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ORIGINAL RESEARCH ARTICLE

Perinatal mortality and neonatal and maternal outcome per gestational week in term pregnancies: A registry-based study

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Abstract

Introduction: Human pregnancy is considered term from 37+0/7 to 41+6/7 weeks. Within this range, both maternal, fetal and neonatal risks may vary considerably. This study investigates how gestational age per week is related to the components of perinatal mortality and parameters of adverse neonatal and maternal outcome at term.

Material and Methods: A registry-based study was made of all singleton term pregnancies in the Netherlands from January 2014 to December 2017. Stillbirth and early neonatal mortality, as components of perinatal mortality, were defined as primary outcomes; adverse neonatal and maternal events as secondary outcomes. Neonatal adverse outcomes included birth trauma, 5-minute Apgar score ≤3, asphyxia, respiratory insufficiency, neonatal intensive care unit admission and composite neonatal outcome. Maternal adverse outcomes included instrumental vaginal birth, emergency cesarean section, obstetric anal sphincter injury, postpartum hemorrhage, hypertensive disorders of pregnancy and composite maternal outcome. The primary outcomes were evaluated by comparing weekly prospective risks of stillbirth and neonatal death using a fetuses-at-risk approach. Secondly, odds ratios (OR) for perinatal mortality, adverse neonatal and maternal outcome using a births-based approach were compared for each gestational week with all births occurring after that week.

Results: Data of 581 443 births were analyzed. At 37, 38, 39, 40, 41 and 42 weeks, the respective weekly prospective risks of stillbirth were 0.015%, 0.022%, 0.031%, 0.036%, 0.069% and 0.081%; the respective weekly prospective risks of early neonatal death were 0.051%, 0.047%, 0.032%, 0.031%, 0.039% and 0.035%. The OR for adverse neonatal outcomes were the lowest at 39 and 40 weeks. The OR for adverse maternal outcomes, including operative birth, continuously increased with each gestational week.

Abbreviations: ACOG, American College of Obstetricians and Gynecologists; CI, confidence interval; ID, instrumental vaginal delivery; NICU, neonatal intensive care unit; OR, odds ratios; OASIS, obstetric anal sphincter injury; SGA, small for gestational age.

Conclusions: The prospective risk of early neonatal death for babies born at 39 weeks is lower than the risk of stillbirth in pregnancies continuing beyond 39+6/7 weeks. Birth at 39 weeks was associated with the best combined neonatal and maternal outcome, fewer operative births and fewer maternal and neonatal adverse outcomes compared with pregnancies continuing beyond 39 weeks. This information with appropriate perspectives should be included when counseling term pregnant women.

KEYWORDS
adverse maternal outcome, adverse neonatal outcome, perinatal mortality, stillbirth; neonatal death, term birth

1 | INTRODUCTION

Human pregnancy is considered term from 37+0/7 to 41+6/7 weeks. Within this range, maternal, fetal and neonatal risks vary considerably. In apparently uncomplicated term pregnancies, risks of maternal, fetal or neonatal complications are considered low. Traditionally, spontaneous onset of labor is awaited with regular obstetric controls. This policy of expectant management was believed to be associated with the highest probability of vaginal birth, the lowest risk of intervention, the best maternal and neonatal outcomes, and greater women's satisfaction. Induction of labor or planned cesarean section is only performed on indication; ie when maternal or fetal risks of expectant management are believed to outweigh the risks of these interventions.

Recent findings have challenged this physiologic approach to childbirth.[1] In pregnancies complicated by hypertension, diabetes, growth restriction or macrosomia, induction of labor between 37+0/7 and 39+6/7 weeks seems to improve maternal and/or neonatal outcome without an increase in obstetric interventions.[2–4] In uncomplicated late-term pregnancies, the Dutch INDEX trial showed a reduction in adverse perinatal outcome after induction at 41 weeks, but a Swedish trial was ended prematurely due to increased intrauterine deaths with expectant management.[5–7] In uncomplicated full-term pregnancies, several trials have shown benefits of elective induction at 39 weeks when compared with expectant management.[8–11] The recently published ARRIVE Trial showed fewer cesarean sections and hypertensive complications and increased women's satisfaction after induction at 39+0–4/7 weeks in nulliparous American women.[10] A subsequent meta-analysis also showed a reduction in adverse neonatal outcomes after induction at 39 weeks.[9] In a large Scottish population-based study, elective induction was associated with decreased odds of perinatal mortality.[11] A meta-analysis including more than 15 million pregnancies showed an increasing risk of stillbirth from 40 weeks of gestation, greater than the risk of neonatal death.[12] Even in high-income countries where the perinatal death rate in apparently uncomplicated term pregnancies seems low, perinatal mortality can still be improved.[13–16]

