ABSTRACT

BACKGROUND AND OBJECTIVES: Little is known about the effect of circumcision on breastfeeding in the hours and days after the procedure. Factors with the potential to negatively impact breastfeeding success in the newborn period may result in higher rates of jaundice requiring phototherapy and formula supplementation, both of which can potentially extend the length of initial hospitalization. Our objective was to determine the impact of circumcision on rates of exclusive breastfeeding, neonatal jaundice requiring phototherapy, and length of stay at hospital discharge immediately after birth.

METHODS: Term male newborn infants whose mothers intended to exclusively breastfeed were included in this retrospective cohort. Bivariate analysis and multivariate logistic regression modeling were used to evaluate target behaviors, comparing infant boys who were circumcised with those who were uncircumcised.

RESULTS: Of the 1109 breastfed male newborns included, 846 (76.6%) were circumcised. There was no significant effect of circumcision status or circumcision timing on the rate of in-hospital formula supplementation. There were no differences in peak bilirubin levels, phototherapy requirement, or length of hospital stay for male newborns based on circumcision status.

CONCLUSIONS: Circumcision did not affect the rate of exclusive breastfeeding, neonatal jaundice, phototherapy requirement, or length of hospital stay in this retrospective analysis of breastfed male newborns.
Neonatal circumcision is a common procedure worldwide and is performed on ~59% of newborn male infants in the United States.1–4 There are many opinions about the effect of circumcision on the feeding patterns of newborn boys and the consequent impact on rates of neonatal weight loss, jaundice, and exclusive breastfeeding during the hospital stay immediately after birth.6–8 Many contend that circumcised newborns are more fussy and feed poorly in the 12 hours after the procedure, creating challenges in establishing effective breastfeeding in the mother-infant dyad.9–11 These beliefs inform decisions by clinicians about the timing of circumcision.4

The current literature does not provide clarity on the impact of circumcision on exclusive breastfeeding and neonatal jaundice. Existing studies have examined whether circumcision and its timing impacted the volume of formula consumed in the days14 and weeks postprocedure15 and whether pain mitigation (acetaminophen and anesthetic interventions) influenced feeding behaviors at discharge and in the weeks later.15–17

The benefits of exclusive breast milk feeds and breastfeeding in newborn infants are beyond dispute.18,19 Feeding patterns, particularly exclusive breastfeeding during the first few days of infant life in the hospital, are critical in determining if mothers continue to exclusively breastfeed.20–22 Physiologic jaundice is more common among breastfed newborns, and problems related to breastfeeding may exacerbate this situation, thereby increasing the need for phototherapy.23 The Joint Commission created a set of 5 Perinatal Care Core Measures, 1 of which tracks exclusive breast milk feeding (perinatal care measure of exclusive breast milk feeding),24 which includes expressed mother’s milk and donor human milk as well as feeding at the breast.25 An increase in formula supplementation, if related to the effects of circumcision, would conceivably have a significant negative impact on exclusive breastfeeding during this critical time, which would be reflected in core measure PC-05.25

The primary aim in this study was to evaluate whether newborn circumcision influences the rate of exclusive breastfeeding before hospital discharge in healthy term male newborns. A secondary aim was to evaluate the association of circumcision with neonatal jaundice and hospital length of stay.

METHODS
We conducted this single-center retrospective cohort study at a 230-bed, independent community hospital in the Northeastern United States with a level II nursery staffed by pediatricians and advanced practice practitioners. It averages 1100 deliveries annually, has been designated as a Baby-Friendly Hospital by Baby-Friendly USA, and has achieved Magnet Recognition Program designation for nursing excellence. Routine newborn care was provided by hospital-employed and private pediatricians as well as faculty and residents from the hospital’s family medicine residency program. We studied all healthy newborn infants who were born between June 1, 2012, and November 30, 2015, at ≥37 weeks’ gestation to mothers who intended to exclusively breastfeed at the time of birth. Exclusion criteria included mother’s choice to formula feed, gestational age <37 completed weeks, and admission to the special care nursery. We electronically abstracted maternal and infant demographic and clinical data from hospital medical records and manually reviewed data for accuracy.

Male infants were circumcised in a consistent manner by pediatricians or family physicians using either Gomco or Plastibell methods. Parents were encouraged to feed their newborn within 1 to 2 hours before circumcision.

Strategies to control pain routinely employed included (1) administering 0.5 to 2 mL of an oral 24% sucrose solution before and during the procedure, (2) local anesthesia with lidocaine 1% administered either by local infiltration of the foreskin or with a dorsal penile nerve block, (3) swaddling the infant on a cushioned restraint device, (4) sucking on an attendant’s gloved finger throughout the procedure. Most providers at that time also provided acetaminophen at a single dose of 15 mg/kg.

