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ORIGINAL RESEARCH

An Investigation into the Safety of Oral Intake During Labor

Findings from this quantitative retrospective study suggest ad lib intake may have benefits.

Practices regarding the allowance of solid and liquid nutrition for women in labor vary greatly worldwide. In the United States, the practice of restricting oral intake during labor dates back to the 1940s, after Curtis Mendelson published a paper that highlighted the risk of vomiting and aspiration in instances where obstetric anesthesia was required.[1] Mendelson reported a mortality rate of 3%, with later researchers citing rates as high as 33%.[2] Since then, significant advances in obstetric analgesia and anesthesia have made the use of general anesthesia during labor a rare occurrence. Epidural anesthesia and single-dose spinal anesthesia ("spinal block") are now the most common forms, and with these methods the risk of aspiration is much lower.[2] Moreover, even general anesthesia has become safer for women in labor. There is evidence that since the mid-1990s, in women undergoing cesarean section, mortality associated with general anesthesia has become comparable to that seen with regional anesthesia.[3,4] And a recent literature review found that the use of advancements such as rapid sequence induction reduced the risk of aspiration and made general anesthesia much safer for patients in whom regional anesthesia is contraindicated.[4] Yet in keeping with current guidelines, most obstetricians and anesthesiologists in the United States continue to recommend restrictions on oral intake for laboring women, although it's recognized that oral intake of liquids may be safe in uncomplicated cases.[5,6]

There is evidence in the literature to support the relaxation of restrictions on oral intake for laboring women, since outcomes for both mothers and babies are similar regardless of whether the mother consumed solid food or liquid during labor. One randomized controlled trial of 2,426 nulliparous nondiabetic women at term found no difference in outcomes for mothers and newborns between women who were allowed to eat during labor and those who weren't.[7] In a review of randomized controlled trials investigating oral intake in laboring women, Singata and colleagues found no statistically significant differences in obstetric outcomes with respect to delivery type and Apgar scores.[8] And King and colleagues reviewed the literature published between 1988 and 2009 on the practice of allowing or refusing oral nutrition to laboring women and concluded that there was little evidence to support restriction.[9]

Since labor involves rigorous physical exertion and often lasts many hours, restricting a laboring woman to ice chips may lead to ketosis and hyponatremia in both mother and newborn.[10] Enforced fasting during labor may also have psychological ramifications.[11,12] It stands to reason that alleviating a patient's hunger and thirst during labor by allowing oral intake would ease any associated psychological discomfort as well. According to Kolcaba, if a patient's comfort needs are met, the patient will feel a sense of relief and calmness.[13,14]

In recent years, many providers have advocated revisiting restrictions on oral intake. Some have pressed their professional organizations to provide evidence that the practice is warranted.[9] In 2007, the American Society of Anesthesiologists (ASA) Task Force on Obstetric Anesthesia affirmed that "oral intake of clear liquids during labor improves maternal comfort and satisfaction," and noted that "although the ASA members are equivocal, the consultants agree

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ABSTRACT

Purpose: The purpose of this study was to compare the maternal and neonatal outcomes among laboring women permitted ad lib oral intake with those permitted nothing by mouth except for ice chips.

Design: This was a quantitative retrospective observational cross-sectional study.

Sample: The initial data set consisted of all closed medical records for 2,817 women who were admitted to a suburban community hospital in the northeastern United States between January 2008 and December 2012. Some subjects' records were missing either covariate data or outcomes data, resulting in final sample sizes of 2,797 women (for comparison across covariates) and 2,784 women (for comparison across outcomes).

Methods: A deidentified limited data set was extracted from the electronic health record for descriptive and inferential comparisons between groups. Demographics and maternal comorbidities present on admission were compared between groups before data analysis. Outcome comparisons were obtained with traditional between-groups analysis and propensity score matching.

Results: The groups were found to be sufficiently equivalent for comparison. The group permitted nothing by mouth was significantly more likely to have unplanned cesarean section births than the group permitted ad lib oral intake. There were no significant differences in unplanned maternal ICU admissions postpartum, in neonate condition as determined by Apgar scores, or in the need for a higher level of care. Allowing women ad lib oral intake during labor caused no increase in morbidity, and there were no mortalities in either group.