Despite all evolutions in perinatal care, one of the most fundamental obstetric questions remains unanswered: "What is the optimal time to deliver?" Simply evaluating the benefits over the harms is complicated, as several, and sometimes conflicting, maternal, fetal and neonatal outcomes have to be considered. Many of these outcomes, such as stillbirth, early neonatal mortality, perinatal asphyxia, and maternal anal sphincter lesions, have a low prevalence but a tremendous impact. It is difficult to achieve enough power to address all important outcomes.[9,14] Sufficiently large cohort studies allow the simultaneous investigation of multiple and rare outcomes. To gain more insight into the optimal time to deliver, we investigated whether and how gestational age at term is related to the components of perinatal mortality and to parameters of neonatal and maternal adverse outcome, using data from the Netherlands birth registry.

Key message

The risk of stillbirth increases with advancing gestation. We assessed the risk of adverse maternal and neonatal outcomes per gestational week in term singleton pregnancies. Birth at 39 weeks is associated with lower numbers of maternal and neonatal adverse outcomes.

2 | MATERIAL AND METHODS

This is a registry study comparing components of perinatal mortality and parameters of neonatal and maternal morbidity per gestational week in term singleton pregnancies in the Netherlands.

The Netherlands is a high-income country with approximatively 178 000 births/year. There is one uniform perinatal healthcare system, which is described in Appendix S1. Data on pregnancy, birth and neonatal outcomes of all pregnancies beyond 22 weeks of gestation are routinely collected prospectively by midwives, gynecologists and pediatricians and stored in the national Perined registry, which contains information on 99% of all births in the Netherlands. A detailed description of the linkage procedures can be found on the Perined website (www.perined.nl). Data on all registered births between January 2014 and December 2017 were obtained from the Perined registry. Singleton pregnancies with a fetus born in cephalic presentation between 37+0/7 and 44+6/7 weeks of gestation were included. Neonates with congenital abnormalities were excluded.

2.1 | Outcome measures

The components of perinatal mortality encompassing stillbirth (fetal: antepartum and intrapartum) and early neonatal mortality (from birth up to 7 days postpartum) were defined as primary outcomes.[17]

Secondary outcomes included neonatal and maternal adverse outcomes. Neonatal adverse outcomes included birth trauma (subdural, subarachnoid or other hemorrhage, tentorial tear, paralysis/paresis [plexus lesions] or other birth trauma), 5-minute Apgar score (5′-Apgar) ≤3, perinatal asphyxia (based on the presence of several or all American College of Obstetricians and Gynecologists [ACOG] criteria), respiratory insufficiency (infant respiratory distress syndrome, aspiration [meconium, other], bronchopulmonary dysplasia [requiring O_2 after 28 days or 36 weeks], pneumothorax, pneumomediastinum, pneumopericardium, emphysema [interstitial, subcutaneous], wet lung/transient tachypnea, recurrent apnea, pulmonary hemorrhage), neonatal intensive care unit (NICU) admission (considered present if NICU stay was at least 1 day), and composite neonatal outcome (the occurrence of at least one of the previously defined adverse neonatal outcomes). Maternal adverse outcomes included instrumental vaginal birth (ID; forceps extraction or ventouse birth), emergency cesarean section, obstetric anal sphincter injury (OASIS, grade III or IV perineal laceration), postpartum hemorrhage (blood loss ≥1000 ml), composite maternal outcome (the occurrence of at least one of the previously defined adverse maternal outcomes) and hypertensive disorders, including gestational hypertension and preeclampsia.[18]

Appendix S2 includes the maternal and fetal demographics considered in the descriptive analyses.[19]

2.2 | Statistical analyses

Categorical variables are reported as numbers and percentages, and continuous variables as means and standard deviations or medians and interquartile ranges. The population was stratified by week of gestation. Because of the low incidence of births from 42 weeks onwards, these pregnancies were combined into one group (42^+ weeks).

