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1 **Abstract**

2 Although induction of labor can be crucial for preventing morbidity and mortality, more and  
3 more women (and their offspring) are being exposed to the disadvantages of this intervention  
4 while the benefit is at best small or even uncertain. Characteristics such as an advanced  
5 maternal age, a non-native ethnicity, a high Body Mass Index, an artificially assisted  
6 conception, and even nulliparity are increasingly considered an indication for induction of  
7 labor. Because induction of labor has many disadvantages, a debate is urgently needed on  
8 which level of risk justifies routine induction of labor for healthy women, only based on  
9 characteristics that are associated with statistically significant small absolute risk differences,  
10 compared to others without these characteristics. [This commentary contributes to this debate](#)  
11 [by arguing why induction of labour should not routinely be offered to all women where there](#)  
12 [is a small increase in absolute risk, and no any other medical risks or complications during](#)  
13 [pregnancy. To underpin our statement, national data from the Netherlands were used](#)  
14 [reporting stillbirth rates in groups of women based on their characteristics, for each](#)  
15 [gestational week from 37 weeks of gestation onwards.](#)

16

17 ***Keywords***

18 [Labor, Induced; Risk; Pregnant Women; Medical Overuse; Population Characteristics](#)

19

20

21 Maternal age is increasingly considered an indication for induction of labor. Adverse  
22 pregnancy outcomes, including antepartum stillbirth, occur more frequently, and increase  
23 exponentially with increasing gestation, in women aged 35 years and older.<sup>2</sup> Whilst the risk of  
24 stillbirth has considerably decreased over the last decades, the risk threshold for induction of  
25 labor continues to fall too. Logically, if ever smaller differences in absolute risk between  
26 older and younger women justify induction of labor, a potential next step will be that other  
27 maternal characteristics, with similar small differences in absolute risk, will become  
28 indications for induction. Examples of such characteristics are: a non-native ethnicity, a low  
29 socioeconomic status, a high body mass index, smoking, an artificially assisted conception,  
30 and even nulliparity. A debate is urgently needed on which level of risk justifies *routinely*  
31 *offering* induction of labor for healthy women, only based on characteristics that are  
32 associated with statistically significant small absolute risk differences, compared to others  
33 without these characteristics. Inductions for medical indications or at women's request fall  
34 outside the scope of this commentary.

35

### 36 ***Disadvantages of induction***

37 In some countries, such as Australia, several hospitals have already implemented policies of  
38 routine induction of labor for women aged 35 years or older, born in India, with a high [Body](#)  
39 [Mass Index](#), or women who had an artificially assisted conception. Since the publication of  
40 the ARRIVE trial,<sup>3</sup> the discussion on such policy changes has extended to inducing all  
41 nulliparous women between 39 and 39+4 weeks with the justification that the trial showed  
42 that induction was associated with a reduction in the caesarean section rate, but it did not  
43 reduce stillbirth rates. However, there are alternative strategies, such as continuous support  
44 during labor, for reducing caesarean section rates, even more than the ARRIVE trial, with  
45 good evidence on a wide range of other benefits and few risks.<sup>4</sup>

46 More and more women are being exposed to the discomfort and disadvantages of an induction  
47 of labor worldwide,<sup>5</sup> while their risk of antepartum stillbirth is very low. Induction of labor  
48 reduces women's choices in care provider and birth place, restricts mobility and is generally  
49 experienced as being more painful than labor with a spontaneous onset.<sup>6</sup> Women who are  
50 induced use more pharmacological pain relief than they intended, with associated potential  
51 harms for themselves and their fetus.<sup>7</sup> Furthermore, induction of labor increases the risk of  
52 complications of labor and delivery, including uterine hyperstimulation, uterine rupture,  
53 perineal lacerations, severe postpartum hemorrhage, and uterine prolapse.<sup>7,8</sup> These adverse  
54 clinical outcomes are likely to contribute to a negative birth experience. To reveal this and  
55 enhance value based birth care, we advocate to systematically measure not only clinical  
56 outcomes but also patient reported outcomes and birth experiences in individual women, as  
57 defined in the outcome set for evaluating and improving perinatal care, proposed by the  
58 International Consortium for Health Outcomes Measurement (ICHOM).<sup>9,10</sup>

