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Caesarean sections in teaching hospitals: systematic review and meta-analysis of hospitals in 22 countries

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ABSTRACT

Objective The aim of this study is to determine the odds of caesarean section in all births in teaching hospitals as compared with non-teaching hospitals.
Setting Over 3600 teaching and non-teaching hospitals in 22 countries. We searched CINAHL, The Cochrane Library, PubMed, sciELO, Scopus and Web of Science from the beginning of records until May 2020.
Participants Women at birth. Over 18.5 million births.
Intervention Caesarean section.
Primary and secondary outcome measures The primary outcome measures are the adjusted OR of caesarean section in a variety of teaching hospital comparisons. The secondary outcome is the crude OR of caesarean section in a variety of teaching hospital comparisons.
Results In adjusted analyses, we found that university hospitals have lower odds than non-teaching hospitals (OR=0.66, 95% CI 0.56 to 0.78) and other teaching hospitals (OR=0.46, 95% CI 0.24 to 0.89), and no significant difference with unspecified teaching status hospitals (OR=0.92, 95% CI 0.80 to 1.05, $\tau2$=0.009). Other teaching hospitals had higher odds than non-teaching hospitals (OR=1.23, 95% CI 1.12 to 1.35). Comparison between unspecified teaching hospitals and non-teaching hospitals (OR=0.91, 95% CI 0.50 to 1.65, $\tau2$=1.007) and unspecified hospitals (OR=0.95, 95% CI 0.76 to 1.20), $\tau2$<0.001) showed no significant difference. While the main analysis in larger sized groups of analysed studies reveals no effect between hospitals, subgroup analyses show that teaching hospitals carry out fewer caesarean sections in several countries, for several study populations and population characteristics.
Conclusions With smaller sample of participants and studies, in clearly defined hospitals categories under comparison, we see that university hospitals have lower odds for caesarean. With larger sample size and number of studies, as well as less clearly defined categories of hospitals, we see no significant difference in the likelihood of caesarean sections between teaching and non-teaching hospitals. Nevertheless, even in groups with no significant effect, teaching hospitals have a lower or higher likelihood of caesarean sections in several analysed subgroups. Therefore, we recommend a more precise examination of forces sustaining these trends.
PROSPERO registration number CRD42020158437.

Strengths and limitations of this study

- ► The major strengths of our systematic review and meta-analysis include a broad literature search, data extraction performed by more than one reviewer, an exploration of study characteristics as a potential source of variation between studies and quality assessment using Quality in Prognosis Studies tool.
- ► Some additional strengths of this study are the large sample size and the inclusion of many hospitals over broad geographic regions.
- ► Potential limitations relate to differences in the characteristics of compared hospitals, study populations, type of data used, types of caesarean section analysed and variables used for adjustment in statistical analyses across studies.
- ► We also lack information on hospital resources, infrastructure and staffing of compared hospitals which could have been useful for a more detailed analysis of the underlying factors that may contribute to differences among teaching and non-teaching hospitals.

INTRODUCTION

Caesarean sections (CSs) are a key surgical procedure in improving long-term health outcomes in high-risk births.[1 2] Key to providing high quality healthcare is avoiding the risks associated with using this procedure in low-risk pregnancies. Despite recommendations by the WHO to decrease CS rates and perform CS based primarily on medical indications,[3–5] CS rates continue to increase, rising to an estimated 21.1% worldwide in 2015.[6] Furthermore, there is a large degree of variation observed. The rate in different countries ranges from dangerously low, that is, below 10%, to extraordinary high rates, for example, 58.1% in the Dominican Republic.[6] Within country variations have also been observed in many countries including the USA.[7] More recently, in Italy, the 2018 data concerning nulliparous, term, singleton, vertex CS show variation between 8.4% and

44.4% among health authorities, with significant and constant intra-regional variation.[8]

It is highly unlikely that such dramatic differences are explained solely by clinical factors. They may stem from a variety of factors, such as insurance status or socioeconomic background.[9–13] Factors affecting patient or clinician preferences may also be responsible for variations in healthcare delivery. Patients prefer caesareans for cultural-related or experience-related reasons. Physicians can be less skilled in relation to natural birth, in comparison to, for example, midwives.[14–21] Hospital factors may also have an effect.[10 22 23]

