Cesarean section might moderately increase offspring obesity risk

Dear Sir:

In the February 2012 issue of the Journal, Barros et al (1) reported on the impact of delivery mode on childhood, adolescence, and early adulthood obesity (1). They found that almost all adjusted prevalence ratios of cesarean compared with vaginal delivery on offspring obesity were not significant and concluded that cesarean delivery appeared not to substantially increase later obesity risk. There are some concerns over this conclusion.

The study consisted of 3 birth cohorts (1982, 1993, and 2004); each cohort consisted of ~4000 individuals, and obesity was assessed at the age of 4, 11, 15, or 23 y. Barros et al estimated prevalence ratios of cesarean compared with vaginal delivery on obesity according to assessment age for male, female, and overall participants. Adjusted point estimates for all participants in the 3 cohorts via RevMan 5.1 (Nordic Cochrane Center) by using a random-effects model and observed that cesarean compared with vaginal delivery modestly increased later obesity risk (pooled RR = 1.17; 95% CI: 1.06, 1.29; P = 0.001). On the basis of this pooled effect estimate and the highest obesity prevalence (10%) reported in children born vaginally (1), 10,000 individuals were needed to guarantee 80% power to detect a significant effect. It is quite unlikely that Barros et al were able to detect a significantly modest effect with a sample size of ~4000. In addition, we combined 3 adjusted prevalence ratios for children aged 4 y and observed that cesarean compared with vaginal delivery modestly increased later obesity risk (pooled RR = 1.17; 95% CI: 1.06, 1.29; P = 0.005). We further conducted similar combined analyses for male and female participants, and again we observed that all pooled RRs were statistically significant, except that for 4-y-old girls (Table 1). Overall, our different combined analyses suggested that cesarean delivery might moderately increase offspring obesity risk.

It is worth noting that such moderately increased risk has significant public health implications. Cesarean births have dramatically increased worldwide during the past decades and currently account for 33%, 50%, and 56% of all births in the United States, Brazil, and China, respectively (1, 2). We estimate that obesity in ~7, 10, and 11 per 100 4-y-old children can be attributed to cesarean delivery in the United States, Brazil, and China, respectively. Indirect evidence in the literature supports the adverse impact of cesarean delivery on later obesity. In addition to the possible pathway of gut microbiota raised by Goldani et al (3), a reduced breastfeeding rate in mothers who experienced cesarean delivery was suggested (4), and breastfeeding was shown to be a protective factor for later obesity (5, 6). In addition, umbilical leptin concentrations were lower in newborns delivered by cesarean delivery than in those born vaginally (7), and a lower leptin concentration in cord blood was suggested to increase childhood obesity risk (8, 9).

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### Table 1

Pooled estimates of adjusted prevalence ratios in 3 cohorts

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pooled RR (95% CI)</td>
<td>P</td>
<td>Pooled RR (95% CI)</td>
</tr>
<tr>
<td>4-y-old groups&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.23 (1.06, 1.41)</td>
<td>0.005</td>
<td>1.27 (1.05, 1.53)</td>
</tr>
<tr>
<td>All age groups&lt;sup&gt;2&lt;/sup&gt;</td>
<td>1.17 (1.06, 1.29)</td>
<td>0.001</td>
<td>1.19 (1.05, 1.35)</td>
</tr>
</tbody>
</table>

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<sup>1</sup> Calculations were based on the adjusted prevalence ratio of 4 y in 1982, 4 y in 1993, and 4 y in 2004.

None of the authors declared a conflict of interest.

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**REFERENCES**


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**Reply to H-t Li et al**

Dear Sir:

We thank Li et al for their letter and for their interest in our article on cesarean section and the risk of obesity (1). We also want to express that we fully agree with their comment that the short- and long-term effects of the epidemic of cesarean sections that has been described in a large number of countries deserve further research. It is known that high rates of cesarean sections are associated with increased morbidity and mortality (2), and we have long warned about the risks associated with the cesarean delivery epidemic in Brazil (3, 4).

However, we would like to express our concern with the strategy adopted by Li et al of pooling together all of our adjusted prevalence ratios, some of them from the same individuals followed up at different ages. Because the observations are not independent, we believe this strategy is problematic, and this is the reason why we decided not to adopt it. In fact, in their book on meta-analysis, Borenstein et al (5) cautioned that this approach leads to an improper estimate of the precision of the summary effect.

In relation to their pooled analysis of the 4-y-old children from all 3 cohorts, the significant pooled estimate should again be interpreted with caution for 2 reasons. First, the possibility of residual confounding cannot be ruled out. All unadjusted RRs decreased in the adjusted analyses, suggesting a role for residual confounding. Second, the association observed at 4 y of age was substantially attenuated in the 2 cohorts (1982 and 1993) for which measurements were available at older ages.

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**Saturated fat and lipemia: importance of study design and triglyceride structure**

Dear Sir:

Recent articles on dietary fats and plasma lipoproteins (1–3) may not sufficiently consider differences in study design and methodology and the fact that postprandial lipemia may not reflect long-term lipoprotein metabolism. Tholstrup et al (1) noted that palm olein increased LDL cholesterol compared with olive oil, in contrast to an earlier study (4) that showed that these 2 vegetable oils were similar. Although Tholstrup et al (1) did not discuss the Australian study (4), the 2 studies differ. The Danish study had I higher total...