First, weekly prospective risks of stillbirth and early neonatal mortality and neonatal and maternal adverse outcome were calculated using a fetuses-at-risk approach.[12,20–22] In this approach, the number of deaths or events is divided by the number of individuals at risk. The number of stillbirths in a particular week was divided by the number of pregnancies at the beginning of the week. The number of neonatal deaths in a particular week was divided by the number of liveborn children in that same week. Perinatal mortality was analyzed by balancing the risks of stillbirth against the risks of neonatal death.

Secondly, differences in perinatal mortality, neonatal and maternal adverse outcomes were compared per week of gestation with all births occurring after this week (eg all births between 37+6/7 with all deliveries occurring from 38+0/7 to 42^+ weeks, etc.). For this purpose, the stillbirth rate and the early neonatal mortality rate were calculated according to a births-based approach, which entails the number of events being divided by the number of births in that time period.[20] Analyses were performed using binary logistic regression providing odds ratios (OR) with *P*-values. To correct for differences in case mix, the models were adjusted for the covariates maternal age, parity, birthweight centiles and ethnicity. To estimate the proportion of small-for-gestational age (SGA) fetuses, neonatal birthweight percentiles were assessed for every fetal death. Data were analyzed using IBM SPSS Statistics version 24 with a *P*-value <0.05 as the limit of significance.

Data were missing in less than 0.5% for most variables. Birthweight centiles could not be assessed in 0.7%, mainly because the neonate's sex was unknown. Data on ethnicity was missing in 1.1%. Asphyxia was reported only in case of pediatric consultation or admission, and was therefore missing in 76.5% of neonates. For the calculation of OR, we presumed asphyxia to be absent in births without pediatric consultation or admission. Given the limited proportions of missing data and the consideration that data were not missing at random, we opted not to use imputation, and handled missing data by list-wise deletion.

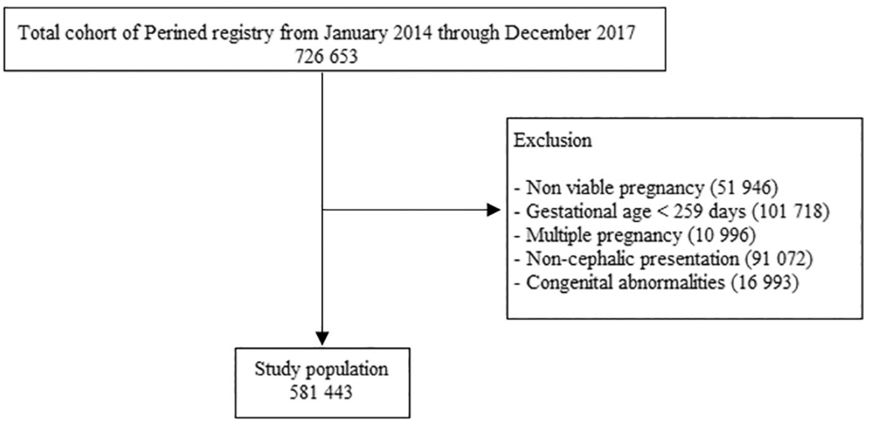

FIGURE 1 Flowchart study population.

TABLE 1 Maternal and neonatal characteristics

	n	%	Missing	Mean	Median	SD	IQR (25th–75th percentile)
Number (*n*)	581 443	100					
Maternal age (years)			23	30.6		4.75	27–34
Maternal age >35 years	121 373	20.9	23				
Gravidity			101		2	1.4	1–3
Parity (nulliparous)	250 328	43.1	210		1	1.02	0–1
Maternal mortality	14	0.0					
Gestational age							
37 weeks	43 016	7.4					
38 weeks	94 611	16.3					
39 weeks	152 951	26.3					
40 weeks	177 244	30.5					
41 weeks	104 995	18.1					
42+ weeks	8626	1.5					
Gender (male)	297 731	51.2					
Ethnicity (Caucasian)	492 175	84.6	6314				
Birthweight (g)				3498		476.49	3180–3810
Birthweight percentile (Hoftiezer)			4249	49.5		29.03	24.00–75.00
5-minute Apgar score					10	0.83	10–10
Pediatric involvement							
Pediatric consultation	95 267	16.4					
Pediatric admission	129 420	22.3					
Type of birth (start labor and birth mode)							
Spontaneous + spontaneous	357 762	61.5					
Spontaneous + instrumental vaginal birth	34 458	5.9					
Spontaneous + cesarean section	27 344	4.7					
Induction + spontaneous	100 415	17.3					
Induction + instrumental vaginal birth	12 434	2.1					
Induction + cesarean section	18 438	3.2					
Planned cesarean section	30 592	5.3					
Place of birth							
Home	84 687	14.6					
Birth facility	17 928	3.1					
Hospital (primary care)	75 398	13.0					
Hospital (secondary care)	402 673	69.3					
Referral primary to secondary care							
Before labor	20 073	34.5					
During labor	147 003	25.3					
Postpartum	11 539	2.0					
Outcome measures							
Perinatal mortality	748	0.13					
Stillbirth	534	0.09					
Early neonatal mortality	214	0.04					
Composite neonatal outcome	17 353	3.0					
Respiratory insufficiency	6854	1.2					
5-minute Apgar score ≤3	1452	0.2	275				
NICU admission	3491	0.6					