Conclusion: Allowing women ad lib oral intake during labor does not increase adverse maternal or neonatal outcomes. It stands to reason that allowing such intake could increase patient satisfaction. Further study is needed to determine what types of food and drink are most beneficial as well as what types are preferred.

Keywords: childbirth, labor, oral intake

that [such intake] *does not* increase maternal complications."[5] The American College of Nurse-Midwives (ACNM) has recommended that women at low risk for pulmonary aspiration be allowed to self-regulate their oral intake, within the parameters of the practice setting in which they will deliver.[15] The American College of Obstetricians and Gynecologists supports the intake of clear liquids during uncomplicated labor.[6] And a working group of the World Health Organization (WHO) concluded that, absent a valid medical reason, a woman's desire for food or drink during labor should not be discouraged.[16] The group noted that such nourishment helps to replenish the tremendous energy requirements of labor and delivery, and thus can help ensure both fetal and maternal well-being.

According to the ACNM, U.S. hospitals have been more restrictive regarding oral intake during labor than those in Britain, Australia, and the Netherlands.[15] One Dutch study published in 1998 found that 73% of obstetricians left decisions regarding oral intake to the mother.[17] Another study found that, as early as 1991, 96% of hospitals in the United Kingdom allowed some type of oral intake, and of these, 33% allowed liquid and solid intake.[18] In contrast, O'Sullivan and colleagues have reported that in 1988, eating or drinking during labor was allowed in only 2% of U.S. hospitals.[19] (It's unclear what the current percentage might be, since our literature search revealed no more recent data, but we believe it remains low.) Moreover, randomized controlled trials of oral intake during labor have generally restricted participation to women who were at low risk for requiring general anesthesia.[7, 20]

The findings of this study support relaxing the restrictions on oral intake in cases of uncomplicated labor.

Study purpose. The primary objective of this study was to compare maternal and neonatal outcomes among two groups of laboring women: those who were permitted ad lib solid and liquid intake (the ad lib group) and those permitted nothing by mouth—*nil per os* (NPO)—except for ice chips (the NPO group). The secondary objective was to increase the robustness of the findings by using propensity

score estimates to compare matched subjects on maternal and neonatal outcomes of interest.

METHODS

Setting and design. The study setting was a suburban community hospital in the northeastern United States. A quantitative, retrospective, observational, cross-sectional study design was chosen.

At the study site, one practice group of providers allows eating and drinking during labor for all their patients, while four other practice groups do not. Women choose a practice group based on multiple factors, including geographic location, insurance carriers, peer influence, and personal preferences. Each practice group's approach to oral intake during labor is based on the providers' choices, which are beyond our control as researchers. This difference in practice norms, combined with the subjects' self-selection to a practice group, provided us with a natural experimental design (one characterized by indiscriminate assignment to treatment). But we had to consider the potential nonequivalence of the study groups. To test our assumption that the groups were sufficiently equivalent to permit comparison, we conducted traditional between-groups analysis, as well as propensity score matching.

Table 1. Intra- and Postpartum ICD-9 Diagnosis Codes

ICD-9 Code	Description
653.0–653.9	cephalopelvic disproportion
656.0–656.9	fetal or placental complications
659.0	failed mechanical induction
659.1	failed medical induction
659.2	maternal pyrexia
659.3	generalized infection during labor
659.7	fetal heart rate abnormality
659.8–659.9	indications for care or intervention related to labor and delivery
660.0–660.9	obstructed labor
661.0–661.9	abnormality of forces of labor
662.0–662.2	prolonged labor
663.0–663.9	cord complications
664.0–664.9	perineal trauma at delivery
665.0–665.9	obstetrical trauma (including rupture of uterus)
666.0–666.3	postpartum hemorrhage
667.0–667.1	retained placenta
668.0–668.9	complications of obstetric anesthesia
669.0	maternal distress
669.1	shock during labor or delivery
669.2	maternal hypotension
669.3	acute renal failure following delivery
669.4	other complications of obstetrical surgery and procedures
669.5	forceps or vacuum extractor delivery
669.7	cesarean section
669.8–669.9	other complications of labor and delivery

Source: World Health Organization, editor. *International Classification of Diseases, ICD-9-CM*. Geneva, Switzerland; 2005.