59 [Although in some countries prostaglandins or misoprostol are used for induction of labor,](#)  
60 [many women still receive oxytocin when labor is induced.](#) Emerging evidence suggests that  
61 exogenous oxytocin has potential side effects regarding postpartum maternal physical and  
62 psychological health.<sup>11,12</sup> The longer term health consequences for children are not yet fully  
63 elucidated. There are studies suggesting that exogenous oxytocin has an adverse impact on the  
64 fetal preparation for the extra-uterine environment and on longer term health problems.<sup>11,13,14</sup>

65 Based on the Hippocratic principle of 'first do no harm' widespread use induction of labor

66 should not be introduced for healthy populations of pregnant women until the potential longer  
67 term harms have been thoroughly investigated, and a clear benefit of a reduction of absolute  
68 risk of stillbirth outweigh the harms of induction.<sup>13</sup>

69

### 70 ***Shared decision making***

71 Offering an induction of labor is the response  
72 of care providers to the increased risk of  
73 stillbirth for women aged 35 years or older.

74 Nowadays, the choice for or against a  
75 treatment strategy is increasingly being  
76 shifted to women. At first sight, this seems  
77 reasonable, because through shared decision  
78 making women are offered a choice whether  
79 or not to accept the disadvantages of an  
80 induction to reduce the risk of stillbirth.

81 However, shared decision making is not  
82 offered consistently. For instance, the  
83 stillbirth rate among nulliparous women is  
84 0.12% and 0.13% among multiparous  
85 women who have given birth twice or more,  
86 and 0.14% for a group of women of low  
87 socioeconomic status (Table 1 and Textbox  
88 1). Routine induction is not offered to for  
89 instance nulliparous women, multiparous  
90 women who have given birth twice or more,  
91 and women of lower socioeconomic status in  
92 the Netherlands, but it is increasingly offered  
93 to women aged 35 to 39 years, despite the  
94 stillbirth rate among this group of women  
95 being 0.12%. Hence, the threshold for shared  
96 decision making is not equally applied.

97 Care providers are obliged to inform women  
98 about the risks of interventions<sup>1</sup>, because interventions are accompanied with iatrogenic side  
99 effects. The EU Convention on human rights and biomedicine states that informed consent is

100 mandatory before applying an intervention  
101 (see Textbox 2).<sup>1</sup> This implies that women  
102 should always be offered the choice whether  
103 they want to be exposed to disadvantages of  
104 induction of labor or not. Informed consent is  
105 the cornerstone of the relationship of patients  
106 with health care providers. However, it is a  
107 misunderstanding that healthy women should  
108 be informed about every small absolute  
109 increase of risk of a certain characteristic, or

#### **Textbox 1: Methods of data analyses (Table 1)**

We analysed data from the Dutch Perinatal Data register (Perined) of 824,653 births  $\geq 37$  weeks from the years 2012 to 2016.

The exclusion criteria were: missing information on maternal age, gestational age, perinatal mortality, or parity, and birth before 37 weeks of gestation. The following risk factors for stillbirth were also excluded from the analyses: lethal fetal congenital disorders, maternal disease, hypertensive disorders, diabetes, intra-uterine growth restriction, suspected macrosomia or polyhydramnios, and other problems such as infection (apart from urinary tract infections), use of medication, drugs or alcohol, blood group incompatibility, placenta previa, lack of antenatal care and fetal heart arrhythmia.

