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**Citation:** MacFarlane, A.J., Blondel, B., Mohangoo, A.D., Cuttini, M., Nijhuis, J., Novak, Z., Olafsdottir, H.S., Zeitlin, J. and the Euro-Peristat Scientific Committee, . (2015). Wide differences in mode of delivery within Europe: risk-stratified analyses of aggregated routine data from the Euro-Peristat study. *BJOG: an International Journal of Obstetrics and Gynaecology*, 123(4), pp. 559-568. doi: 10.1111/1471-0528.13284

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# Wide differences in mode of delivery within Europe: risk-stratified analyses of aggregated routine data from the Euro-Peristat study

AJ Macfarlane,<sup>a</sup> B Blondel,<sup>b</sup> AD Mohangoo,<sup>c</sup> M Cuttini,<sup>d</sup> J Nijhuis,<sup>e</sup> Z Novak,<sup>f</sup> HS Ólafsdóttir,<sup>g</sup> J Zeitlin,<sup>b</sup> the Euro-Peristat Scientific Committee

<sup>a</sup> Centre for Maternal and Child Health Research, City University London, London, UK <sup>b</sup> INSERM, Obstetrical Perinatal and Paediatric Epidemiology Research Team, Centre for Epidemiology and Biostatistics (U1153), Paris-Descartes University, Paris, France <sup>c</sup> Department of Child Health, TNO, the Netherlands Organisation for Applied Scientific Research, Leiden, the Netherlands <sup>d</sup> Research Unit of Perinatal Epidemiology, Bambino Gesù Children's Hospital, Rome, Italy <sup>e</sup> Department of Obstetrics and Gynaecology, GROW School of Oncology and Developmental Biology, Maastricht University Medical Centre, Maastricht, the Netherlands <sup>f</sup> Perinatology Unit, University Medical Centre, Ljubljana University, Ljubljana, Slovenia <sup>g</sup> Department of Obstetrics and Gynaecology, Landspítali University Hospital, Landspítali v/ Hringbraut, Iceland

Correspondence: Professor A Macfarlane, School of Health Sciences, City University London, 1 Myddelton Street, London EC1R 1UW, UK. Email A.J.Macfarlane@city.ac.uk

Accepted 3 November 2014. Published Online 6 March 2015.

**Objective** To use data from routine sources to compare rates of obstetric intervention in Europe both overall and for subgroups at higher risk of intervention.

**Design** Retrospective analysis of aggregated routine data.

**Setting** Thirty-one European countries or regions contributing data on mode of delivery to the Euro-Peristat project.

**Population** Births in participating countries in 2010.

**Methods** Countries provided aggregated data about overall rates of obstetric intervention and about caesarean section rates for specified subgroups.

**Main outcome measures** Mode of delivery.

**Results** Rates of caesarean section ranged from 14.8% to 52.2% of all births and rates of instrumental vaginal delivery ranged from 0.5% to 16.4%. Overall, there was no association between rates of instrumental vaginal delivery and rates of caesarean section, but similarities were observed between some countries that are geographically close and may share common traditions of practice. Associations were observed between caesarean section rates for

women with breech and vertex births and with singleton and multiple births but patterns of association for women who had and had not had previous caesarean sections were more complex.

**Conclusions** The persisting wide variations in caesarean section and instrumental vaginal delivery rates point to a lack of consensus about practice and raise questions for further investigation. Further research is needed to explore the impact of differences in clinical guidelines, healthcare systems and their financing and parents' and professionals' attitudes to care at delivery.

**Keywords** Breech birth, caesarean section, Euro-Peristat, instrumental vaginal delivery, international comparisons, mode of delivery, parity, repeat caesarean section, twins.

**Linked article** This article is commented on by FG Mariona. To view this mini commentary visit <http://dx.doi.org/10.1111/1471-0528.13354>. This article is also commented on by M Mathai. To view this mini commentary visit <http://dx.doi.org/10.1111/1471-0528.13344>.

Please cite this paper as: Macfarlane AJ, Blondel B, Mohangoo AD, Cuttini M, Nijhuis J, Novak Z, Ólafsdóttir HS, Zeitlin J, the Euro-Peristat Scientific Committee. Wide differences in mode of delivery within Europe: risk-stratified analyses of aggregated routine data from the Euro-Peristat study. BJOG 2015; DOI: 10.1111/1471-0528.13284.