Table 2. Antenatal ICD-9 Diagnosis Codes Identified in the NPO and Ad Lib Oral Intake Groups

ICD-9 Code	Description
278.0	obesity, unspecified
649.1	obesity complicating pregnancy, childbirth, or puerperium
642.0–642.9	hypertension
645.0–645.2	post-term pregnancy
646.0–646.9	pregnancy complicated by excessive weight gain, genitourinary and liver complications
648.0–648.9	pregnancy complicated by diabetes, thyroid dysfunction, anemia
657.0	polyhydramnios
658.0–658.9	oligohydramnios, premature rupture of membrane, amnionitis
659.5	elderly primigravida
659.6	elderly multigravida
659.4	grand multiparity

NPO = nothing by mouth except for ice chips.
Source: World Health Organization, editor. *International Classification of Diseases, ICD-9-CM*. Geneva, Switzerland; 2005.

Approval from the hospital's institutional review board was obtained before data collection began.

Sample and data collection. The initial data set consisted of all closed medical records of 2,817 women who presented in labor at the study site during the five-year period from January 1, 2008, through December 31, 2012. The medical records were reviewed and data were extracted by a researcher (one of us, ASL) and an expert in the medical record database system. To protect subjects' privacy, their extracted data were coded with a random number generator. To ensure subjects' anonymity, Health Insurance Portability and Accountability Act (HIPAA) identifiers were not collected. The records review and data extraction occurred during a one-week period in December 2013. A secure data protection plan for data extraction, storage, transfer, analysis, and disposal was followed throughout the study.

Because this was not a randomized controlled trial, we did not exclude women with comorbidities that had been diagnosed during the prenatal period. That said, we did exclude women with conditions that would result in birth by scheduled cesarean section, since this necessitates the patient being permitted nothing by mouth. Excluded subjects' medical records indicated International Statistical Classification of Diseases and Related Health Problems, Ninth Revision (ICD-9), codes 652.0 through 652.9 (fetal malposition); 654.0 through 654.9 (congenital abnormalities of uterus complicating pregnancy); and 641.0 (placenta previa) or 663.5 (vasa previa), or both. The initial sample size was determined by the number of women who were admitted in active labor over the five-year period and did not meet exclusion criteria. Consent to participation in the study was waived, as the research could not have been feasibly carried out if consent had been required.

In this study, allowing laboring women ad lib oral intake did not increase the incidence of adverse outcomes among either mothers or infants.

Variables of interest. The treatment variable of interest had two levels: ad lib oral intake and nothing by mouth except ice chips. Because the aforementioned practice groups follow different protocols for oral intake during labor, women were assigned to one of two treatment groups using physicians' practice codes as a proxy variable. Maternal and neonatal outcomes of interest were type of delivery, maternal disposition postpartum, neonate Apgar scores at one

and five minutes, and admission to neonatal ICU. The outcome data were operationally defined and extracted using intra- and postpartum ICD-9 codes in the medical record (see Table 1).

Although maternal and neonatal outcomes were the primary variables of interest when comparing the two groups, potential confounding variables between the groups were also of interest. These included maternal obesity, hypertension, pregnancy complicated by excessive weight gain, diabetes mellitus, thyroid dysfunction, and anemia. As with the outcome variables of interest, these confounding covariates were operationally defined and extracted using the associated ICD-9 codes in the medical record (see Table 2). To control for potential bias and variability in data extraction, we used predetermined operational definitions of variables, performed data extraction strictly by ICD-9 code presence or absence, and involved the medical records expert in reviewing and extracting the data.

