Oral Intake During Labor

Geraldine O'Sullivan, MD, FRCA
Bing Liu, MS
Andrew H. Shennan, MBBS, FRCOG, MD
St Thomas' Hospital
London, UK

Oral food intake during labor was raised as a risk factor for gastric-content aspiration in the 1940s, if a general anesthetic were required during labor. Nil by mouth policies were introduced since then in to reduce pulmonary aspiration after general anesthesia. However, "nil by mouth" has been challenged for more than a decade by clinicians, particularly midwives, due to lack of evidence to support that this policy is beneficial. Many midwives are concerned that fasting laboring women may lengthen labor duration, subsequently increase medical intervention, and compromise birth outcomes, based on theoretical metabolic principles and psychologic benefits.[1–3]

Available surveys have shown huge variation in both practice and policies regarding feeding and drinking in labor,[4–8] despite a number of researchers conducting studies to investigate the influence of restricting or not restricting oral intake on laboring women. The sample sizes were insufficient and the results in conflict. A more liberal management with respect to oral food intake in labor has been observed among many labor wards and birth units in the United Kingdom, the Netherlands, and Australia.[4–8] The maternal mortality rate due to Mendelson syndrome[9] in countries with such a liberal policy, however, is no higher than in countries where a restrictive policy is advocated.[10–12]

In the meantime, the improvements in obstetric anesthetic practice over the last 50 years have greatly contributed to the decline and disappearance of pulmonary aspiration on labor wards.[13–18] Pulmonary aspiration is so rare it is an impossible end point to investigate even by large multicenter clinical trials. Whether or not the rarity of aspiration justifies the risk of allowing a more liberal approach to caloric intake in

REPRINTS: GERALDINE O'SULLIVAN, DEPARTMENT OF ANESTHETICS AND DEPARTMENT OF WOMEN'S HEALTH, ST THOMAS' HOSPITAL, LONDON, UK, E-MAIL: GERALDINE.OSULLIVAN@GSTT.STHAMES.NHS.UK

normal laboring women remains to be proven; this will depend, in part, on the benefits associated with feeding. There is no adequate evidence to support either the liberal approach advocated by many midwives, nor the opposing opinion of most anesthesiologists. Opinion leaders, whose interpretation of the available facts is based on physiologic principles and limited observational data or anecdotal reports, inevitably drive practice.

■ Anesthesia-related Pulmonary Aspiration Risk Factors in Adults and Pregnancy

The debate regarding oral intake of laboring women has revolved around whether the benefits of feeding can outweigh the possibly increased risk of pulmonary aspiration by increased gastric contents. The volume and nature of gastric contents, undetected gastro-oesophageal reflux, patient factors, and poor judgment in the choice and performance of anesthetic technique are the most important risk factors for aspiration.[19]

Patient and Anesthetic Factors

Airway management problems frequently precipitate pulmonary aspiration. Air blown into the stomach, and bucking and coughing due to light anesthesia may cause gastro-oesophageal reflux. Obese patients, patients with known gastro-oesophageal reflux disease and patients with difficult airways are particularly prone to pulmonary aspiration, independent of their gastric contents.[19] Kulger and Short reviewed 240 incidents of vomiting and aspiration reported to the Anesthetic Incident Monitoring Study database in New Zealand. Of these, 133 cases were recorded as aspiration, indicating that passive regurgitation occurred 3 times more commonly than active vomiting. Knowledge-based error, technical error, and inadequate patient preparation, and not violations of fasting precautions, were identified as the most common contributing factors.[20] These results are consistent with previous reports on human failure component of incidents done by Williamson's group in 1993.[21] It suggested that the anesthesiologist is probably as important a factor as the gastric contents.