## Introduction

The recommendation from a World Health Organization (WHO) conference in 1985 that 'Countries with some of the lowest perinatal mortality rates in the world have caesarean section rates of <10%. There is no justification for

any region to have a rate higher than 10–15%',<sup>1</sup> is still frequently cited even though rates of obstetric intervention have continued to rise substantially in both high- and middle-income countries.<sup>2–11</sup> Data from the Organisation for European Co-operation and Development (OECD) show a continuing rise in caesarean section rates in most member

countries, despite signs of flattening off in a few countries with high rates.<sup>10,11</sup> Consequences of the rise in caesarean section rates include associations with raised risks for mothers and babies, including placenta accreta, placenta praevia, placental abruption and stillbirth in subsequent pregnancies.<sup>12–15</sup> A number of factors have been cited as possible explanations, including fear of litigation, financial incentives related to methods of payment,<sup>16–18</sup> women's requests for caesarean section<sup>19</sup> and the perception that caesarean section is a safe procedure.<sup>20</sup>

Caesarean sections are clearly necessary in some high-risk situations, such as placenta praevia or fetal distress. For other situations, there is ongoing debate about the systematic use of caesarean section, for example for breech presentation,<sup>21–25</sup> multiple births<sup>26–31</sup> or women with previous caesarean section.<sup>20,32,33</sup>

A succession of comparative analyses, from the 1980s onwards, have shown major variations between high-income countries in their rates of obstetric intervention.<sup>2,3,5,6,10,11,34</sup> These include the first Euro-Peristat study, which compiled routinely collected data for the 15 members of the European Union in 2000. This found that rates of caesarean section varied from 11.7% to 30.8% and rates of instrumental vaginal delivery, using either forceps or vacuum extraction, ranged from 4.9% to 15.0%.<sup>34</sup>

The subsequent Euro-Peristat project extended data collection to the 25 states that were members of the European Union in 2005, plus Norway.<sup>35</sup> It was based on data for 2004 and found that rates of caesarean section had increased and differences had widened, ranging from 14.4% to 37.8%. Induction rates ranged even more widely, from 5.9% to 37.9%.

It is well established that caesarean rates vary by a number of factors, notably parity, previous caesarean section, fetal presentation and multiplicity,<sup>36–41</sup> but to date international comparisons based on aggregated data have not stratified methods of delivery by these factors.

This study aims to use aggregated population-based data from routine sources to explore differences between intervention rates at delivery for European countries, and the extent to which clinicians in countries with high overall caesarean rates were also more likely to intervene in specific situations.

## Methods

### Data sources

Data come from the Euro-Peristat project, a collaboration between 26 member states of the European Union and Norway, Iceland and Switzerland, to assess perinatal health in Europe using a common set of ten core and 20 recommended perinatal health indicators.<sup>42,43</sup> A distinctive feature of the Euro-Peristat project is the collection of data by

prespecified subgroups to improve the comparability and usefulness of the indicators.

Each participant was requested to provide nationally aggregated population-based data from its routine data collection systems for the year 2010 and these were used to compile the full set of indicators, including data about women's demographic characteristics, care provided and outcome for mothers and babies. These are available on the Euro-Peristat web site.<sup>43</sup> In some member states, data collection is devolved to constituent regions or countries. In Belgium, Flanders, Brussels and Wallonia provided the data from separate regional sources and England, Wales, Scotland and Northern Ireland provided data for the countries of the UK. France provided data from the National Perinatal Survey, a nationally representative survey of a sample of 14 000 births in 2010, which was the most recent of its series of such surveys.<sup>44</sup>

Participants were also asked to document the way data were recorded in their countries' routine systems and the definitions they used. The implications of the observed differences in these were discussed at collaborators' meetings, and are documented in Euro-Peristat publications.<sup>34,43,45</sup>

This analysis includes 31 countries and regions that contributed data about mode of delivery. Of these, 27 contributed data about at least one specified subgroup for the mode of delivery indicator.