Hospital teaching status is one of hospital characteristics that may explain the variability of CS among hospitals. In general, teaching hospitals are known to have higher overall rates of surgery, which is perhaps reflective of more complex caseloads.[24–26] For this reason, it may be intuitively assumed that teaching hospitals have a higher proportion of high-risk births and, as such, higher likelihood of CS. But this doesn't seem to be the case with CSs. Teaching hospitals are generally associated with a higher standard of care and better outcomes.[26–32] There is more adherence to evidence-based guidelines and/or clinical protocols. Higher quality care, in turn, can also translate to a lower likelihood of caesarean delivery as a result of fewer unnecessary procedures. Teaching hospitals also generally have access to a certain level of technology, and it is easier to apply protective measures, such as requiring a second opinion on CS procedures.[27] The goal of this review is to examine the odds of CS in teaching and non-teaching hospitals. We aim to determine whether there is a significant difference, evaluate the effect size and variations among different groups and subgroups, and thereby understand the differences in delivery care provision between teaching and non-teaching hospitals.

MATERIALS AND METHODS

This meta-analysis was constructed as per previous meta-analyses carried out by members of our group[22 33–35] and in accordance with the structure suggested by Dekkers and coworkers,[36] the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines[37] and Meta-analysis of Observational Studies in Epidemiology guidelines for meta-analysis of observational studies.[38] We produced a protocol, which was submitted and registered with PROSPERO.

Eligibility criteria, information sources, search strategy

In order to get the widest spread of data possible, we searched CINAHL, The Cochrane Library, PubMed, sciELO, Scopus and Web of Science from the beginning of records until May 2020. The search terms were based on a four-level strategy, with terms related to CSs, terms related to hospital teaching status, terms related to area of research, that is, health system variation and so on, and terms related to study design.

Study selection

The primary criterion for study inclusion was the presence of an OR for CSs in teaching and non-teaching hospitals. Reports which included other data (ie, regression coefficients, case data by type of hospital and delivery outcome) allowing the ORs to be calculated were also included. Study inclusion was also contingent on study design, targeting in this reviews, systematic reviews, cohort studies and cross-sectional studies. Studies were excluded to remove overlapping data. This refers to the situation where more than one identified article (during screening/full-text review) seems to have used same data sets. Studies were also excluded in case they were not reported in English language. The eligibility of each study was assessed independently by at least two researchers, and disagreements were resolved by consultation.

Data extraction

Data extraction was carried out by at least two independent researchers for each study. Another reviewer performed a final review of all extracted data. Disagreements were resolved by discussion. A data extraction spreadsheet was constructed to facilitate the process, and included a number of pertinent data, such as publication data, effect estimate, confidence limits, main determinant being studied and sample size, among other data. For the purpose of classification of population of each study, we extracted exclusion/inclusion criteria data that were used by authors in order to specify their study population. Such data enabled us to classify population for each study based on Robson system. Robson's 10 group classification system is based on five main population features including obstetric history, onset of labour, presentation of features, number of neonates and gestational age.[39] This is a standardised comparison method that is helpful and widely used to analyse trends and determinants of CS.[40]

Assessment of risk of bias

The risk of bias for included studies was assessed in terms of six domains—study participation, study attrition, prognostic factor measurement, study confounding, and statistical analysis and reporting, using the Quality in Prognosis Studies (QUIPS) tool.[41] Although it is a standardised tool for prognostic studies, it fits very well with overall structure of included papers and it has already been used in methodologically similar reviews.[32 33 35]

Data synthesis

The ORs were combined using standard inverse-variance random-effects meta-analysis, where an OR lower than one shows a lower likelihood of CS in teaching hospitals than non-teaching hospitals.[42]

Using definitions and classifications provided by Ayanian and Weissman[43] as well as definitions used by papers included in the review, we specified three main categories of hospitals: University hospital, other teaching hospital and non-teaching hospital. University hospital

 Hoxha I, et al. BMJ Open 2021;11:e042076. doi:10.1136/bmjopen-2020-042076

is a major teaching hospital affiliated with a medical school.[43] It is the institution where residency programmes take place, high-end care is provided and research activity takes place. Other teaching hospitals do not meet such criteria, but they do provide residency training.[43] Non-teaching hospitals are hospitals that do not provide venue for training of residents. In case studies were not clear on the definition of comparing hospitals, we marked them as unspecified teaching or as unspecified hospital. In case where studies did not specify to which type of teaching hospitals they were referring to, we marked them as unspecified teaching hospital. In such cases, it is highly likely, that is, studies for USA, that such category of hospitals includes both university and other teaching hospitals. In case where studies did not specify reference hospital, we marked them as unspecified hospital. Based on our assessment, such categorisation of hospitals is likely to include both non-teaching hospitals or other teaching hospitals or one of them.