■ The Decline in Maternal Mortality From Pulmonary Aspiration of Gastric Contents

The true reason for the decline in maternal deaths (Fig. 1) is difficult to ascertain but it is understandable that any new practice associated with this reduction would be eagerly accepted and rapidly introduced. From the 1940s onwards, strategies to reduce gastric volume and

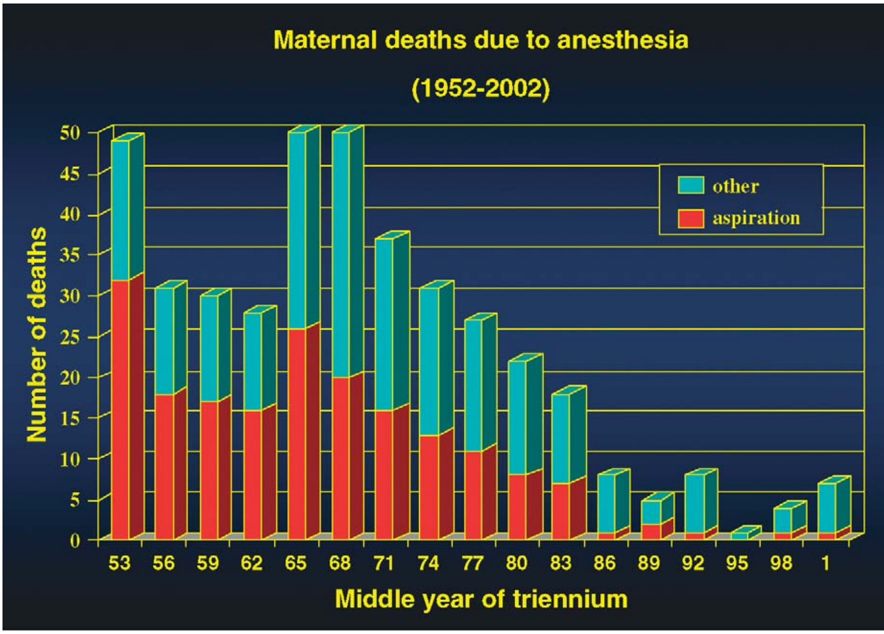

Figure 1. *Confidential enquiry triennial reports illustrating anesthetic related deaths.*

increase pH were introduced as the evidence at that time suggested that the physical consistency of the aspirate intake was an important cause of this lethal complication. Within obstetric anesthetic practice a number of other improvements in management were also becoming popular.

Tracheal intubation almost certainly played a significant part in reducing the incidence of pulmonary aspiration in obstetrics. However, in obstetrics, its use is always associated with a rapid sequence induction (RSI) of anesthesia with cricoid pressure. The universal use of this technique in every term obstetric patient, both elective and emergency, could be questioned. A randomized controlled trial, to assess the efficacy of RSI with cricoid pressure in obstetric patients has never been performed, and its use is now often associated with difficult/failed intubation in obstetrics.

After a decline in anesthesia-related maternal mortality in the late 50s and early 60s, its incidence subsequently increased, at which time failed or misplaced intubation was recognized to be a significant complication of general anesthesia within the pregnant population. In these situations, extensive manipulation of the airway in the course of a difficult intubation was frequently associated with aspiration. Understandably, then, anesthetists preferred a starved patient. Unfortunately, even modern obstetric practice has a significant incidence of failed intubation, reported to be as high as 1 in 250.[22] In obstetrics, anesthesia is induced with the mother lying in a tilted position; it is therefore more likely that cricoid pressure will be incorrectly applied with consequent distortion of the larynx. Is it therefore necessary to perform a RSI with cricoid pressure in all mothers presenting for elective cesarean section under general anesthesia?

The evidence that H_2 antagonists reduce morbidity and mortality has not been conclusively demonstrated. At the time of their introduction into obstetric clinical practice maternal mortality was already declining. Again, practice has been dictated, probably correctly, by physiologic principles. In this case, that reducing gastric volume and acidity will limit damage with aspiration pneumonitis.

Perhaps the most significant change in practice that has reduced the risk of pulmonary aspiration has been the dramatic reduction in the use of general anesthesia for cesarean section. However, the cesarean section rates have also escalated in recent decades, and therefore the decline in the overall number of general anesthetics, that is, those most at risk of pulmonary aspiration, have not significantly reduced in absolute terms. In the United Kingdom The National Sentinel Caesarean Section Audit (NSCSA)[23] showed that 1 in 29 mothers in England and Wales were unconscious during childbirth. This fact was not reported directly or even commented upon, but the audit found that the overall cesarean section rate in England and Wales had risen to 21.5%. As general anesthesia was used for 9.5% of the elective and 22.8% of the emergency cases (n = 10,923 and 18,534, respectively) it can be calculated that 5244 (3.5%) of the 3-month cohort of 150,139 must have delivered under general anesthesia. Therefore, a reduction in the percentage use of general anesthesia cannot be the only explanation of the remarkable reduction in deaths from aspiration. Improved training in obstetric anesthesia with better understanding of the risks associated with general anesthesia will have contributed to the overall decline.