Maternal age categories of 40-44 and  $\geq 45$  years were combined, because of the low number in the category of  $\geq 45$  years. To calculate the mortality rates at each week of gestation, we estimated the incidence of stillbirths that occurred during that week among all women that were still pregnant at the beginning of that week. The registered gestational age was based on the moment of birth and not the moment of death, but we assumed that the time period between death and birth was limited to a few days. A limitation of Perined data is that risk factors are not very well registered in this database. The population without known risk factors will, therefore, contain a proportion of women with existing risk factors that were not registered.

In the Dutch Perinatal register, different non-native ethnic groups are inaccurately registered and therefore we only classified women into Dutch or non-Dutch ethnicity. A woman was assigned to a socioeconomic status category based on the education, employment, and income level of her residential postal code area.

#### **Textbox 2: Convention on Human Rights and Biomedicine<sup>1</sup>**

*“Chapter II – Consent  
Article 5 – General rule*

*An intervention in the health field may only be carried out after the person concerned has given free and informed consent to it.*

*This person shall beforehand be given appropriate information as to the purpose and nature of the intervention as well as on its consequences and risks.”*

110 about all risks of pregnancy itself. This is simply not achievable nor desirable. Neither is it  
111 compulsory by law.

112

### 113 ***Too much, too soon***

114 Interventions during childbirth are crucial for preventing mortality and other adverse  
115 outcomes. However, safety is not limited to clinical outcomes. Psychosocial factors are also  
116 very important for women to feel safe.<sup>15</sup> Ignoring this can have unintended consequences. For  
117 example, studies indicate that the care provider’s pressure to induce labor is one of the  
118 reasons women avoid mainstream systems of birth care and choose to have unattended births  
119 or high risk homebirths<sup>16</sup>, [or travel long distances to avoid interventions.](#)<sup>17</sup> The majority of  
120 women highly value a positive birth experience and to give birth without medical  
121 interventions.<sup>15</sup>

122 The perinatal mortality rate has decreased substantially in the past century. On the other hand,  
123 the rate of many childbirth interventions, including induction of labor, is rising. After the  
124 ‘point of optimality’ an increase in the use of interventions will lead to more harm than  
125 benefits at a population level.<sup>18</sup> Interventions are potentially harmful and costly when used  
126 inappropriately or routinely.<sup>8</sup> The Lancet Series on Maternal Health identifies high rates of  
127 induction of labor as care that is provided “too much, too soon”.<sup>8</sup> Experts at the World Health  
128 Organization and authors of the Lancet Series on Caesarean Section, have recently also  
129 warned against excessive use of obstetric interventions.<sup>8,19,20</sup> They call for a reduction in the  
130 overuse of interventions, since it causes avoidable harm and interventions can increase the  
131 need for further interventions, with a risk of an exponential increase in harm.<sup>8,19,20</sup> Inducing  
132 women to prevent small absolute risks based on trials undertaken with very discrete  
133 populations neglects these warnings. Besides, a small increase in absolute risk does not  
134 necessarily mean that outcomes will be improved if labor is induced. Without the full picture  
135 of longer term outcomes from single and multiple cumulative interventions, and in the  
136 absence of a clear understanding of the compiled morbidity that may eventuate over a  
137 woman’s life time of reproduction, it is not possible to achieve fully informed judgements.

138

### 139 ***Limited resources***

140 An associated unintended consequence of overuse of induction of labor is the pressure put on  
141 health care resources, which are already constrained. Overuse of interventions for women at  
142 very marginal risk of adverse outcomes will reduce the availability of resources for those with  
143 high-risk factors and complications, and for prevention.<sup>8,19</sup> It also limits resources for the  
144 implementation of evidence-based non-medical interventions, such as continuous support  
145 during labor, which has been shown to reduce the rate of caesarean section by 25%, and a low  
146 five-minute Apgar score by 38%, and may therefore also reduce perinatal mortality and  
147 morbidity if implemented on a large scale.<sup>4</sup> Continuous labor support is also more likely to be  
148 associated with spontaneous vaginal birth, less need for pharmacological pain relief, shorter  
149 labors, and fewer women reporting a negative childbirth experience.<sup>4</sup>