TABLE 1 (Continued)

	n	%	Missing	Mean	Median	SD	IQR (25th–75th percentile)
Birth trauma	7180	1.2					
Asphyxia	1991	0.3	444 700				
Composite maternal outcome	129 299	22.2					
Emergency cesarean birth	43 758	7.5					
Instrumental vaginal birth	47 107	8.1					
Obstetric anal sphincter injury	12 501	2.1					
Postpartum hemorrhage	36 184	6.2					

Abbreviations: IQR, interquartile range; SD, standard deviation.

TABLE 2 Weekly prospective risks of stillbirth, early neonatal mortality, adverse neonatal outcome and adverse maternal outcome (%)

	Perinatal mortality: weekly prospective risks of stillbirth and neonatal death					
	37 weeks	38 weeks	39 weeks	40 weeks	41 weeks	42+ weeks
Stillbirth (*n*)[a]	88/581 443	119/538 427	136/443 816	105/290 865	79/113 621	7/8626
Prospective risk of stillbirth (%)	0.015%	0.022%	0.031%	0.036%	0.069%	0.081%
Early neonatal mortality (*n*)[b]	22/42 928	44/94 492	49/152 815	55/177 139	41/104 916	3/8619
Prospective risk of early neonatal mortality (%)	0.051%	0.047%	0.032%	0.031%	0.039%	0.035%
Composite adverse neonatal outcome (*n*)[b]	2043/42 928	3006/94 492	3886/152 815	4667/177 139	3394/10 491	357/8619
Prospective risk of composite adverse neonatal outcome (%)	4.759%	3.181%	2.543%	2.635%	3.235%	4.142%
Composite adverse maternal outcome (%)[c]	8999/43 016	18 094/94 611	27 780/152 951	39 580/177 244	31 182/104 995	3664/8626
Prospective risk of composite adverse maternal outcome (%)	20.920%	19.125%	18.163%	22.331%	29.699%	42.476%

Note: The number of events are presented as a fraction with the numerator indicating the number of events and denominators indicating the number of fetuses[a] (pregnancies), neonates[b] (live births) or mothers [c](births) at risk for each gestational week.

2.3 | Ethics statement

Approval to use the data for this purpose was obtained from the Perined review board (Perined 19.21) on May 30, 2019.

3 | RESULTS

From January 2014 to December 2017, data of 726 653 births had been registered in the Dutch Perinatal registry database, of which 581 443 met our inclusion criteria (Figure 1).

Maternal and neonatal characteristics are shown in Table 1. The mean maternal age was 30 years; the mean birthweight was 3498 g. Perinatal mortality occurred in 748 cases (perinatal mortality rate 0.13%), of which 534 (71.4%) were stillbirths. The composite neonatal outcome was present in 3.0% of all births. Both respiratory insufficiency and birth trauma occurred in 1.2% of neonates, 5′-Apgar ≤3 in 0.2%, perinatal asphyxia in 0.3%, and NICU admission in 0.6%. Maternal mortality occurred in 14 cases (maternal mortality rate of 2.4/100 000). Composite maternal outcome was present in 22.2% of births, and emergency cesarean section, ID, OASIS and postpartum hemorrhage occurred in 7.5%, 8.1%, 2.1%, and 6.2%, respectively.