In the past 15 years the incidence of aspiration in the United Kingdom has been negligible.[13–15] Approximately, 700,000 women deliver annually in the United Kingdom, which in a 15-year period represents about 10 million deliveries during which time there have been only 4 fatal cases of aspiration. There has also been a reversal in the restrictive policies of nil by mouth, and there is evidence that many more women do eat in labor.[3–7] Perhaps, the most telling statistic will be in the forthcoming triennial reports. If, despite this practice, pulmonary aspiration remains low, this may be the best evidence yet that there is not a causal relationship between feeding and mortality. However, there is still uncertainty and correct practice remains unclear.

It is well known that there is a large discrepancy in practices and policies with respect to food intake in labor between North America and Britain. In 1988, less than 2% of units in the United States allowed solid intake, although this figure was almost 33% in the United Kingdom.[2]

The volume and component of food intake during labor varied from ice water only to whatever women desire.[4] These large differences in practice have not been reflected by increased mortality from gastric aspiration in the United Kingdom. A more recent survey conducted in the United States indicates that little has changed.[24] Equally, the increased liberalization in the United Kingdom over the last decade has not resulted in an increase in maternal morbidity or mortality.

■ The Adverse Effects of Fasting in Labor

It is undisputable that labor and birth require a large caloric expenditure. Available studies show that the energy requirements of labor may be similar to the energy consumption of continuous moderate aerobic exercise.[25] Many professionals argue that starvation in labor is both physiologically and psychologically detrimental for women.[26,27] It is not surprising that prolonged fasting in labor is associated with an increased production of ketones, in particular hydroxybutyrate and acetoacetic acid.[28,29] These have been shown to occur rapidly after withdrawal of calories in pregnant women.[30] However, the increase in these acids, including nonesterified fatty acids which increase with starvation, have not been shown to be related to maternal and fetal acid base balance.[31,32]

In the 1960s and 70s intravenous dextrose was given in an attempt to reduce maternal ketosis. This was soon abandoned when it was clear this caused lactic acidosis in the babies along with jaundice and hypoglycemia.[31,33,34] The compromised fetus was particularly at risk.[34,35] Fluid overload was also a concern. It is not clear whether ketosis is as detrimental as initially thought and now it has been demonstrated that ketones can be utilized by both the mother and fetus. Indeed, this may be a normal physiologic response in labor, which should not be tampered with. This understanding has also coincided with a more aggressive approach to labor management so that a long labor is far less tolerated and prolonged exposure to an intense ketotic state is rare.[36]

Whether ketosis or other effects of starvation has altered the progress and outcome of labor remain unclear. Some investigators have evaluated the effect of rehydration on labor outcome.[31,33] Infusions of normal saline have reduced maternal ketosis and possibly improved fetal well being.[37] Other investigators have demonstrated that infusing a liter of normal saline will reduce uterine contractility.[38] A randomized controlled trial of the effect of increased intravenous hydration during labor (Ringer lactate solution—125 mL vs. 250 mL h^{-1}) showed that the incidence of labor lasting more than 12 hours was statistically higher in the 125 $mL\,h^{-1}$ group.[39] It was also suggested that the incidence of oxytocin use was less in the 250 $mL\,h^{-1}$ group. This is a large amount of fluid to give intravenously to a normal pregnant woman; perhaps it might be more physiologic to allow the mother to drink in response to thirst.

The latest study conducted by Tranmer et al[40] investigated the effect of unrestricted oral carbohydrate intake on labor progress using a 7-point scale measuring the degree of thirst, hunger, nausea, and fatigue caused by labor. However, it showed no significant difference between women, who were allowed unrestricted access to their choice of foods and fluids and women, who only had ice chips, popsicles, or sips of fluid during labor in the hospital.