Statistical methods. *Descriptive statistics.* Data were first exported into multiple American Society for Clinical Investigation files and then imported and analyzed using Stata 11 (StataCorp LLC) and IBM SPSS Statistics for Windows, Version 21 software. Principal and secondary ICD-9 codes were used to determine the number of women with comorbidities diagnosed during the prenatal period. ICD-9 codes that indicated intrapartum issues that might result in the need for operative vaginal birth or cesarean section were also considered.

Traditional between-groups analysis, which involves bivariate comparison, was conducted to estimate the "sameness" of potentially confounding covariates and to ensure that the groups were enough alike to permit comparison.

Propensity score matching allows more complex, "real life" multivariate comparison. This method was used to further ensure that the two groups were sufficiently equivalent for comparison. For a brief explanation of between-groups analysis and propensity score matching, see *A Note on Statistical Methods*.[21-26]

RESULTS

Sample. Of the 2,817 women who met the inclusion criteria, 20 (fewer than 1%) were missing some

A Note on Statistical Methods

Traditional between-groups analysis is usually done when study data are observational and researchers want to make comparisons between two treatment groups. The method involves comparing the groups by examining covariates that are hypothesized to influence either treatment assignment or an outcome of interest—in other words, potentially confounding variables. This method can be used to answer questions such as, "Are the two groups of mothers of similar average age?" By comparing the averages and proportions of specific covariates across groups, such analysis allows researchers to deem whether two groups are similar enough for comparison. This is essential before any analysis of outcome variables. If groups lack sufficient equivalence, they should not be compared.

Traditional between-groups analysis is limited to bivariate comparison (such as that of mothers' average ages between groups). It doesn't permit a more complex, "real life" multivariate comparison (such as that of mothers' average ages, babies' average gestational ages, and types of delivery).

Propensity score matching. Multivariate comparison across groups would necessitate taking the profile of each subject in one treatment group and finding her hypothetical counterpart in the second treatment group—someone similar enough on all variables to plausibly represent the first subject as if she had undergone the second treatment. Propensity score matching allows such comparison.

The propensity score has been defined as "the conditional probability of assignment to a particular treatment given a vector of observed covariates."[21] The method involves taking multiple covariates and creating a single covariate—a propensity score—for each subject. For binary treatment options—such as ad lib oral intake versus nothing by mouth during labor—this method allows the two groups to be balanced across a large number of covariates.

That said, the purpose of propensity score matching is not to balance covariates, but rather to determine whether two groups are equivalent.[22] The propensity score is constructed based on the probability that a particular subject will be assigned to a particular treatment group, given all the covariates.[23] Subjects are then matched using their estimated propensity scores, and the outcomes of interest can be compared across individuals and their counterparts in both groups.

Propensity score matching assumes that treatment assignment is ignorable; this assumption is met if all potentially confounding covariates have been considered in the analysis.[21, 24, 25] Furthermore, if the assumption is met, the inference of the analysis can now be considered causal.[26]

Table 3. Between-Group Comparison of Covariates

Covariate	NPO	Ad Lib Oral Intake	*P*[a]
	(n = 1,599)	(n = 1,198)	
Insurance type, n (%)			0.24
Private insurance	634 (40)	443 (37)	
Managed care	712 (45)	599 (50)	
No insurance	127 (8)	84 (7)	
Self-pay	126 (8)	72 (6)	
Average maternal age, mean (SD)[b]	30.5 (5.1)	31.1 (5.1)	0.28
	(n = 1,344)	(n = 1,035)	
Has preexisting medical condition, n (%)	194 (14)	208 (20)	< 0.001[c]

NPO = nothing by mouth except for ice chips.
[a] *P* values are based on χ^2 tests of significance for discrete variables and the independent sample *t* test for continuous variables.
[b] Mean and SD are only reported on continuous variables.
[c] Indicates significance at $P \leq 0.05$.

covariate data, resulting in a sample size of 2,797 women for comparison across covariates. Of that original sample of 2,817 women, 33 (1%) were missing some of the outcome variables of interest, resulting in a sample size of 2,784 women who were included in the traditional between-groups analysis and propensity score matching.