### Definitions

The mode of delivery indicator was defined as the percentage distribution of total births, live and stillborn, by mode of delivery for all births. This was then subdivided by mother's parity, whether she had had a previous caesarean section, fetal presentation and plurality.

In Poland, Portugal, England and Wales, rates were reported per woman. This may result in slight underestimates of operative deliveries, as two or more multiple births to the same woman were counted only once, but the impact of this was minimal.

Mode of delivery was subdivided into spontaneous vaginal delivery, operative vaginal delivery and two categories of caesarean section. Countries differed in the ways that they classified caesarean section. Some countries subdivided them according to whether they were undertaken before or during labour. Others used the subdivision into elective caesarean section, which includes all those planned before the onset of labour and so was likely to include a few that took place after labour had started, and emergency or unplanned caesarean section, which could include a few caesareans in emergency situations before labour started. The definitions used in each country were documented but in the Euro-Peristat tables, data about elective caesareans were grouped with caesarean sections before labour and emergency sections were grouped with those undertaken in labour.

Some countries were excluded from specific subgroup analyses because of questions about the validity of the data. Malta was excluded from analyses of repeat caesarean sections because the percentages of previous caesareans were unlikely and Lithuania was excluded from analyses by presentation because only 0.4% of births were recorded as breech.

### Statistical analysis

Associations between caesarean section rates and rates of instrumental vaginal delivery were examined, as were associations between the percentages of caesarean sections to women with and without previous caesarean section and associations between caesarean section rates for breech and vertex births and between rates for twins and singletons. Statistical associations were tested by calculating Spearman's ranked correlations, using IBM SPSS STATISTICS, version 21 (IBM, Armonk, NY, USA).

## Results

### Mode of delivery

The numbers of births ranged from under 5000 in Malta and Iceland to well over 500 000 in England, Italy and Germany (Table 1). There was wide variation in overall rates of caesarean section in Europe in 2010, from 14.8% in Iceland to 52.2% in Cyprus, with a median value of 25.2%.

By far the highest rates of caesarean section that were undertaken or planned before labour were 38.8% in Cyprus and 24.9% of births in Italy. Elsewhere, rates ranged from 6.6% in Finland to 17.9% in Luxembourg. In Romania, 33.1% of births were by caesarean section undertaken in an emergency or in labour. This was very much higher than that for any other country. Rates for other countries ranged less than for elective rates, from 8.6% in Sweden to 16.7% in Malta. Hence, if the extreme rates for Cyprus, Italy and Romania were disregarded, the range of rates of caesarean sections that were planned or undertaken before labour was wider than the range of rates of caesarean section that were classified as emergency or undertaken in labour.

Rates of instrumental vaginal delivery also varied widely, from 0.5% in Romania to 16.4% in Ireland, with a median value of 7.5%. There was no statistical association between rates of caesarean section and instrumental vaginal delivery (Figure 1), but the data showed considerable differences in practice. The countries with very low rates of instrumental vaginal delivery,  $\leq 2\%$  had caesarean section rates ranging from 23.1% to 34.0%. When rates for these countries were excluded, there was still no statistical association between rates of caesarean section and spontaneous vaginal birth. In the 24 countries that could subdivide caesarean rates, there was no statistical association,

positive or negative, between instrumental vaginal delivery and rates of caesarean sections that were emergency or undertaken in labour. This was still the case when the countries that made minimal use of operative vaginal delivery were excluded (not shown).

### Caesarean section rates by subgroup

Caesarean section rates for babies by parity, by whether or not women had had a previous caesarean section, as well as for babies in vertex and breech presentations and for singleton and twin babies, are shown in Table 2.

### Parity and previous caesarean section

Countries with high caesarean section rates for births to primiparous women tended to have high rates among births to multiparous women.

Caesarean section rates among women who had a previous caesarean section were high overall but ranged from between 45% and 55% in The Netherlands, Norway, Finland and Iceland to 92.9% in Latvia and 93.5% in Cyprus (Table 2, Figure 2). Caesarean section rates among women without a previous caesarean section ranged from 11.3% in The Netherlands to 28.9% in Italy. This was highly correlated with rates among those with a previous caesarean section, but the degree of association varied.