■ Influence of Oral Intake During Labor on Labor Outcome and Birth Outcome

A key question in labor outcome is whether there are significant improvements in women who take either calories or light diet in labor. There is a scarcity of good controlled data looking specifically at delivery outcome, but there are some randomized control trials that have evaluated obstetric end points. We are aware of 5 randomized controlled trials that can be analyzed meaningfully to ascertain obstetric end points in relation to caloric intake (Table 1). In 1999, Scrutton et al[28] investigated whether a light diet would affect a woman's metabolic profile and increase her residual gastric volume. Labor outcome was also evaluated. Eighty-eight women were randomized. The light diet consisted of cereal, milk, toast, bread, semisweet biscuits, and low fat cheese. Light diet was compared with water only, and women beyond 37 weeks gestation who had a singleton fetus with cephalic presentation were eligible if their cervical dilation was less than 5 cm. Women who had received intramuscular meperidine were excluded from the trial, as were women with significant obstetric or medical complications. Randomization method was by sealed envelopes. Gastric volumes were measured with real time ultrasound all by the same investigator and power was based on differences in metabolic end points, namely plasma β-hydroxybutyrate and nonesterified fatty acids and plasma glucose. Women were stratified by parity and low-dose epidural analgesia with bupivacaine and fentanyl was permitted. Glucose levels were higher in the eating group, whereas eating prevented the rise in hydroxybutyrate and fatty acids. With these numbers, there were no significant differences in other labor end points. Mothers in the eating group, however, did have significantly larger gastric volumes at the time of delivery and these women vomited larger volumes, which contained a considerable amount of solid residue.

Table 1. *Randomized Controlled Trials Included in Meta-analysis*

Study	No. Patients per Group	Methods	Participants	Interventions	Outcomes
Yiannouzis and Parnell[42]	297	Randomization with sealed envelopes	Multiparae and nulliparae, singleton fetus, cephalic presentation, gestation ≥37 wk, cervical dilatation ≤3 cm	Light diet after randomization versus water only	Duration of labor, mode of delivery, Apgar scores, oxytocin requirement, vomiting incidence
Scrutton et al[28]	88	Computer rando-mization with sealed envelopes	Multiparae and nulliparae, singleton fetus, cephalic presentation, gestation ≥37 wk, cervical dilatation ≤3 cm	Light diet after randomization versus water only	Duration of labor, interventions, mode of delivery, Apgar scores, oxytocin requirement, blood gases, vomiting incidence, volume, gastric volume. Metabolic profile in early and late labor—ketones, FFA, glucose, insulin, lactate
Kubli et al[29]	60	Computer rando-mization with sealed envelopes	Multiparae and nulliparae, singleton fetus, cephalic presentation, gestation ≥37 wk, cervical dilatation ≤5 cm	Isotonic drinks (carbohydrate 64 g/L) after randomization versus water only	Duration of labor, interventions, mode of delivery, Apgar scores, oxytocin requirement, blood gases, vomiting incidence, volume, gastric volume. Metabolic profile in early and late labor—ketones, FFA, glucose, insulin, lactate
Scheepers et al[41]	201	Double blinding randomization with sealed envelopes	Nulliparae, singleton fetus, cephalic fetus, gestation ≥37 wk, cervical dilatation 2-4 cm	Carbohydrate (126 g/L) drinks after randomization versus water only	Duration of labor, mode of delivery, Apgar scores, oxytocin requirement, arterial pH, pain medication

A further study from the same unit randomized 60 women comparing the metabolic effects of isotonic sports drink to water only during labor.[29] As with the previous trial, the metabolic profile was examined, along with labor outcome and residual gastric volumes. Similar criteria were followed. Those receiving sports drinks were encouraged to drink up to half a liter in the first hour and then a similar amount every 3 to 4 hours. They could also take water if they wished. The water only group had no restrictions. Despite the caloric limitation of the isotonic fluids, it was shown that these drinks prevented the rise in β-hydroxybutyrate and nonesterified fatty acids seen in the starved group. Once again, there was no change in any outcome of labor, but in contrast to the light diet allowed in the original study, there was no increase in residual gastric volume in the isotonic sport drink group. Although this approach may not provide the whole answer, it does at least provide a way of preventing ketosis that might be acceptable to the majority of anesthesiologists.