Statistics. *Descriptive statistics.* The women in the two groups were predominantly white (94%). The average age in both groups was 31 years. A majority in both the NPO and the ad lib groups carried managed care (non-Medicaid) or private insurance (85% and 87%, respectively). A majority in both the NPO and ad lib groups had no preexisting medical conditions that complicated pregnancy (86% and 80%, respectively).

Traditional between-groups analysis. The data were analyzed to determine whether the specified outcomes differed for the women in the ad lib group (n = 1,198) compared with those in the NPO group (n = 1,599). (Because not all data were available for all subjects, some calculations were based on slightly smaller group sizes.) The data analysis indicated there were no significant between-group differences in average maternal age or insurance type. There was a statistically significant between-group difference in medical conditions that were diagnosed in the prenatal period. Of the 2,379 women for whom these data were available, 14% in the NPO group and 20% in the ad lib group had a medical condition complicating pregnancy that was identified prenatally. (See Table 3.)

Although the women in the NPO group started out with fewer such complications, data analysis revealed that they had a significantly higher incidence of intrapartum complications than those in the ad lib group. They were also significantly more likely to give birth via cesarean section than women in the ad lib group (see Table 4). There was no significant difference between the groups regarding postpartum disposition of mothers to a higher level of care. There was also no significant difference in neonatal outcomes as measured by Apgar score (see Table 5). Allowing women ad lib oral intake during labor caused no increase in morbidity, and there were no mortalities in either group.

Table 4. Maternal Outcomes Comparison Between NPO and Ad Lib Oral Intake Groups

Covariate	χ^2	*P*[a]
Forceps birth	0.032	0.86
Unplanned cesarean birth	13.39	< 0.001[b]
Intrapartum complicating diagnoses	9.52	0.002[b]

NPO = nothing by mouth except for ice chips.
[a] *P* values are based on χ^2 tests of significance for discrete variables.
[b] Indicates significance at $P \leq 0.05$.

Table 5. Neonatal Outcomes Comparison Between NPO and Ad Lib Oral Intake Groups

Covariate	*t*	*P*[a]
Apgar 1 minute	0.94	0.107
Apgar 5 minute	1.28	0.2

NPO = nothing by mouth except for ice chips.
[a] *P* values are based on independent sample *t* tests of significance for continuous variables.

Propensity score matching. Using a matching-with-replacement technique, the propensity score analysis yielded equivalent matches for women in both groups for the entire sample (see Figure 1). Propensity score estimates indicated that the probability of being assigned to the ad lib group was about 0.43 (43%), confirming near-equivalence of assignment to treatment. Differences in outcomes of interest were essentially unchanged from those identified using traditional between-groups analysis.