The weekly prospective risks of stillbirth, early neonatal mortality, and neonatal and maternal adverse outcome are presented in Table 2. The weekly prospective risks of stillbirth and neonatal mortality are also depicted in Figure 2. At 37 and 38 weeks' gestational age, the risks of neonatal death were higher than the risks of stillbirth. As from 40 weeks onwards, the risk of stillbirth was higher than the risk of neonatal death.

In Table 3, perinatal mortality and composite neonatal and maternal outcomes are stratified according to the gestational week in which women delivered and are compared with all births occurring in the following weeks. The OR of overall perinatal mortality were above 1 at 37, 38 and 39 weeks. The OR for composite neonatal outcomes were significantly increased at 37 and 38 weeks, and became significantly decreased from 39 weeks in comparison with later gestational weeks. At 39 weeks, respiratory insufficiency, NICU admissions

FIGURE 2 Perinatal mortality: weekly prospective risk of stillbirth and neonatal death (%).

and perinatal asphyxia were significantly less prevalent than in later gestational weeks, at 40 weeks birth trauma and 5′-Apgar ≤3 were significantly less prevalent than in later gestational weeks.

All maternal adverse outcomes were significantly less prevalent at each gestational week from 37 weeks onwards, as compared with later gestational ages, with a most prominent reduction at 38 and 39 weeks. Hypertensive disorders complicated 10 905 (3.7%) of pregnancies delivered beyond 39+6/7 weeks.

4 | DISCUSSION

In this study, we assessed the components of perinatal mortality as well as the neonatal and maternal adverse outcomes according to gestational week of birth in term singleton pregnancies in the Netherlands over a recent 4-year period.

Our analysis shows that weekly prospective risks of stillbirth are lower than those of early neonatal death before 39 weeks, are similar at 39 weeks and surpass them after 39 weeks. The odds for neonatal adverse outcomes decrease from 37 weeks onwards, are lowest at 39 weeks, and then rise. The odds of maternal adverse outcomes and operative birth continuously increase with each gestational week. The data suggest a tipping point for best combined neonatal and maternal outcome at 39 weeks, where birth is associated with less perinatal mortality, less neonatal and maternal morbidity and fewer operative births, as compared with pregnancies continuing beyond 39+6/7 weeks of gestation.

The strength of our study lies in the inclusion of a large population, which enabled us to assess both rare and more common outcomes in mother and child. It adds to current knowledge by providing a more complete evaluation of maternity care at term in a single, homogeneous and contemporary population. While confirming separate findings from the different trials, it also provided new information on other rare but important outcomes (OASIS, postpartum hemorrhage, ID), permitting a more balanced evaluation of different maternal, fetal and neonatal risks. The selected outcomes may all have substantial short-term or long-term health and/or socioeconomic impacts.[19,23–25] We analyzed the outcomes using a fetuses-at-risk and a births-based approach, both leading to similar conclusions, indicating the robustness of the findings.[1,20] Our data were derived from the Dutch perinatal registry, with all the inherent benefits and limitations of national registration programs. The registration is embedded in routine perinatal care, the information is provided by healthcare professionals and managed by database experts and missing data are limited. Most adverse perinatal outcomes are provided by the obstetric as well as pediatric part of the registration, thereby limiting the risk of underreporting of events. We are therefore confident that our results accurately reflect Dutch perinatal outcomes. Limitations include our assumption of the absence of asphyxia in cases without pediatric consultation or admission and the limited number of pregnancies continuing beyond 41 weeks. In addition, the registry data is not sufficiently specific to correct for all maternal and fetal risk factors. Furthermore, it is debatable whether ID and emergency cesarean section are to be labeled as maternal adverse outcomes. When these interventions are used appropriately, they may reduce maternal and neonatal morbidity. Still, they are relevant birth outcomes associated with increased risks. In analogy with other literature, we opted to label them as maternal adverse outcomes, so as to allow comparison. Lastly, the observational nature of our study did not permit assessment of the impact of elective induction on outcomes.

When considering perinatal mortality, the risk of early neonatal death for babies born at 39 weeks is lower than the risk of stillbirth in pregnancies continuing beyond 39+6/7 weeks. Our findings are in line with those of a recent systematic review on perinatal mortality at term, showing a continuously increasing risk of stillbirth from 37 weeks, with a steeper rise from 40 weeks, surpassing the risk of neonatal death at 38 weeks.[12] In the present study, the risk of stillbirth surpassed the risk of early neonatal death 1 week later, at 39 weeks.