As a result, based on classification of teaching hospitals and reference hospitals studies used, we analysed adjusted and crude estimates reported by studies independently in six different groups: university versus non-teaching hospital, university versus other teaching hospital, university versus unspecified hospital, other teaching versus non-teaching hospital, unspecified teaching hospital versus non-teaching hospital, unspecified teaching hospital versus unspecified hospital.

Subgroup analysis for adjusted estimates by country, study design, period of data collection, population by Robson groups and criteria, type of CS analysed, type of data used and level of (QUIPS) risk of bias domains was used to examine between-study heterogeneity and χ^2 test used to calculate p values for interaction among subgroups.

Statistical analysis was carried out using STATA, release V.15 (StataCorp).

Patient involvement

No patients were involved in this study. We used data from published papers only.

RESULTS

Study selection

We identified a total of 5233 records: 344 from CINAHL, 1049 from the Cochrane Library, 1522 from PubMed, 651 from sciELO, 534 from Scopus, 1133 from Web of Science. Additional 68 records were identified from a manual search (figure 1). We removed 783 duplicates; 4518 records were screened for eligibility. We performed full-text examination on 908 records. We excluded 827 that did not report hospital teaching status, 46 that were otherwise irrelevant and three records with overlapping populations. Finally, 32 records describing 32 separate studies,[18 27 44–73] including 18.5 million births in 22 different countries, were included in the review and meta-analysis. Of these, 18 studies were included in the meta-analyses of adjusted ORs and 27 studies were used in the meta-analyses of crude ORs.

Study characteristics

Characteristics of included studies are shown in table 1 and online supplemental appendix 1. Most included studies were retrospective studies, with some prospective studies also included. The studies were from a variety of countries and health systems. Sample size varied from 214 to 8.48 million births. The oldest study was from 1991, but the vast majority of included studies were carried out post-2000. Case exclusion criteria and covariates for statistical adjustment also varied considerably (online supplemental appendix 1).

Risk of bias of included studies

The main potential source of bias is study confounding, where 17 of the 32 studies included had a high risk of bias and 9 studies had a moderate risk of bias. With respect to study participation, four studies had a moderate risk of bias, with the remainder having a low risk of bias. A low risk of bias in all studies was reported for study attrition, prognostic factor measurement and outcome measurement, while only two studies had a moderate risk of bias for the statistical analysis and reporting domain.

Synthesis of results

Figure 2 presents meta-analyses for primary outcome measures, that is, adjusted ORs for all six groups we analysed. In the first group, including one study, university hospitals had lower odds of CS than non-teaching hospitals (OR=0.66, 95% CI 0.56 to 0.78). Similarly, in second group, university hospitals CS was 0.46 times as likely than in other teaching hospitals (95% CI 0.24 to 0.89). In the third comparison group involving three studies, university hospitals did not have significantly different odds of CS compared with unspecified hospitals (OR=0.92, 95% CI 0.80 to 1.05) with low heterogeneity between studies ($\tau2$=0.009). Analysis of the group of other teaching hospitals in comparison with non-teaching hospitals from one study showed higher odds of CS (OR=1.23, 95% CI 1.12 to 1.35). Comparison group of unspecified teaching hospitals with non-teaching hospitals, which incorporated 11 studies and was the largest adjusted analysis, showed no significant difference (OR=0.91, 95% CI 0.50 to 1.65) with high heterogeneity between studies ($\tau2$=1.007). Similarly, including three studies, unspecified teaching hospitals did not have significantly lower odds than unspecified hospitals (OR=0.95, 95% CI 0.76 to 1.20) with no heterogeneity between studies ($\tau2$<0.001).