In the Netherlands, Scheepers et al[41] performed a randomized controlled trial in 200 women who received either carbohydrate solutions or placebo. Nulliparous women with a singleton fetus with a cervical dilatation of between 2 and 4 cm were included. Exclusion criteria included women who were at high risk of cesarean section. However, both high-risk pregnancies at all gestations were included and notably, many women underwent induction of labor, including a significant number of postterm pregnancies. Both groups were allowed to drink at will, and standardized amounts of food or drink were given on specific demand. The main outcomes were operative deliveries, labor duration, and need for analgesia. Again, envelopes were used for randomization and the trial was blinded. They found a 3-fold increase in cesarean section in women who received calories (21/101 vs. 7/99, $P = 0.007$).

A fourth study, available only as an abstract, contains information regarding labor outcomes.[42] This trial is included in the meta-analysis of obstetric outcomes below.

Tranmer et al[40] conducted a randomized trial to determine if unrestricted oral carbohydrate intake during labor reduced the incidence of dystocia, defined as a cervical dilatation rate of less than 0.5 cm/h for a period of 4 hours after a cervical dilatation of 3 cm, in low-risk nulliparous women. Three hundred twenty-eight women were randomized. Women were eligible if they were nulliparous, at or beyond 30 weeks gestation, with a singleton fetus, and no recorded fetal or maternal complications. Exclusion criteria included planned cesarean section, diabetes, fetal growth restriction, and fetal abnormalities. Women in intervention group were encouraged to eat easily digestible foods or fluids in frequent and small amounts as their desired selections during labor, whereas the control group were permitted ice chips, popsicles, or sips of fluid during labor. There was no significant difference in the incidence of dystocia between intervention and control group (36% vs. 44%, odds ratio = 0.7, 95% confidence interval = 0.5, 1.1); however, there was a trend toward a positive effect when less stringent rate criteria of 1.0 cm/h was used instead of 0.5 cm/h, but the effect was not statistically significant. Moreover, induction of labor, types of uterine stimulants administrated, delivery method, and indication of cesarean section were also evaluated and there were no significant difference between groups. It is worthwhile to mention that the participants in the intervention group, only 56% of them actually ate or drank some source of carbohydrates, in comparison to 13% fed in the control group. The limited sample size and considerate proportion of crossover could have influenced the results.

■ Labor Duration

When comparing the effect of any caloric intake versus no caloric intake, labor was increased in duration in 3 trials and decreased in one. The actual duration of labor was not measured in the Tranmer study. However, there was significant heterogeneity in the trials that is, they disagreed with each other. The one trial in which oral intake shortened labor did not allow solid caloric intake. These data do not support the concept that caloric data shortens the duration of labor (Fig. 2).

■ Mode of Delivery

The data on outcome of labor from the 4 trials can be combined in a meta-analysis. When comparing any caloric intake versus no caloric intake, there were no significant differences, either in the rate of cesarean section or spontaneous vaginal delivery, (Figs. 3, 4). There was significant heterogeneity. Although 3 of the trials showed a slight decrease in the cesarean section rate[28,29,42] in patients who were fed, Scheepers et al[41] reported a statistically significant result in the opposite direction. However, in this trial, the cesarean section rate in the placebo group was only 7% compared with the historical rate of 19% for that institution. Further, one would expect that the nulliparous, high-risk population recruited for this study should have had a much higher cesarean section rate. The 3-fold increase in cesarean section rate (7% vs. 21%) is therefore likely to be due to a type 1 statistical error (false positive, when no difference exists). These studies do not support the claim that oral intake decreases the cesarean section rate.