We used the following definitions to categorize the study variables: gestational age is completed weeks’ gestation based on best obstetric estimates, supplementation is the use of any formula in a breastfeeding infant, peak bilirubin level is the highest level of total bilirubin (serum or transcutaneous) available in the infant’s medical record during the initial hospital stay before discharge, and race and ethnicity are based on the mother’s recorded race or ethnicity.

We employed univariate comparisons of circumcision status by maternal and infant demographics and clinical data using χ² tests for categorical variables or Student’s t tests for continuous variables. Similarly, we performed univariate analyses for supplementation status to identify factors that lead to increased supplementation. We performed a multivariable logistic regression analysis to address the question of whether circumcision status had an effect on supplementation rates (outcome), adjusting for independent risk factors identified in the univariate analysis (P < .1). The Hosmer-Lemeshow goodness-of-fit test evaluated how satisfactorily the final model fit these data. We excluded infants with missing data from analysis of only the particular variable that was missing but included them in analyses of other variables for which their data were available.

On the basis of the 76% circumcision rate and an 18% supplementation rate, the sample size of 1109 boys provided >80% power for an α of .05. We used SPSS version 24.0 (IBM SPSS Statistics, IBM Corporation). All P values were 2 sided, and significance was set at α < .05. Middlesex Health Institutional Review Board approved the study.

RESULTS
Study Population
A total of 2890 infants were born during the period of study. After excluding infants <37 weeks’ gestation, formula-fed infants, and those admitted to the special care nursery, there were 2250 term infants who were breastfed per the mother’s choice. There were 1141 female and 1109 male newborns. Of the 1109 male breastfeeding
infants >37 weeks’ gestation, 846 (76.6%) were circumcised and 263 (23.4%) remained uncircumcised before hospital discharge (Fig 1).

Maternal-Infant Characteristics and Circumcision Status in Boys
Maternal and infant characteristics were stratified by the circumcision status of the infant (Table 1). Infants of white mothers were more likely to be circumcised relative to infants of nonwhite mothers (79% vs 65%; *P* < .001). Likewise, infants who were cared for by private physicians were more likely to be circumcised (81% vs 72%; *P* < .002). The mean maternal age of circumcised infants was lower (30.6 ± 4.8 years versus 31.4 ± 5.1 years; *P* = .02). Timing of circumcision by private providers versus hospitalists was not different (45.6 ± 20.6 hours versus 49.4 ± 51.5 hours; *P* = .28). No significant differences were observed in circumcision status by maternal epidural status and delivery mode.

On multiple logistic regression analysis, incorporating all the above variables (Table 2), nonwhite maternal race, maternal age >30 years, and care under a hospital physician showed significant association with the decision not to circumcise, whereas cesarean delivery and epidural analgesia showed no significant relationship. Of the circumcised infants, 51% were circumcised at ≤24 hours of age, 64% were circumcised at ≤36 hours of age, and 96% were circumcised at ≤48 hours of age. The most common time for circumcision was between 24 and 48 hours of age.

Infant Outcomes and Circumcision Status
There were no differences in exclusive breastfeeding rates among male newborns who were circumcised (84%) versus not (84%) or even among female newborns (84%) (Table 1). The need for phototherapy, infant length of stay, peak bilirubin level, and mode of delivery were not affected by circumcision status.

Circumcision and Hyperbilirubinemia
The timing of measurement of bilirubin during the birth stay was similar among circumcised and uncircumcised infants. Peak bilirubin level in milligrams per deciliter was similar in circumcised (mean 7.85 ± 2.77) versus uncircumcised boys (7.95 ± 2.62; *P* = .82). There were 23 (of 739) male newborns who received phototherapy in the circumcised group versus 9 (of 231) in the uncircumcised group (*P* = .56). Breastfeeding exclusivity rates and length of stay were also similar for both groups. There was no significant relationship between the timing of circumcision and need for phototherapy during the birth hospitalization. It was not possible to evaluate the rate of jaundice requiring phototherapy after discharge because not all newborns were readmitted to our institution. Infants who received phototherapy were circumcised at a mean of 50.41 ± 33.41 hours, and those who never required phototherapy were circumcised at a mean of 46.87 ± 41.63 hours (*P* = .665).

