of the 553 women in the cohort, 26 experienced a substantial blood loss. Univariate associations (Table 2a & 2b) indicated several predictive factors. Birth weight above 4200g, BMI above 30, pre-gestational physical inactivity, CD, operative vaginal delivery and perineal lacerations degree three or four were explored in multiple analyses. After adjustment, the only significant predictors of severe haemorrhage were birth weight above 4200g and BMI above 30, with a possible contribution of pre-gestational physical inactivity (Table 7).

## **Discussion**

Acute CDs, operative vaginal delivery, perineal lacerations of third and fourth degree or abnormal blood loss are all serious maternal delivery complications.

The current finding concerning the classical risk factors for birth complications are in accordance with previous studies (20). It is well known that women with BMI above 30 kg/m<sup>2</sup> have more complications during pregnancy and delivery than women with lower BMI. In the present study high BMI was most strongly associated with induction of labor and acute CD. There was no effect of high BMI on the risk of operative vaginal delivery. This is in accordance with recent studies, which indicate that obese women may have poorer uterine contractility and therefore a prolonged first stage of labor, which may increase the use of acute CD (21). This may also explain why we found no association between high BMI (above 30) and perineal lacerations.

Fetal macrosomia was, in accordance with previous findings, found to be a risk factor for severe haemorrhage and acute CD (22). However, neither macrosomia nor physical inactivity was found to influence operative vaginal delivery.

We were surprised by the effect of infant gender. Boys had a significantly higher risk of being delivered by vacuum or forceps. We can only speculate on the reasons. The sex difference in operative vaginal deliveries remained significant after adjustment for birth weight or head circumference. A frequent indication for operative vaginal deliveries is

abnormal fetal heart rate pattern. Interestingly, boys and girls exhibit different heart rate patterns during delivery (23). This may have influenced the decision to deliver operatively. The present study indicates that physical inactivity before pregnancy may represent an additional independent risk factor for perineal lacerations of 3<sup>rd</sup> or 4<sup>th</sup> degree. Most importantly, the effect of low level of physical exercise on perineal lacerations was still significant, also after adjustment for first trimester BMI and birth weight. The latter is of particular interest because we recently have shown that pre-gestational physical inactivity is also an independent determinant of fetal macrosomia ( $\geq 4200\text{g}$ ) (10). The effect of physical inactivity on perineal lacerations seems therefore to be exerted by other mechanisms than by size of the newborn, as referred to below.

Operative vaginal delivery is among the strongest predictors of perineal lacerations (24). The effect of physical inactivity remained significant even after adjustment for operative vaginal delivery, supporting the independent role physical inactivity as a determinant of perineal lacerations.

Data which are subjected to clinical decisions during a project constitute methodological challenges. Selection mechanisms caused by decisions of elective and acute CDs, makes analysis of confounding factors a complex task. It can not be ruled out that possible confounders might have contributed to the results if they were to be considered at a later stage in the process. This is illustrated by the above notification about effect of macrosomia on operative vaginal deliveries. However, this counterfactual way of thinking was considered beyond the scope of this work.

The current cohort and the methods employed have been discussed elsewhere (10). As emphasized there evaluating physical activity with a questionnaire during week 32-36 has limitations.

It is, however, unlikely that there has been a recall bias among women who later suffered perineal lacerations, i.e. that these women reported lower level of physical activity than they actually performed compared to the women with less risk of perineal lacerations.

The mechanisms that may underlie the effect of physical inactivity can only be subject of speculations. Poor physical condition of the mother may reduce the capacity to push resulting in prolonged second stage which is associated higher risk of perineal lacerations (16;25;26).

Physical inactivity may also be associated with poor function of the pelvic levator muscles resulting in insufficient rotational forces and prolonged second stage of delivery.

Much attention has recently been given to obstetrical laceration of the perineal tissues for several reasons. First, it lengthens and complicates the post partum period. Secondly, the long term effect sever perineal lacerations may be debilitating. Thirdly, the risk of perineal damage has been used as an argument of elective CD (27). The studies of causes and prevention of perineal injuries are dominated by factors operating at the time of delivery (15;28). Less attention has been given to pregestational and pre-delivery determinants of perineal injuries. The current study points to factors associated with sedentary lifestyle as determinants for delivery complications. Such factors are usually modifiable and target for preventing measures.

There are no disclosures of interest

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## **Figure legends**

Figure 1: Description of birth outcomes of the 553 infants born in the cohort

Table 1:

Selection in the cohort with respect to cesarean sections and other complications. Numbers and percentages of cesarean section versus subgroups defined as possible predictors of macrosomia and birth complications.