■ Other Outcomes

In the 2 trials that evaluated metabolic effects,[28,29] caloric intake significantly reduced ketone levels by a mean of 0.496 mmol/L

	Mean (SD) (study)	Mean (SD) (control)
Scrutton 1999	710 (222)	641 (225)
Kubli 2002	477 (150)	533 (176)
Yiannouzis 1992	586.8 (411.8)	493.2 (582.2)
Scheepers 2002	370 (367.8)	300 (290)

Test for Heterogeneity p=0.050
Test for overall effect z=1.354 p=0.176

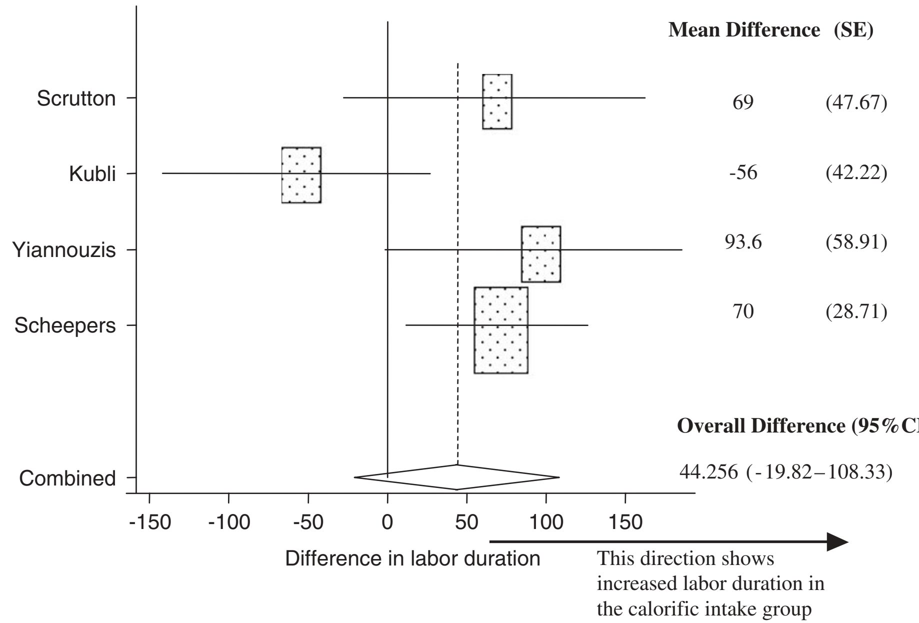

Figure 2. *Combined effects of caloric intake during labor versus noncaloric intake. Outcome: difference inlabor duration.*

	Treatment	Control
Scrutton 1999	9/45	12/43
Kubli 2002	6/30	8/30
Yiannouzis 1992	4/154	7/143
Scheepers 2002	21/102	7/99
Tranmer 2005	41/162	32/165
Total (95% CI) =	81/493	66/480
Test for Heterogeneity		p = 0.118
Test for over all effect	z =	p =