Breastfeeding Exclusivity Measured by Supplementation
Formula supplementation occurred most frequently during the first 36 to 48 hours after birth with a decline soon after that period (Table 3). The rate of exclusive

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**FIGURE 1** Derivation of the study cohort and the distribution of various study groups that were analyzed, excluding those <37 weeks’ gestation or admitted to the special care nursery.
breastfeeding was higher among infants of white mothers (740 of 841; 85%) compared with nonwhite mothers (189 of 238; 79%), which was statistically significant (P = .04). There was no difference in the rate of breastfeeding exclusivity among infants who were managed by private physicians and those who were managed by hospital-employed physicians, who often delayed circumcision. Nonexclusivity of breastfeeding, identified by supplementation use, was more commonly associated with cesarean delivery, higher peak bilirubin levels, longer length of stay, and need for phototherapy.

**Multivariate Analyses of Factors Associated With Supplementation**

In multiple logistic regression analysis incorporating the influences of covariates that were significant at 0.1 or less in the bivariate analyses, we found that maternal race was a strong predictor of nonexclusive breastfeeding regardless of circumcision status (Table 4). Use of epidural analgesia and cesarean delivery were both significantly associated with decreased exclusive breastfeeding that manifested as increased formula supplementation use.

**DISCUSSION**

Our study found that newborn circumcision was not associated with lower rates of exclusive breastfeeding during the initial hospitalization. It is important to characterize this relationship because early feeding patterns are known to predict future infant feeding behavior. It has been previously reported that circumcision does not affect the feeding behavior of formula-fed infants. More recently, Mondzelewski et al examined the impact of circumcision on breastfeeding exclusivity in male newborns at hospital discharge and 2 subsequent newborn visits. Our data are consistent with Mondzelewski et al’s finding that circumcision did not adversely affect breastfeeding exclusivity at the time of hospital discharge. This work is unique in that it directly compares rates of exclusive breastfeeding and related outcomes for circumcised male newborns to a control group of uncircumcised male infants throughout the critical first few days of the birth hospitalization. This suggests that recommendations to delay circumcision until after hospital discharge or to perform the procedure at specific times will likely not improve rates of exclusive breastfeeding. Our study also explored the timing of circumcision and its relationship to when formula was provided and found no significant correlation. Formula supplementation is initiated for many reasons and varies by medical provider; however, the rationale for intervention would likely be the same in each of our large cohorts, and thus, we did not explore the specific reasons prompting each decision.

The effect of circumcision on neonatal jaundice has not previously been reported for newborn male infants in the United States. A Turkish study of 40 infants found that circumcision performed on day 2 of life did not significantly impact infant feeding behavior on day 3 or bilirubin levels by day 4 of life. Similarly, our study, with its larger sample of breastfeeding infants, demonstrated that circumcision had no significant impact on peak bilirubin levels or need for phototherapy.

It is widely appreciated that race and ethnicity play important roles in parental decisions about circumcision and in the mother’s choice regarding breastfeeding. However, the interactions of race, ethnicity, circumcision, and breastfeeding have not been explored. A recent study from the Eunice Kennedy Shriver National Institute of Child Health and Human Development in the United States...

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**TABLE 1** Characteristics of Male Newborn Infants With and Without Circumcision (N = 1109)

<table>
<thead>
<tr>
<th>Maternal variable</th>
<th>No Circumcision (N = 263)</th>
<th>Circumcision (N = 846)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>179 (21)</td>
<td>692 (78)</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>84 (35)</td>
<td>154 (65)</td>
<td>&lt;.001*</td>
</tr>
<tr>
<td>Epidural, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cesarean delivery, n (%)</td>
<td>91 (35)</td>
<td>343 (41)</td>
<td>.08*</td>
</tr>
<tr>
<td>Maternal age, y, mean ± SD</td>
<td>31.4 ± 5.1</td>
<td>30.6 ± 4.8</td>
<td>.02*</td>
</tr>
<tr>
<td>Infant variable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestational age at birth, wk, mean ± SD</td>
<td>39.5 ± 1.3</td>
<td>39.4 ± 1.2</td>
<td>.36*</td>
</tr>
<tr>
<td>Formula supplementation, n (%)</td>
<td>43 (16)</td>
<td>137 (16)</td>
<td>.95*</td>
</tr>
<tr>
<td>Phototherapy need (data from 970 infants), n (%)</td>
<td>9 (4)</td>
<td>23 (5)</td>
<td>.56*</td>
</tr>
<tr>
<td>Peak bilirubin, mg/dL, mean ± SD</td>
<td>7.95 ± 2.82</td>
<td>7.85 ± 2.77</td>
<td>.92*</td>
</tr>
<tr>
<td>Length of stay, h, mean ± SD</td>
<td>53.8 ± 16.5</td>
<td>54.5 ± 17.7</td>
<td>.55*</td>
</tr>
</tbody>
</table>

*Generated from a χ² test.  
*Generated from a Student’s t test.