Repeat section rates were high in Italy, Cyprus and Malta, which also had high rates among births to women without a previous caesarean section, but were also high in Latvia and Lithuania where primary caesarean section rates were lower. Among the countries that had lower rates for births to women without previous caesarean sections, repeat caesarean section rates ranged more widely, from <50% to 80% (Figure 2).

### Breech presentation

Breech deliveries accounted for around 4% of all births. In the 21 countries that could contribute data, a high degree of correlation was found between rates of caesarean section for breech births and rates for all vertex births (Figure 2). More than 80% of breech babies were delivered by caesarean section in 16 countries. In nine of these, rates were over 90%. Nevertheless, caesarean section rates for breech births varied widely in countries that had low rates for vertex births.

### Twin and singleton births

Caesarean section rates were high for twin births, but here again there were wide variations in practice. The strong association between caesarean section rates for twin births with rates for all singleton births is shown in Figure 2. It also shows that, on the other hand, caesarean section rates for twin births varied very widely between countries that had low rates for singletons.

**Table 1.** Births in participating countries by mode of onset of labour and delivery

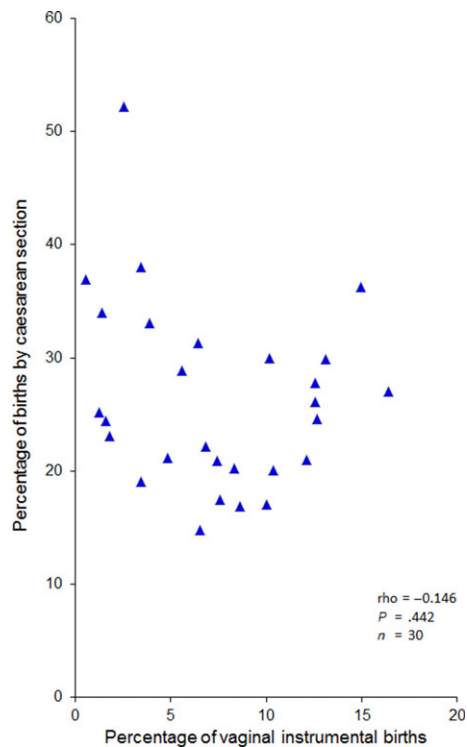
Country/coverage	Number of total births	Number with mode of delivery stated	Percentage of total births with mode stated: Mode of delivery				
			Vaginal spontaneous	Vaginal instrumental	Caesarean elective/before labour	Caesarean emergency/during labour	Caesarean section, all
<b>Belgium</b>							
Brussels	25 098	25 009	71.5	8.3	9.7	10.4	20.2
Flanders	69 976	69 976	69.6	10.4	11.3	8.8	20.1
Wallonia	38 430	38 310	71.6	7.5	10.4	10.5	20.9
<b>Czech Republic</b>	114 406	113 917	75.1	1.8	12.7	10.4	23.1
<b>Denmark</b>	63 513	63 460	71.0	6.9	9.4	12.8	22.1
<b>Germany</b>	637 664	619 903	62.2	6.4	15.4	15.9	31.3
<b>Estonia</b>	15 884	15 884	74.0	4.9	7.8	13.4	21.2
<b>Ireland</b>	75 595	75 564	56.6	16.4			27.0
<b>Greece</b>							
<b>Spain</b>	478 037	478 037					26.3
<b>France</b>	14 903	14 731	66.9	12.1	11.3	9.7	21.0
<b>Italy</b>	547 568	546 133	58.6	3.4	24.9	13.1	38.0
<b>Cyprus</b>	8603	8591	45.3	2.5	38.8	13.4	52.2
<b>Latvia</b>	19 246	19 246	74.0	1.6	11.5	13.0	24.4
<b>Lithuania</b>	30 977	30 977	73.5	1.3	9.4	15.8	25.2
<b>Luxembourg</b>	6560	6560	59.9	10.2	17.9	12.1	30.0
<b>Hungary</b>							
<b>Malta</b>	4036	4036	63.0	3.9	16.4	16.7	33.1
<b>The Netherlands</b>	178 838	177 607	72.9	10.0	7.7	9.4	17.0
<b>Austria</b>	78 989	78 989	65.6	5.6			28.8
<b>Poland</b>	402 826	402 578	64.6	1.4			34.0
<b>Portugal</b>	100 280	100 130	48.8	14.9			36.3
<b>Romania</b>	174 692	174 692	62.5	0.5	3.8	33.1	36.9
<b>Slovenia</b>	22 416	22 404	77.5	3.5	8.3	10.8	19.1
<b>Slovak Republic</b>							
<b>Finland</b>	61 371	61 368	74.5	8.6	6.6	10.2	16.8
<b>Sweden</b>	114 955	114 955	74.9	7.6	8.9	8.6	17.5
<b>United Kingdom</b>							
England	622 303	661 926	62.8	12.6	9.9	14.7	24.6
Wales	32 649	32 523	61.3	12.6	11.1	15.0	26.1
Scotland	57 438	57 166	59.7	12.6	11.9	15.9	27.8
Northern Ireland	25 359	24 884	57.0	13.1	14.6	15.2	29.9
<b>Iceland</b>	4903	4903	78.6	6.5			14.8
<b>Norway</b>	62 591	62 591	73.0	9.9	6.6	10.5	17.1
<b>Switzerland</b>	80 276	79 565	55.8	11.0			33.1
<b>Median</b>	62 591	62 591	66.2	7.5	10.7	12.9	25.2
<b>Minimum</b>	4036	4036	45.3	0.5	3.8	8.6	14.8
<b>Maximum</b>	637 664	661 926	78.6	16.4	38.8	33.1	52.2
<b>Number</b>	31	31	30	30	24	24	31