	Number in sub-group	Elective CD n=44 (8%*)	Acute CD n=67 (13%**)	Total number of CD n=111 (21%*)
Birth weight $\geq$ 4200g	84 (15%)	11	18	29 (35%)
Parity, primiparous	293 (53%)	32	19	51 (20%)
Maternal age, above Q <sup>3</sup>	148 (27%)	15	25	40 (27%)
Gestational age, above Q <sup>3</sup>	129 (23%)	6	19	25 (19%)
Infant gender (boy)	295 (53%)	26	45	71 (24%)
Fasting glucose above Q <sup>3</sup> , week 14-16	127 (24%)	9	15	24 (19%)
Fasting glucose above Q <sup>3</sup> , week 30-32	124 (24%)	14	20	34 (27%)
BMI $\geq$ 25	222 (24%)	22	36	58 (26%)
BMI $\geq$ 30	59 (11%)	7	14	21 (36%)
Weight gain $\geq$ median	244 (50%)	26	25	51 (21%)
<b>Physical inactivity</b>	.	.	.	.
Less than one hour/week pre-gestational	33 (9%)	2	4	6 (18%)
Less than one hour/week 1st trimester	92 (28%)	3	15	18 (20%)
Less than one hour/week 2nd trimester	114 (38%)	8	13	21 (18%)



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Less than one hour/week	129 (48%)	9	19	28 (22%)
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3rd trimester

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\* Percentage of total \*\* Percentage of total after excluding elective cesarean deliveries

CD; cesarean delivery, VD; vaginal delivery, Q<sup>3</sup>; above upper quartile

Table 3: Adjusted effects of predictors of induction of labor. Variables entered were birth weight above 4200g, parity, maternal age and gestational age in the upper quartile, fasting glucose at week 30 - 32 in the upper quartile, gender and BMI above 30. Elective cesarean sections were excluded.

	n=122	p-value	OR	95% CI	
Parity, primiparous		<0.01	2.1	1.3	3.5
Maternal age Q <sup>3</sup>		<0.01	2.0	1.2	3.4
Gestational age Q <sup>3</sup>		0.01	1.9	1.1	3.1
BMI ≥ 30		<0.01	4.2	2.2	7.8

Table 4: Adjusted effects of predictors of acute cesarean sections. Variables entered were Birth weight above 4200g, parity, maternal age in the upper quartile, fasting glucose at week 30 - 32 in the upper quartile, gender, BMI above 30 and induction of labor. Elective cesarean sections were excluded.

	n=67	p-value	OR	95% CI	
Birth weight $\geq$ 4200g		<0.01	3.7	1.7	8.1
Parity 0		<0.01	3.5	1.7	7.2
Maternal age Q <sup>3</sup>		<0.01	2.6	1.3	5.3
BMI $\geq$ 30		0.08	2.1	0.9	4.7
Induction of labor		<0.01	4.8	2.6	9.1

Table 5: Adjusted effects of predictors of operative vaginal delivery.

Variables entered were birth weight above 4200g, parity, maternal age and gestational age in the upper quartile, BMI above 30 and weight gain above median. All cesarean sections were excluded.

	n=57	p-value	OR	95% CI	
Parity 0		<0.01	8.7	3.8	20
Gestational age Q <sup>3</sup>		0.07	1.8	1	3.4
Gender of child (boy)		<0.01	2.2	1.2	4.1

Table 6: Adjusted effects of predictors of perineal lacerations degree 3-4

Variables entered were birth weight above 4200g, parity, low level of pre-gestational physical exercise and operative vaginal delivery. All cesarean sections were excluded.

	n=12	p-value	OR	95% CI	
Pre-gestational physical inactivity		<0.01	6.1	1.6	22.9
Operative vaginal delivery		0.01	5.1	1.5	17.6

Table 7: Adjusted effects of predictors of severe haemorrhage above 1000 ml.

Variables entered were birth weight above 4200g, BMI above 30, low level of pre-gestational physical exercise, acute cesarean section, operative vaginal delivery and perineal lacerations third or fourth degree.

	n=26	p-value	OR	95% CI	
Birth weight $\geq$ 4200g		0.02	4.2	1.2	14.7
BMI $\geq$ 30		0.03	4.6	1.2	17.7
Pre-gestational physical inactivity		0.08	3.4	0.9	13.4

Figure 1