---

**TABLE 2** Multiple Logistic Regression Analysis: Circumcision and Its Correlates in Newborn Boys (N = 832)

<table>
<thead>
<tr>
<th>Variable (reference)</th>
<th>OR (95% CI)*</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplementation (yes)</td>
<td>0.90 (0.59–1.38)</td>
<td>.63</td>
</tr>
<tr>
<td>Maternal age &gt;30 y</td>
<td>0.70 (0.50–0.99)</td>
<td>.04</td>
</tr>
<tr>
<td>Maternal race (nonwhite)</td>
<td>0.56 (0.38–0.81)</td>
<td>.002</td>
</tr>
<tr>
<td>Epidural no (yes)</td>
<td>1.21 (0.86–1.71)</td>
<td>.27</td>
</tr>
<tr>
<td>Cesarean delivery (yes)</td>
<td>1.30 (0.91–1.85)</td>
<td>.15</td>
</tr>
<tr>
<td>Hospital physician</td>
<td>0.60 (0.43–0.85)</td>
<td>.004</td>
</tr>
</tbody>
</table>

CI, confidence interval; OR, odds ratio.  
*OR >1.0 indicates increased odds of in-hospital supplementation.
highlighted racial and ethnic factors that influence breastfeeding rates.\textsuperscript{30} Circumcision rates also vary with race and ethnicity.\textsuperscript{31} In exploring the effect of circumcision on breastfeeding and need for formula supplementation in different racial groups, we found that maternal race predicts the likelihood of formula use regardless of circumcision status when adjusted for other variables. We found that nonwhite infants (comprised of 37% Latino, 28% African American, 22% Asian American, and 13% other) were more likely to receive formula compared with white newborns. The percentage of nonwhite newborns in our sample whose mothers chose to breastfeed was small, and given that our population was predominantly white, our findings require validation in a larger, more diverse population.

It is plausible that maternal pain and comfort status may influence a mother’s breastfeeding ability and confound the findings in terms of exclusive breastfeeding rates. The use of epidural analgesia for labor has previously been shown to impact breastfeeding practices.\textsuperscript{32} Instrumented or surgical modes of delivery may also influence the establishment of breastfeeding and may be another confounding factor in evaluating the use of formula supplementation in newborns.\textsuperscript{33}

To our knowledge, this is the first study to focus on the relationships between newborn circumcision and exclusive breastfeeding during the first few days of life before initial hospital discharge. Our results complement those of previous studies that examine these relationships at the time of hospital discharge and in the first few weeks of life. We believe that our work makes an important contribution to the understanding of this issue by providing objective findings that inform the discussion of how best to achieve higher rates of exclusive breastfeeding in the first few days after delivery. Our findings have implications for newborn care providers, lactation consultants, and nurses who develop nursery policies and protocols. Our study suggests that hospitals who are seeking to help mothers increase breastfeeding exclusivity, which is reflected by improvement in The Joint Commission’s core measure PC-03 scores, may be better served by enhancing strategies to support mothers, especially those giving birth by cesarean delivery or with epidural anesthesia, than attempting to change circumcision practices.

### TABLE 3

Characteristics of Male Infants With and Without Formula Supplementation ($N = 1109$)

<table>
<thead>
<tr>
<th>Maternal variable</th>
<th>No Supplementation ($N = 929$)</th>
<th>Supplemented ($N = 180$)</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race, $n$ (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>740 (80)</td>
<td>131 (73)</td>
<td>.040\textsuperscript{a}</td>
</tr>
<tr>
<td>Nonwhite</td>
<td>189 (20)</td>
<td>49 (27)</td>
<td></td>
</tr>
<tr>
<td>Epidural, $n$ (%)</td>
<td>352 (38)</td>
<td>82 (46)</td>
<td>.055\textsuperscript{a}</td>
</tr>
<tr>
<td>Cesarean delivery, $n$ (%)</td>
<td>271 (29)</td>
<td>79 (44)</td>
<td>.0001\textsuperscript{a}</td>
</tr>
<tr>
<td>Maternal age, y, mean $\pm$ SD</td>
<td>30.7 $\pm$ 4.8</td>
<td>31.3 $\pm$ 5</td>
<td>.114\textsuperscript{a}</td>
</tr>
<tr>
<td>Infant variable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gestational age at birth, wk, mean $\pm$ SD</td>
<td>39.5 $\pm$ 1.2</td>
<td>38.3 $\pm$ 1.2</td>
<td>.105</td>
</tr>
<tr>
<td>Hour of life circumcised, mean $\pm$ SD</td>
<td>45.97 $\pm$ 39.4</td>
<td>52.98 $\pm$ 36.7</td>
<td>.064</td>
</tr>
<tr>
<td>Hospital-based treating physician\textsuperscript{c}</td>
<td>471 (63)</td>
<td>96 (64)</td>
<td>.750</td>
</tr>
<tr>
<td>Phototherapy need, $n$ (%)</td>
<td>21 (3)</td>
<td>11 (7)</td>
<td>.005\textsuperscript{a}</td>
</tr>
<tr>
<td>Peak bilirubin, mg/dL, mean $\pm$ SD</td>
<td>7.65 $\pm$ 2.6</td>
<td>8.91 $\pm$ 3.4</td>
<td>.0001\textsuperscript{a}</td>
</tr>
<tr>
<td>Length of stay, h, mean $\pm$ SD</td>
<td>52.9 $\pm$ 16.5</td>
<td>61.9 $\pm$ 19.7</td>
<td>.0001\textsuperscript{a}</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Generated from a $\chi^2$ test.
\textsuperscript{b} Generated from a Student’s $t$ test.
\textsuperscript{c} Missing $n = 213$.