During the study period, 191 fetal deaths occurred in pregnancies continuing beyond 39+6/7 weeks. The prospective risk of stillbirth after 39+6/7 weeks was 0.066% (1 per 1523 pregnancies) and was double the risk of early neonatal death of 0.032% (1 per 3119 births) for children born at 39 weeks. None of these fetuses had congenital abnormalities and most would likely have had an excellent chance of survival if only born a few days earlier. While apparently low in absolute numbers, these figures can be put into perspective by comparing them with other national health outcomes. In the period 2014–2017, the Dutch Central Bureau of Statistics reported 186

TABLE 3 Perinatal mortality and adverse neonatal and maternal outcomes

	37 vs. 38+ weeks			38 vs. 39+ weeks			39 vs. 40+ weeks			40 vs. 41+ weeks			41 vs. 42+ weeks		
	37 weeks	38+ weeks	OR (95% CI)	38 weeks	39+ weeks	OR (95% CI)	39 weeks	40+ weeks	OR (95% CI)	40 weeks	41+ weeks	OR (95% CI)	41 weeks	42+ weeks	OR (95% CI)
Number (*n*)	43016	538427		94611	443816		152951	290865		177244	113621		104995	8626	
Perinatal mortality															
Perinatal mortality	110 (0.26%)	638 (0.12%)	**2.04, (1.67–2.50)**	163 (0.17%)	475 (0.11%)	**1.67, (1.43–2.00)**	185 (0.12%)	290 (0.10%)	**1.25, (1.04–1.52)**	160 (0.09%)	130 (0.11%)	0.84, (0.66–1.06)	120 (0.11%)	10 (0.12%)	1.59, (0.58–4.35)
Stillbirth	88 (0.20%)	446 (0.08%)	**2.33 (1.85–2.94)**	119 (0.13%)	327 (0.07%)	**1.75 (1.43–2.17)**	136 (0.09%)	191 (0.07%)	**1.41 (1.12–1.75)**	105 (0.06%)	86 (0.08%)	0.83 (0.62–1.11)	79 (0.08%)	7 (0.08%)	1.41 (0.44–4.55)
SGA, *n* (%)[a]	25 *(28.4%)*			32 *(26.9%)*			38 *(27.9%)*			31 *(29.5%)*			21 *(26.6%)*	0 *(0%)*	
Early neonatal mortality	22 (0.05%)	192 (0.04%)	1.42, (0.90–2.17)	44 (0.05%)	148 (0.03%)	**1.47, (1.05–2.08)**	49 (0.03%)	99 (0.03%)	0.98, (0.69–1.39)	55 (0.03%)	44 (0.04%)	0.85, (0.56–1.27)	41 (0.04%)	3 (0.03%)	2.13, (0.29–14.29)
Neonatal adverse outcomes (%)															
Composite neonatal outcome[b]	4.7%	2.8%	**1.72, (1.64–1.79)**	3.2%	2.8%	**1.16, (1.12–1.22)**	2.5%	2.9%	**0.92, (0.88–0.95)**	2.6%	3.3%	**0.85, (0.81–0.89)**	3.2%	4.1%	0.93, (0.81–1.08)
Respiratory insufficiency	2.4%	1.1%	**2.22, (2.08–2.38)**	1.2%	1.0%	**1.22, (1.15–1.30)**	0.9%	1.1%	**0.87, (0.81–0.93)**	1.0%	1.3%	**0.81, (0.76–0.88)**	1.3%	1.7%	1.06, (0.83–1.35)
5-minute Apgar score ≤3	0.5%	0.2%	**1.89, (1.61–2.22)**	0.3%	0.2%	**1.32, (1.15–1.49)**	0.2%	0.2%	1.02, (0.89–1.16)	0.2%	0.3%	**0.75, (0.64–0.88)**	0.3%	0.4%	1.01, (0.60–1.69)
NICU admission	1.4%	0.5%	**2.63, (2.38–2.86)**	0.7%	0.5%	**1.32, (1.20–1.43)**	0.4%	0.6%	**0.78, (0.71–0.85)**	0.5%	0.7%	**0.81, (0.74–0.89)**	0.7%	0.9%	1.05, (0.75–1.47)
Birth trauma	1.3%	1.2%	1.02, (0.93–1.12)	1.3%	1.2%	1.04, (0.98–1.11)	1.2%	1.2%	0.96, (0.90–1.01)	1.2%	1.4%	**0.89, (0.83–0.96)**	1.3%	1.6%	0.84, (0.67–1.04)
Asphyxia	0.4%	0.3%	1.16, (1.00–1.37)	0.3%	0.3%	0.93, (0.82–1.05)	0.3%	0.4%	**0.77, (0.69–0.86)**	0.3%	0.5%	**0.72, (0.64–0.81)**	0.5%	0.8%	0.88, (0.61–1.27)
Maternal adverse outcomes (%)															
Composite maternal outcome[c]	20.9%	22.3%	**0.89, (0.88–0.92)**	19.1%	23.0%	**0.82, (0.80–0.83)**	18.2%	25.6%	**0.69, (0.68–0.70)**	22.3%	30.7%	**0.72, (0.71–0.74)**	29.7%	42.5%	**0.77, (0.72–0.82)**
Instrumental vaginal birth	6.7%	8.2%	**0.76, (0.72–0.79)**	6.4%	8.6%	**0.78, (0.75–0.80)**	6.7%	9.5%	**0.76, (0.75–0.78)**	8.5%	11.1%	**0.85, (0.82–0.87)**	10.8%	14.2%	0.93, (0.85–1.00)
Emergency cesarean section	7.8%	7.5%	**1.05, (1.01–1.09)**	7.0%	7.6%	**0.95, (0.93–0.98)**	5.4%	8.8%	**0.65, (0.63–0.67)**	6.8%	11.8%	**0.62, (0.61–0.64)**	11.1%	20.1%	**0.71, (0.40–0.77)**
Obstetric anal sphincter injury	1.2%	2.2%	**0.50, (0.46–0.55)**	1.4%	2.4%	**0.60, (0.57–0.64)**	2.1%	2.6%	**0.83, (0.80–0.87)**	2.6%	2.6%	1.05, (1.00–1.10)	2.6%	2.5%	1.12, (0.94–1.35)
Postpartum hemorrhage	6.8%	6.2%	**1.11, (1.08–1.16)**	5.6%	6.3%	**0.88, (0.85–0.91)**	5.2%	6.9%	**0.78, (0.75–0.79)**	6.2%	7.9%	**0.81, (0.79–0.83)**	7.8%	9.8%	**0.85, (0.77–0.93)**