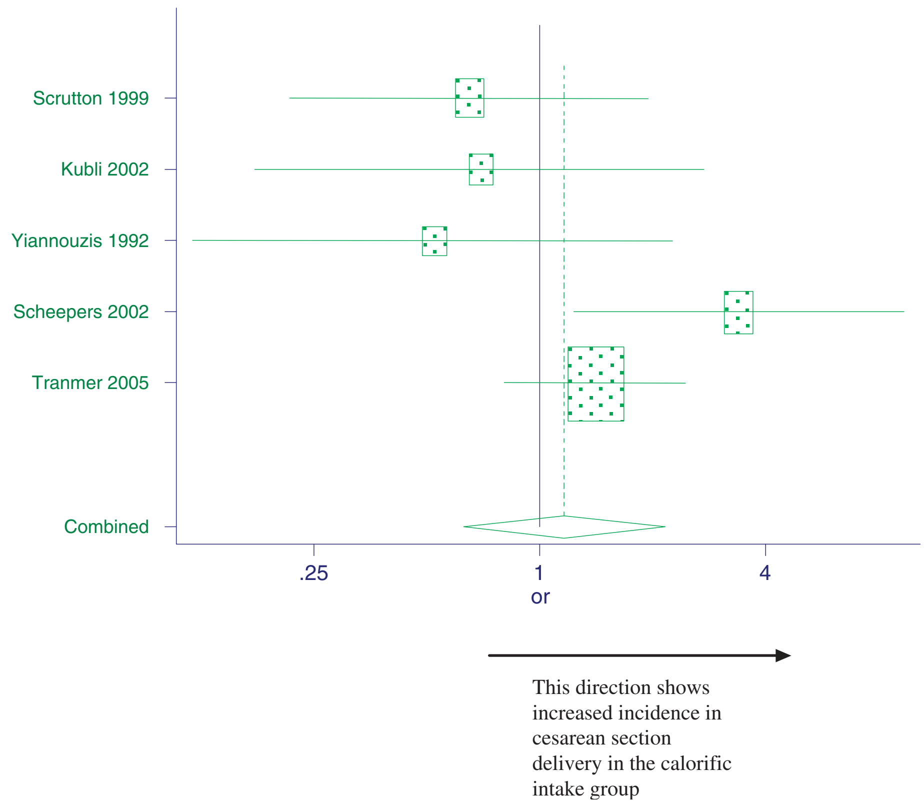

Figure 3. *Combined effects of caloric intake during labor versus noncaloric intake. Outcome: cesarean delivery versus all other delivery types.*

	Treatment	Control
Scrutton 1999	20/45	18/43
Kubli 2002	18/30	18/30
Yiannouzis 1992	135/154	130/143
Scheepers 2002	52/102	56/99
Tranmer 2005	68/162	80/165

Total (95% CI) = 293/493 302/480
Test for Heterogeneity p=0.949
Test for overall effect z = - p=

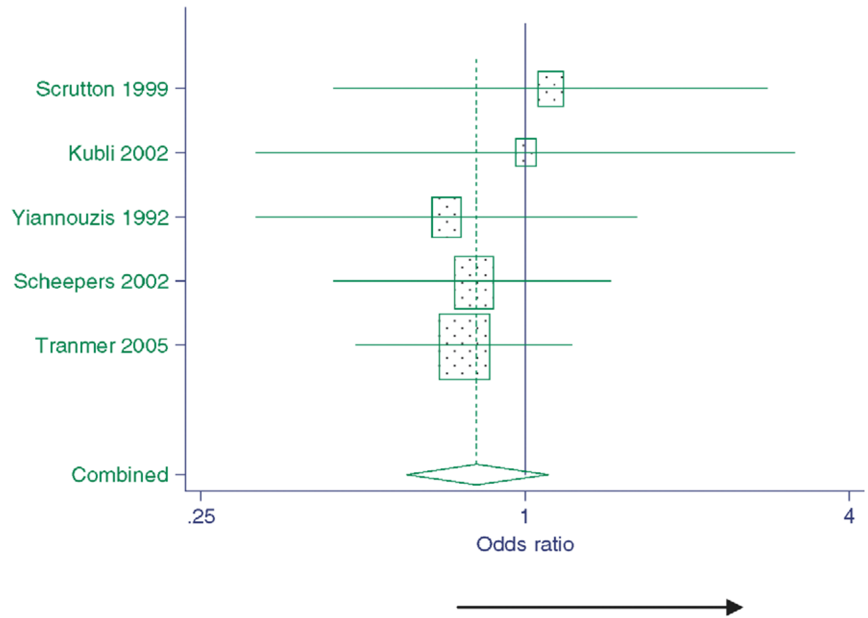

Figure 4. *Combined effects of caloric intake during labor versus noncaloric intake. Outcome: spontaneous delivery versus all other delivery types.*

(95% confidence interval, −0.740 to −0.252; $P = 0.0001$). There was a similar reduction in nonesterified fatty acids.

Caloric intake did not seem to affect the incidence of a low Apgar score (less than 7) at 1 minute or mean umbilical artery pH. Further, there was no change in the use of intrapartum oxytocin. Again, feeding does not seem to be an advantage, although it is difficult to draw firm conclusions from these limited numbers.

■ Summary

The incidence of fatal aspiration pneumonitis in the parturient, related to general anesthesia, is extremely low. Because aspiration is a rare occurrence, there is no data on this outcome from randomized controlled trials. It is unlikely that the low incidence is directly related to a policy of restriction of oral intake during labor although it may be a factor. Although a policy of "nil per os" may be responsible for unnecessary discomfort, there is very little evidence that it causes other harm. Current available studies suggest there is no change in the length of labor, the obstetrical outcome or neonatal outcome when parturients are fasted intrapartum compared with those who are fed.

Clear fluids reverse the biochemical markers associated with fasting and provide some maternal comfort. Until further evidence is available, it is rational to restrict solid foods, but allow clear fluids to promote maternal comfort in labor. Women who wish to eat solid foods during labor should be informed of the known risks and benefits.

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