Pelvic organ prolapse is an important health issue that often requires surgical intervention. Many factors like age, smoking, body mass index, abdominal hernia, connective tissue diseases, family history, gynecologic surgery, and lung disease contribute to the development of pelvic organ prolapse. Parity is another major risk factor, increasing parity being associated with an increased risk of developing pelvic organ prolapse.

There is little information in the literature on when damage to the pelvic floor actually occurs. Damage has been described already during pregnancy, but injury also occurs during vaginal delivery because of denervation of the pelvic floor. Evidence as to whether cesarean section offers some protection is conflicting. Denervation of the pelvic floor has been shown to be present in women who have had a cesarean section during labor but not in those who have had an elective cesarean section.

Whether cesarean section offers protection from development of pelvic organ prolapse as determined by symptoms, pelvic examination, or need for surgical intervention is not clear. Studies evaluating small numbers of case control pairs have led to conflicting or imprecise results as evidenced by wide confidence intervals.

The aim of our study was to provide clearer evidence for an association between route of delivery and pelvic organ prolapse by studying a large number of case control pairs from 2 Swedish health registries.

### Materials and Methods

The Swedish Hospital Discharge Registry (HDR), kept by the National Board of Health and Welfare (Stockholm, Sweden), was used to identify women with a diagnosis of pelvic organ prolapse. Using the personal identification number assigned to each resident in Sweden, the data were linked to the Swedish Medical Birth Registry (MBR), which is also kept by the National Board of Health.

The HDR contains information on diagnoses (1987-1996: International Classification of Diseases, 9th revision [ICD9]; 1997 and onward: International Classification of Diseases, 10th revision [ICD10]) and operation codes of all in-patients admitted to any Swedish hospital. The MBR contains medical information on nearly all deliveries in Sweden (coverage about 99%). All deliveries beyond gestational age of 28 weeks are included whether or not the infants are stillborn. Standardized record forms are used at all antenatal clinics, all delivery units, and all pediatric examinations of newborn infants in the maternity ward. Copies of these forms are sent to the National Board of Health and Welfare at which the information is stored electronically.

In total, 16,605 women who were diagnosed with pelvic organ prolapse (ICD9: n = 618, ICD10: n = 881) and who had deliveries during 1973-2004 were identified. No data were excluded. For women who had been diagnosed...
with pelvic organ prolapse more than once, only the first diagnosis was counted. Women also had to have had their first diagnosis of pelvic organ prolapse more than 365 days after the last labor because symptoms of pelvic organ prolapse may develop shortly after delivery but improve with time. Women with a diagnosis of pelvic organ prolapse made beyond the age of 60 years were excluded. We chose this cut off because women over this age probably would have given birth before 1973 when the MBR started. Therefore, information on their mode of delivery and parity was not available. Also, information on date of death was not available. The final study group consisted of 15,007 cases with the selection procedure presented in Table 1.

All hospitals in Sweden were included and the study period was long; why the diagnostic criteria of pelvic organ prolapse were not standardized, but the condition was diagnosed after pelvic examination.

Table 2 shows the demographic characteristics of the case group, those with pelvic organ prolapse, and the control group, those with no pelvic organ prolapse. Compared with the controls, women in the case group were likely to be born before 1950, were more likely to have delivered during the 1970s or 1980s, and were more likely to have delivered only 1 child or more than 3 children during the study period.

Odds ratios (ORs) were obtained using the Mantel-Haenszel procedure. Stratification was made by the women’s year of birth (2 year intervals), the year of the last delivery (1 year interval), and the parity at the last delivery (previous deliveries plus 1), 95% confidence intervals (CIs) were calculated using the method proposed by Miettinen.

As a complement to the Mantel-Haenszel analyses, Cox analyses were performed to estimate hazard ratios for pelvic organ prolapse after the last labor. The time at risk for each woman was recorded by counting the number of days between the individual dates of study entrance and exit. For each woman, the time for the study entrance was set at Jan. 1, 1987 (when the HDR started) or at the date of the last delivery (if after 1987). The time for the study exit was set at the date of the first diagnosis of pelvic organ prolapse, the date the women turned 60 years old, or on the Dec. 31, 2004 (when the data set was retrieved), depending on which event happened first. The women’s age at study entrance was entered in the Cox analyses as a continuous variable, whereas delivery mode (cesarean section only or vaginal only) and parity were entered as class variables.

The study was approved by the Research Ethics Committee at Karolinska Institutet (Stockholm, Sweden).

**Results**

Of the women with inpatient diagnosis of pelvic organ prolapse 78.2% had undergone surgery for pelvic organ prolapse.

During the study period, the rate of instrumental deliveries and ruptures of the anal sphincter were 7% and 3%, respectively, in vaginally delivered women. Instrumental delivery was not more frequent in women with prolapse.

Results of method of delivery in those with and without pelvic organ prolapse can be seen in Table 3. Only about 2% of the women with a diagnosis of pelvic organ prolapse had no vaginal deliveries and 1 or more cesarean sections,
whereas in women with no pelvic organ prolapse, the corresponding figure was almost 9%. Thus, women with pelvic organ prolapse were significantly more likely to have had a vaginal delivery than those without.

The crude OR for pelvic organ prolapse (cesarean section vs vaginal births) was significantly below 1. Even though heavy confounding from maternal year of birth, parity, and year of last delivery was suspected, the adjusted and crude ORs were almost identical. Thus, there appeared to be a significant reduction in the risk of pelvic organ prolapse in those who had undergone cesarean section compared with vaginal delivery.

Cox analyses revealed that the overall hazard ratio, (cesarean section only vs vaginal births only) controlling for women’s age and parity (see Materials and Methods) was 0.20 (0.18-0.22), thus similar to the OR obtained from the Mantel-Haenzsel analysis.