Note: The models were adjusted for the covariates maternal age, parity, birthweight centiles and ethnicity. Bold values are the OR with a 95%CI that does not overlap the null value (e.g. OR = 1) as a proxy for significance.

Abbreviations: CI, confidence interval; OR, odds ratio.

[a]To estimate the proportion of small-for-gestational-age (SGA) fetuses in stillborn children, neonatal birthweight percentiles were assessed for every fetal death.[19]

[b]Composite neonatal outcome include respiratory insufficiency, 5-minute Apgar score ≤3, NICU admission, birth trauma, asphyxia.

[c]Composite maternal outcome include instrumental vaginal birth, emergency cesarean section, obstetric anal sphincter injury and postpartum hemorrhage.

cases of accidental death (traffic accident, fall, poisoning, drowning, and other) in the 2 803 712 children aged between 0 and 15 years—corresponding with a risk of 0.0066% (1 per 15 073).[26] Thus, for children the risk of intrauterine death is 10 times higher during the few days that pregnancy continues beyond 39+6/7 weeks than the risk of accidental death during their first 15 years of life. This perspective is probably different from that of most obstetric professionals, pregnant women, parents and policy makers, as are the efforts and investments in safety measures to prevent these rare but dramatic events. For the affected parents, the emotional impact of losing a term unborn child is probably similar to that of the loss of a liveborn child. Societal recognition often remains different.[23,27]