## Discussion

### Main findings

This analysis confirms the wide variations in overall caesarean section rates reported elsewhere, as well as in specific subgroups. Caesarean section rates among women with a previous caesarean section were highly correlated

statistically with rates for births to women without a previous caesarean section. In addition, there were strong statistical associations between caesarean rates for breech and vertex births and singleton and twin births. The patterns of association are more complex, however, with a wide range of rates, despite the highly significant rank correlations. There was no inverse association between



**Figure 1.** Comparison between caesarean section and vaginal instrumental birth rates, 2010.

rates of operative vaginal delivery and overall caesarean section rates.

### Strengths and limitations

These tabulations of mode of delivery by parity, previous caesarean section, presentation and multiplicity are not found in other international reports based on data that are collected routinely within member states. Routine data are collected every year for countries' own purposes and the data in the Euro-Peristat report came from 129 different systems. As they cover the whole population of countries and regions, they avoid the selection biases that can arise in studies based on samples of individual maternity units.<sup>4,8</sup> With some well-documented exceptions, routine data are of good quality and virtually complete. Most of the gaps arise where particular data items are not included in specific countries' systems.<sup>33,43,45</sup>

In the Euro-Peristat project, steps are taken to make comparisons as reliable as possible by using harmonised definitions, compiling numbers as well as rates to enable checking for inconsistencies and collecting information about missing data.<sup>43</sup> The clinicians and data experts on the Euro-Peristat Scientific Committee have been actively involved in discussing and interpreting the results.

On the other hand, with aggregated data, it is not possible to adjust operative delivery rates for known risk factors:

sociodemographic factors such as mothers' ages, individual or area-based measures of socio-economic status or clinical complications. These may not explain observed differences between countries, however. For example, an analysis of national age-specific caesarean rates for OECD countries found that adjusting caesarean section rates for age made little difference to the wide variation observed.<sup>46</sup>

Risk-adjusted analyses to compare rates for maternity units in England have found that known risk factors explained only a small proportion of the variance, even though they explained a higher proportion of variation in emergency than elective caesarean section rates,<sup>37-40</sup> but the authors pointed out that their conclusions may not necessarily apply elsewhere. An analysis of data about deliveries of low-risk women in France found differences in intervention rates for units after adjustment for mothers' and unit characteristics. It found higher rates of instrumental vaginal delivery in units with over 3000 births and higher rates of any intervention in private units compared with public units.<sup>17</sup> Similar analyses within countries with different levels of intervention or with separate public and private systems of health care might yield further information about factors that can influence intervention rates.