Among women who had only had vaginal deliveries, a strong and almost linear association between parity and the risk of pelvic organ prolapse was found (Figure). Among women who had had a cesarean section but no vaginal births, no such association could be found. Thus, the protective effect of cesarean section on pelvic organ prolapse was more pronounced among multiparous women than among primiparous women (OR, 0.063; 95% CI, 0.05-0.081 and OR, 0.26; 95% CI, 0.23-0.29, respectively).

On the other hand, only about 1% of vaginally delivered women developed pelvic organ prolapse during the study period (ie, before the age of 60 years).

### TABLE 3

<table>
<thead>
<tr>
<th>Mode of delivery</th>
<th>Prolapse (n = 15,007)</th>
<th>No prolapse (n = 1,444,548)</th>
<th>Crude OR</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaginal deliveries only</td>
<td>13,935 (92.9)</td>
<td>1,193,661 (83.5)</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Vaginal and CS</td>
<td>791 (5.3)</td>
<td>108,212 (7.6)</td>
<td>0.63</td>
<td>0.75 (0.69-0.81)</td>
</tr>
<tr>
<td>CS only</td>
<td>281 (1.9)</td>
<td>127,668 (8.9)</td>
<td>0.19</td>
<td>0.18 (0.16-0.20)</td>
</tr>
</tbody>
</table>

The odds ratios (ORs) were obtained after stratification for maternal year of birth, year of last delivery, and parity at last delivery. CI, confidence interval; CS, cesarean section.

The management of deliveries may have changed during our study period, but whether this has affected our results is unknown.

Because vaginal delivery has been the mode of delivery for most women, it has been difficult to separate pregnancy from vaginal delivery as the etiology of pelvic organ prolapse. Previous studies on the protective effect of cesarean section are small and have come to divergent conclusions. Three studies based on interviews or self-reported questionnaires, asking about symptoms of pelvic organ prolapse, found conflicting evidence as to whether cesarean section is protective.

MacLennan et al interviewed 1546 women and showed that both cesarean section and vaginal delivery were associated with symptoms of pelvic floor dysfunction, and there was no difference between acute and elective cesarean births. In the studies by Lukacz et al and Tegerstedt et al, 4458 and 5489 women, delivery after the age of 60 years. Only a longer follow-up would allow this to be evaluated. In the year 2003, 3705 women with the diagnosis of pelvic organ prolapse were admitted to hospital in Sweden after the age of 60 years and 2095 before this age.

The present study shows that cesarean section is associated with a lower risk of inpatient diagnosis of pelvic organ prolapse than vaginal delivery.

This study also shows a further decrease in risk after several cesareans as compared with several vaginal deliveries.

A disadvantage of our case-control study is that we were unable to separate patients who had had a trial of labor prior to a cesarean section from those who had not. Some studies suggest a higher risk of pelvic floor damage in those who have had a trial of labor. On the other hand, if this distinction had been possible, the calculated risk would have been even lower.

We were unable to identify other potentially confounding factors for pelvic organ prolapse including family history, obesity, gynecological surgery, smoking, or lung disease. Other studies have shown that these factors increase the risk of pelvic organ prolapse. If women with these risk factors are undergoing vaginal delivery more often than cesarean section, this may have affected our results.

Symptoms of pelvic organ prolapse usually develop after the menopause, which is why a long period of follow-up for this condition is mandatory. Most women have their last period around the age of 50 years. Because of the design of our study, which excluded women over the age of 60 years, we were unable to determine whether women who have had a cesarean section present with symptoms of pelvic organ prolapse to a lesser extent than women with vaginal delivery after the age of 60 years.
respectively were evaluated with divergent results: OR for pelvic organ prolapse was 1.82 in the first study after vaginal delivery as compared with cesarean delivery and 0.5 in the second after cesarean section, although the circumstances of the cesareans, planned vs emergency, was not indicated in the 2 studies.

Four case-control studies on women subjected to surgery for pelvic organ prolapse with a total of 1017 cases and 1829 controls reported that cesarean section protects the pelvic floor, although there were large confidence intervals with no information on the indications for cesarean delivery.18,21 Two other studies with nonoptimal design reported no protection from cesarean section.5,20

In 2 studies in which the degree of pelvic organ prolapse was investigated by a gynecological examination shortly after birth, cesarean section was shown to be only partly protective.18,21 Nygaard et al22 investigated risk factors for pelvic organ prolapse by examining 270 older women and showed that the definition of pelvic organ prolapse influenced the results.

Although we were unable to stratify for all known risk factors of pelvic organ prolapse, this is the only large study that investigates the risk of pelvic organ prolapse by method of delivery, cesarean section vs vaginal, and we found a significantly protective effect from cesarean birth.

Women already request a cesarean section to protect the pelvic floor without evidence that it is protective, although in certain cases it may be.28 Fortunately, most women will not need surgical intervention to treat the condition. Even nulliparous women do occasionally develop pelvic organ prolapse. Only 1% of vaginally delivered women in our study developed pelvic organ prolapse before the age of 60 years. Pelvic organ prolapse is a multifactorial disease, which is why optimal design of studies to determine all potential contributory factors is difficult. The benefits and potential risks of a cesarean section29,30 with resultant uterine scar31 have to be weighed against the risk of developing pelvic organ prolapse. Decisions on the mode of delivery can be complex which is why accurate information should be provided to women requesting a cesarean section.

In the future, studies with a longer follow-up that control for confounding factors other than parity and age should help to clarify the relationship between method of delivery and pelvic organ prolapse.

REFERENCES