150

## 151 **Conclusion**

152 Although induction of labor can be crucial for preventing morbidity and mortality, more and  
153 more women (and their offspring) are being exposed to the disadvantages of this intervention

154 while the benefit is at best small or even uncertain. Induction of labor should only be offered  
155 to individual women if there is a medical necessity. Moreover, induction should not be  
156 offered, **until there is sufficient evidence** that it has the best clinical and psychosocial  
157 outcomes for women and their babies in both the short and longer term, compared to  
158 expectant management. Care providers should be aware of groups of women that have higher  
159 rates of stillbirth, including those over 35 years of age, and use this information in clinical  
160 decision making together with individual women. However, we argue that a small absolute  
161 increase in risk on its own, without any other medical risks or complications during  
162 pregnancy, does not justify a policy of routinely offering induction of labor without strong  
163 evidence of the benefits of that policy.  
164

## 165 **Declarations**

### 166 *Declaration of interests*

167 The authors declare that they have no competing interests.  
168

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171

### 172 *Ethics approval and consent to participate*

173 Ethical approval was not required for this article and there were no participants involved.  
174

### 175 *Consent for publication*

176 Not applicable  
177

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180  
181  
182

183 **Table 1. Stillbirth rates  $\geq 37$  weeks in a population of healthy pregnant women in the**  
 184 **Netherlands specified for gestational age of birth (2012-2016).**

	Gestational age at birth in weeks													
	Total		37+0 - 37+6		38+0 - 38+6		39+0 - 39+6		40+0 - 40+6		41+0 - 41+6		$\geq 42+0$	
<b>Total pregnant women</b>	631,437		631,437		597,282		510,318		341,360		134,270		10,566	
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>
<b>Total stillbirths</b>	690	0.11	105	0.02	137	0.02	166	0.03	161	0.05	107	0.08	12	0.11
<b>Parity</b>														
Nulliparous	330	0.12	42	0.02	61	0.02	69	0.03	81	0.05	69	0.10	8	0.12
Multiparous (para 1)	198	0.08	28	0.01	41	0.02	54	0.03	43	0.03	29	0.06	3	0.13
Multiparous ( $\geq$ para 2)	162	0.13	35	0.03	35	0.03	43	0.05	37	0.06	9	0.04	1	0.07
<b>Maternal age</b>														
<20 years	4	0.06	1	0.02	2	0.03	1	0.02	0	0.00	0	0.00	0	0.00
20-24 years	58	0.10	12	0.02	9	0.02	14	0.03	15	0.05	7	0.06	1	0.11
25-29 years	199	0.10	26	0.01	42	0.02	45	0.03	50	0.05	32	0.08	4	0.14
30-34 years	259	0.11	38	0.02	57	0.02	66	0.03	57	0.04	40	0.08	1	0.02
35-39 years	133	0.12	24	0.02	21	0.02	33	0.04	28	0.05	21	0.09	4	0.19
$\geq 40$ years	37	0.19	4	0.02	6	0.03	7	0.05	11	0.11	7	0.17	2	0.49
<b>Ethnicity</b>														
Dutch	511	0.10	81	0.02	110	0.02	119	0.03	113	0.04	79	0.07	9	0.11
Non-Dutch	179	0.14	24	0.02	27	0.02	47	0.04	48	0.07	28	0.11	3	0.13
<b>Socioeconomic status</b>														
Low	99	0.14	11	0.02	16	0.02	24	0.04	27	0.08	20	0.15	1	0.10
Medium	536	0.11	91	0.02	112	0.02	126	0.03	119	0.04	77	0.07	9	0.11
High	44	0.08	1	0.00	8	0.01	12	0.03	13	0.04	9	0.07	1	0.11
<b>Conception</b>														
Spontaneous	641	0.11	100	0.02	126	0.02	157	0.03	145	0.04	100	0.08	11	0.11
Artificially assisted	49	0.23	5	0.02	11	0.05	9	0.06	16	0.15	7	0.15	1	0.22

185

186

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