Studies that collect data about population or unit-based samples of individual women and their babies<sup>4,8,47</sup> can define their data items prospectively and thus consistently, but are expensive. This restricts either their sample size or frequency. The WHO surveys of practice included only small numbers of hospitals in each participating country.<sup>4,8</sup> The National Caesarean Section Sentinel Audit collected more detailed data than routine systems,<sup>47</sup> but was expensive and has not been repeated. As with studies using routinely collected data, known risk factors explained only a small proportion of the variance between units and the cost of replicating it in every country in Europe would be prohibitive.

### Interpretation

The differences observed raise questions about why there are such wide variations in clinical practice.

In some specific situations, the need for intervention is clear. For others there is ongoing debate, for example about the use of caesarean section for breech presentation,<sup>21-25, 48-50</sup> multiple births<sup>26-31</sup> and women with previous caesarean section.<sup>20,30,31,51,52</sup> The data presented here suggest that for breech births and twin births, practice is associated with factors that influence the overall rate of caesarean section, although the extent of association can differ between countries.

The data do suggest that there are some groups of countries with common or similar traditions, and that identifying these could explain some similarities in practice, such as the low rates of operative vaginal delivery in some



**Table 2.** Caesarean section rates in participating countries by parity, fetal presentation and multiplicity

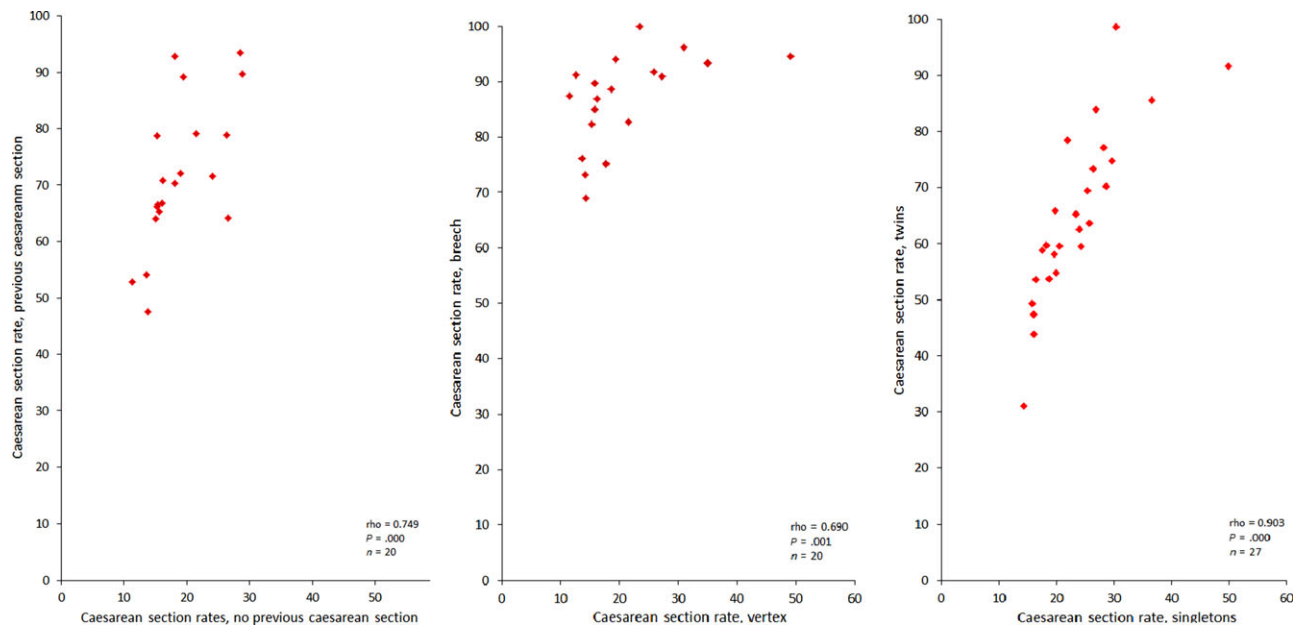
Country/ coverage	Caesarean sections as percentages of total births in category for which data are available							
	Nulliparous women	Multiparous women	Women with previous caesarean section	Women without previous caesarean section	Vertex presentation	Breech presentation	Singleton birth	Multiple birth
<b>Belgium</b>								
Brussels	22.0	18.8	64.0	15.1	15.8	85.0	18.2	59.7
Flanders	21.9	18.5	66.2	15.2	15.9	89.7	18.7	53.7
Wallonia	22.7	19.5	66.6	15.4	16.2	86.8	19.6	58.1
<b>Czech Republic</b>	26.0	20.4	72.1	19.0	19.4	94.0	21.9	78.4
<b>Denmark</b>	23.8	20.8	66.8	16.1	18.7	88.6	20.5	59.6
<b>Germany</b>	35.9	26.5	64.2	26.6	27.3	91.0	29.6	74.8
<b>Estonia</b>	23.4	19.5	70.8	16.1		89.4	19.8	65.9