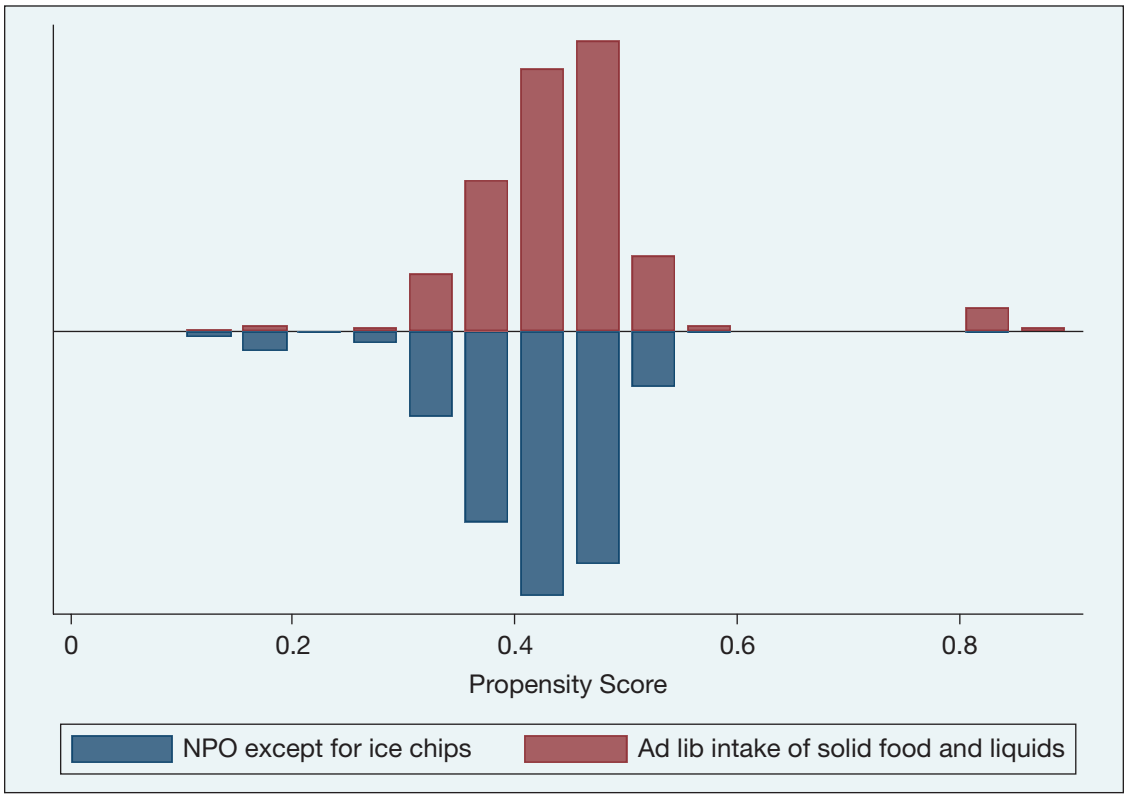
DISCUSSION

In this study, allowing laboring women ad lib oral intake did not increase the incidence of adverse outcomes among either mothers or infants. Our findings support permitting women who are at low risk for an operative birth to self-regulate their intake of both solid food and liquids during labor. This conclusion is consistent with those of earlier published reports.[7-9]

Furthermore, as noted earlier, the practice of allowing laboring women ad lib oral intake is supported by both the ACNM[15] and the WHO.[16] Yet in its most recent guideline (issued jointly with the Society for Obstetric Anesthesia and Perinatology), the ASA continues to recommend that women in labor avoid solid food, stating that there is insufficient evidence "to address the safety of *any* particular fasting period for solids" in these patients.[27] We believe that our findings support changing this recommendation.

Limitations. Because the study was observational with a naturally occurring experimental design, there was a lack of random assignment to treatment level (ad lib oral intake or nothing by mouth during labor), which limited causal inference from the findings. As noted earlier, women choose obstetric providers based on various factors, resulting in nonpredictive allocation to a practice group, and this was outside our control. We were unable to discern whether any of our subjects selected their provider based on that provider's philosophy regarding nourishment during labor. However, by using traditional between-groups analysis

Figure 1. Propensity Score Matching between the NPO and Ad Lib Oral Intake Groups



and propensity score matching, we were able to support the assumption of equivalence of the two groups. The untestable assumption made in propensity score matching (or matching of any sort) is that all potential confounding covariates have been considered in the analysis. Still, this methodology allowed for more robust causal inference than would have been plausible otherwise.

As this was a retrospective closed chart review, subjects' adherence to dietary restrictions during labor was not observed by investigators. This poses a threat to the validity of our findings, since we could not control for adherence to treatment level. Lastly, regarding the ad lib group, amounts of oral intake were not extracted from the data set, so variations in patient profiles and in complications associated with varying amounts of ad lib intake could not be determined.

CONCLUSION

Many women enter the hospital in spontaneous labor after eating a full meal. None are denied an epidural if requested or an emergent cesarean section if warranted. Yet if a woman is admitted to the hospital for cervical ripening or labor induction, she is often denied oral intake despite the often long and grueling process of labor and delivery. Restricting oral intake to a laboring woman who is hungry or thirsty may intensify her stress. Conversely, allowing her to eat and drink ad lib during labor can contribute to both her comfort and her sense of autonomy. The findings of this study support relaxing the restrictions on oral intake in cases of uncomplicated labor. Further study is needed to determine what types of food and drink are most beneficial in labor. ▼

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