In 2010, the Dutch obstetric healthcare system enrolled a national program to reduce perinatal mortality, resulting in improvements according to the 2018 Euro-Peristat report.[28] This global plan aimed at improving maternity care and included guidelines recommending induction of labor in pregnancies found at risk (hypertensive disorders, SGA, reduced fetal movements, etc.) before 40 weeks, or upon recognition thereafter. Despite these measures, our data demonstrate that current methods of prenatal surveillance are still insufficient to ensure fetal well-being at term. Considering the limited proportion of "missed" SGA fetuses—only 27% of the stillborns were SGA—and the challenges of accurate detection of intrauterine compromise, it is questionable whether strategies of intensified prenatal surveillance can prevent most of the stillbirths.[29] With important improvements unlikely in the near future, birth may be a safer alternative. Most of the neonatal adverse outcomes and all maternal outcomes were significantly lower for births at 39 weeks as compared with pregnancies continuing beyond 39+6/7 weeks. The odds for ID and emergency cesarean section also increased in pregnancies continuing beyond 39+6/7 weeks. This can be explained on physiological grounds, as fetal growth continues linearly in the last few weeks of pregnancy.[30,31] Despite increased fetal demands, the relative uterine perfusion and thus placental supply diminishes.[32] The augmenting fetal size and reduction in fetal reserve increase the risk of dystocia and fetal compromise. This reflects our inability to ensure most optimal outcomes and birth beyond a certain gestational age, irrespective of expertise, complexity of care or setting.

Our results support the increasing evidence for improved neonatal outcomes and increased chance of vaginal birth after elective induction of labor as compared with expectant management.[8–11,33,34] In these trials, the benefits are often limited in magnitude or number of outcomes, with sometimes conflicting results between different parameters or between mother and child. The difficulty, even for professionals, of balancing the rare but important outcomes based on the limited evidence of comparative trials is reflected in the ambivalence in recommendations of several obstetric societies on elective induction. Following the ARRIVE trial, these evolved from discouragement to cautious consideration.[35–39] For pregnant women, the evaluation may even be more complex. Our population consisted of all term singleton pregnancies in the Netherlands between 2014 and 2017. Most pregnancies with known risks were likely to be delivered before 40+0/7 weeks. Most pregnancies continuing beyond 39+6/7 weeks were presumed not to be at risk. Despite a potential healthy survivor effect in this group, our results showed lower odds for all fetal, neonatal and maternal adverse outcomes, ID, and emergency cesarean section in births at 39 weeks as compared with pregnancies continuing beyond 39+6/7 week, thereby revealing the potential benefits of birth at 39 weeks and potential risks of expectant management on a national level. We believe this information should be included with perspectives in the counseling of all term pregnant women, along with genuine discussion of the inconveniences of induction and attention to women's expectations and preferences in order to come to an individualized shared decision. This would encourage women to be involved in making informed choices for their birthing plan by including their choice on when to deliver, besides how and where. By doing so, women preferring elective induction could feel comforted in their choice.[10,40] It could help them to cope with the annoyances of induction and improve their satisfaction about birth. Women opting for expectant management would be allowed to make a truly informed choice, which, along with appropriate attention and support, could also increase their satisfaction and outcome. Views on childbirth may be very different between individuals and cultures. Still, they should continuously evolve along with socioeconomic changes and new insights. This highlights the importance of continuing research on this topic. When strong evidence fails to provide sufficient answers to questions on delicate matters, personal feelings, obstetric ideologies and organizational constraints prevail in the debate, whereas the discussion should be about the best, safest and most enjoyable way to deliver for mother and child.[41] In the light of value-based healthcare, we advocate high-quality trials combining clinical outcomes with patient-reported outcomes and experiences as well as women's preferences on induction, labor and birth.[40,42] Standardized follow-up should be included to evaluate the impact on long-term health and well-being.[25,43–46] Encouragement trial designs would ensure that women with clear preferences on elective induction are not excluded and would invite others to reflect on the issue. Such trials could contribute to the refinement of obstetric healthcare systems from a women's and child's perspective.[47]

5 | CONCLUSION

Our results show that the risk of stillbirth exceeds the risk of neonatal death after 39+6/7 weeks. Additionally, the odds for combined neonatal and maternal adverse outcome are the lowest for births at 39 weeks as compared with both earlier and later gestational weeks in the term period. We believe that this information should be included in the counseling of term pregnant women. Still, more research on patient-reported experiences and outcomes is needed to determine the best role for elective induction.

AUTHOR CONTRIBUTIONS

JC conceived the study with involvement of CJS and LCMB. CJS and LCMB collected the data and analyzed them along with JC. JC, CJS and EW performed the literature search. All authors were involved in interpreting the data. JC and CJS wrote the draft article and all authors provided input at the writing stage. All authors read and approved the final version of the article.

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CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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