<b>Ireland</b>	28.5	26.0					25.7	63.6
<b>Greece</b>								
<b>Spain</b>	29.4	24.8					25.4	69.4
<b>France</b>	23.2	19.0	65.2	15.6	17.7	75.2	19.9	54.8
<b>Italy</b>	37.3	36.6	89.7	28.9	35.1	93.3	36.5	85.6
<b>Cyprus</b>	57.0	47.3	93.5	28.5	49.1	94.5	49.9	91.6
<b>Latvia</b>	25.3	23.6	92.9	18.1	21.5	82.7	23.4	65.3
<b>Lithuania</b>	27.3	23.3	89.2	19.5	25.2		24.2	59.5
<b>Luxembourg</b>	32.7	27.5	71.5	24.1	25.8	91.8	28.2	77.1
<b>Hungary</b>								
<b>Malta</b>	33.3	32.9	78.8	26.4	31.0	96.1	30.3	98.6
<b>The Netherlands</b>	19.5	14.8	52.9	11.3	13.6	76.1	16.1	43.9
<b>Austria</b>	30.5	27.4					26.8	83.9
<b>Poland</b>								
<b>Portugal</b>								
<b>Romania</b>								
<b>Slovenia</b>	21.4	16.7	78.7	15.3	15.3	82.3	17.5	58.8
<b>Slovak Republic</b>								
<b>Finland</b>	15.8	13.8	47.6	13.8	14.1	73.2	15.8	49.4
<b>Sweden</b>	19.1	15.5			11.5	87.4	16.4	53.6
<b>United Kingdom</b>								
England	24.9	24.4	70.3	18.0			23.9	62.6
Wales								
Scotland	28.5	27.2	79.1	21.4	23.5	100.0	26.4	73.3
Northern Ireland	30.5	20.5					28.6	70.2
<b>Iceland</b>	15.4	14.4	47.6		12.6	91.2	14.3	31.1
<b>Norway</b>	19.1	15.6	54.2	13.6	14.4	69.0	16.0	47.4
<b>Switzerland</b>					27.8	95.4	31.4	77.5
<b>Median</b>	24.9	20.5	70.3	17.1	18.2	89.6	22.6	63.1
<b>Minimum</b>	15.4	13.8	47.6	11.3	11.5	69.0	14.3	31.1
<b>Maximum</b>	57.0	47.3	93.5	28.9	49.1	100.0	49.9	98.6
<b>Number</b>	27	27	21	20	22	22	28	28

countries in the east of Europe and the overall low levels of intervention in the Nordic countries and the Netherlands.

A number of approaches could be used to investigate the differences in practice documented here. A review of national policies and guidelines would be useful for comparing national policies with data about practice. It

would have to take account of the fact that, where within-country data are available, they show considerable variations between maternity units within the same healthcare system with common guidelines and policies.<sup>17,37–40</sup> Where individual level data are available, constructing the ten groups defined by Robson,<sup>41,53</sup> might be a useful approach





**Figure 2.** Comparison between caesarean rates for women with previous caesarean section and rates for women with no previous caesarean section, between rates for breech births and vertex births, and rates for twin births and singleton births

to identifying categories which differ, although many EU countries do not record all the data items required.