Comparisons were made only among 832 infants from a total of 1109 male infants because of missing data. CI, confidence interval; OR, odds ratio.

\textsuperscript{a} OR $>1.0$ indicates increased odds of in-hospital supplementation.

### TABLE 4

Multiple Logistic Regression Analysis: Predictors of Formula Supplementation in Male Infants

<table>
<thead>
<tr>
<th>Variable (reference)</th>
<th>OR (95% CI)$^a$</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circumcision (yes)</td>
<td>0.89 (0.58–1.37)</td>
<td>.60</td>
</tr>
<tr>
<td>Maternal age $&gt;30$ y</td>
<td>1.42 (0.94–2.13)</td>
<td>.09</td>
</tr>
<tr>
<td>Maternal race (nonwhite)</td>
<td>1.64 (1.07–2.54)</td>
<td>.02</td>
</tr>
<tr>
<td>Epidural (yes)</td>
<td>1.75 (1.18–2.61)</td>
<td>.006</td>
</tr>
<tr>
<td>Cesarean delivery (yes)</td>
<td>2.19 (1.48–3.24)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Private pediatric physician</td>
<td>1.14 (0.77–1.70)</td>
<td>.51</td>
</tr>
</tbody>
</table>

$^a$ Generated from a logistic regression model.
A potential confounder exists in the relationship between circumcision timing and early breastfeeding difficulties. Interestingly, part of the impetus for this study was that infants with private physicians were routinely circumcised in the morning regardless of perceived feeding difficulties, whereas hospital-based physicians were more likely to delay the procedure until later in the day. However, our analysis found that there was no significant difference in the mean time of circumcision between the groups and, likewise, no difference in the rates of exclusive breastfeeding.

The strengths of this study include a sample of 1108 term male newborns born over a 2-year period at a single community birthing hospital. Data extraction from the electronic hospital record yielded findings that are representative of the population at this institution, where newborns were cared for by private pediatricians, pediatric hospitalists, family medicine faculty, and residents. The fact that our findings validate those from previous studies strengthens their utility.

Our study had several limitations. Missing data values for source of pediatric hospital care (19.2%) and phototherapy status (12.5%) may have systematically biased our observed results. Additionally, the study is limited in that it is retrospective and was conducted at a single community hospital in an area where the population is predominantly white, limiting the generalizability of our findings. Larger studies that include urban populations and greater ethnic diversity are needed to more definitively characterize the impact of circumcision on exclusive breastfeeding practices and the consequences of poor feeding. We did not explore other potential confounding factors, such as maternal parity, strength of breastfeeding intent, or perceived support of breastfeeding by parents and hospital staff. Further studies are needed to understand the impact of these important factors.

CONCLUSIONS

Circumcision did not adversely influence rates of exclusive breastfeeding, neonatal hyperbilirubinemia, phototherapy, or newborn hospital length of stay in this retrospective analysis of term male newborns whose mothers planned to exclusively breastfeed. Hospitals working to assist mothers who intend to exclusively breastfeed may be better served by enhancing processes and services that support lactation in the critical first few days of life rather than focusing on changing circumcision practices.

Acknowledgments

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The Effect of Circumcision on Exclusive Breastfeeding, Phototherapy, and Hospital Length of Stay in Term Breastfed Newborns
Cliff O’Callahan, Silena Te, Aaftab Husain, Stephanie E. Rosener and Naveed Hussain

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