There is growing evidence from surveys and other research that health system issues, notably differences in the organisation of health care and methods of payment, can influence choice of mode of delivery, both in Europe<sup>16–18</sup> and more widely,<sup>54–56</sup> with higher rates in the private sector. Comparisons of the content and scope of obstetric and midwifery education and the roles and responsibilities of midwifery and obstetric staff would also be informative. Women's requests for caesarean section have been cited as a reason for the rising rates but only a minority of women in a wide range of countries have expressed a preference for caesarean section.<sup>57–59</sup> Studies in a number of countries have shown that many women who ended up having caesarean section would have preferred vaginal delivery and are influenced by models of care and healthcare providers' preferences.<sup>54, 60–63</sup> The results of the WHO global surveys of maternal and perinatal health in Latin America and Asia have pointed to the potential dangers and excessive costs associated with caesarean sections that are clinically unnecessary.<sup>4,8,9</sup>

Any initiatives to counter trends towards higher rates of clinically unnecessary obstetric intervention need monitoring using routine data, so an ongoing European perinatal monitoring system is needed. Using the subgroups in Euro-Peristat to monitor trends over time in mode of delivery is more informative than simply monitoring over-

all trends in caesarean section. Future studies could add additional risk subgroups, such as the ten groups defined by Robson,<sup>41,63</sup> but to do this, some countries would have to expand the range of data items that they record routinely.

## Conclusions

The persisting wide differences in mode of delivery in Europe are a cause for concern because they point to a lack of consensus about best practice. Research is needed to investigate the reasons for these differences, including comparing the basis for formulation of and adherence to clinical guidelines, exploring the impact of differences in healthcare systems and their financing and parents' and professionals' attitudes to care at delivery.

## Disclosure of interest

The authors declare that they have no competing interests to disclose.

## Contribution to authorship

AJM and BB discussed the design of the paper, ADM compiled the data from data contributed by all members of the Euro-Peristat group, AJM drafted the paper. All the authors commented on drafts of the paper and approved the final version. JZ had overall scientific responsibility for the project.

## Details of ethics approval

This study was based on aggregated routinely collected data, so ethics approval was not required.

## Funding

The results from this study are based on data from the Euro-Peristat project, a European project for monitoring and evaluating perinatal outcomes at a European level. The Euro-Peristat project received funding from the European Union in the framework of the Health Programme (grant number: 20101301). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

## Acknowledgements

This article drew on the work of the many people who contributed to the European Perinatal Health Report: Health and Care of Pregnant Women and Babies in Europe in 2010. They include statisticians, researchers, clinicians, administrators and others from each of the collaborating countries who compiled aggregated data for their countries and sent them to Euro-Peristat. They are too numerous to list here, but their names can be found online at Appendix S1 and in Appendix A1 of the European Health Report at [www.europeristat.com](http://www.europeristat.com). The authors would like to thank them for their contributions.

## The Euro-Peristat scientific committee

Gerald Haidinger (Austria), Sophie Alexander (Belgium), Pavlos Pavlou (Cyprus), Petr Velebil (Czech Republic), Anne-Marie Nybo Andersen (Denmark), Luule Sakkeus (Estonia), Mika Gissler (Finland), Béatrice Blondel (France), Nicholas Lack (Germany), Aris Antsaklis (Greece), István Berbik (Hungary), Helga Sól Ólafsdóttir (Iceland), Sheelagh Bonham (Ireland), Marina Cuttini (Italy), Janis Misins (Latvia), Jone Jaselioniene (Lithuania), Yolande Wagener (Luxembourg), Miriam Gatt (Malta), Jan Nijhuis (Netherlands), Kari Klungsoyr (Norway), Katarzyna Szamotulska (Poland), Henrique Barros (Portugal), Mihai Horga (Romania), Jan Cap (Slovakia), Živa Novak-Antolic (Slovenia), Francisco Bolívar (Spain), Karin Gottvall (Sweden), Sylvie Berrut (Switzerland), Alison Macfarlane (United Kingdom). Project coordination: Jennifer Zeitlin, Marie Delnord, Ashna Mohangoo.

## Supporting Information

Additional Supporting Information may be found in the online version of this article:

**Appendix S1.** Acknowledgements. ■

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