Subgroup analyses of adjusted ORs in teaching and non-teaching hospitals (online supplemental appendix 1) showed some variation. For the comparison of university hospitals and unspecified hospitals, lower odds of CS were observed for France (OR=0.84, 95% CI 0.74 to 0.97), while for USA the odds were the same (OR=1.00, 95% CI 0.95 to 1.06). Lower odds were observed also in the subgroup with single number of fetuses, studies with low

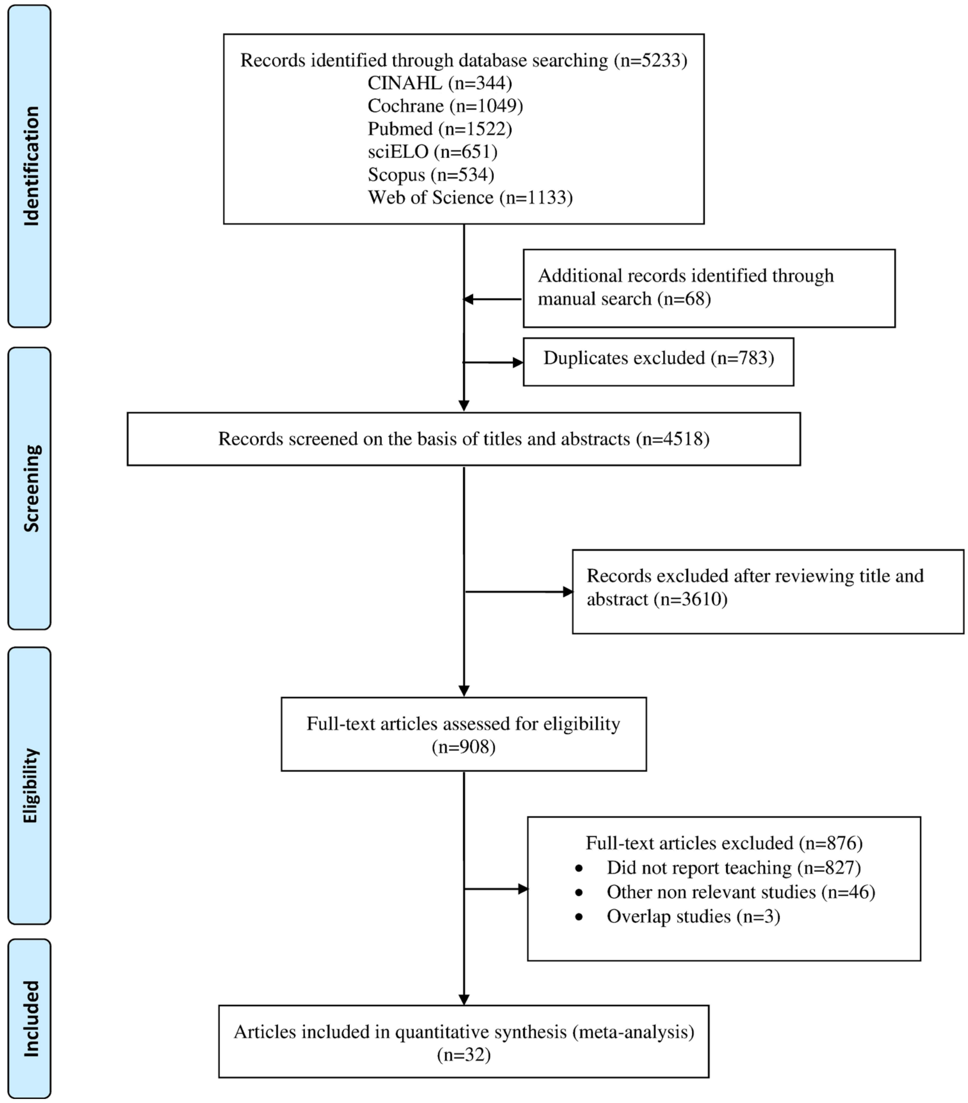

Figure 1 The flow diagram of review.

risk of confounding (as defined by QUIPS), studies using hospital data, as well as studies not using birth registry data.

Subgroup analysis for the comparison of unspecified teaching hospitals with non-teaching hospitals highlighted difference in many factors. Inter-country variation was particularly notable, where France (OR=0.30, 95% CI 0.16 to 0.58), Palestine (OR=0.53, 95% CI 0.37 to 0.77), Taiwan (OR=0.86, 95% CI 0.82 to 0.91) and USA (OR=0.80, 95% CI 0.72 to 0.88) had lower odds of CS. Conversely, Korea (OR=4.95, 95% CI 4.82 to 5.09) and Lebanon (OR=1.40, 95% CI 1.30 to 1.50) had higher odds of CS in teaching hospitals. There was also variation in Robson subgroups. Studies using groups 1 and 3 showed lower odds of CS in teaching hospitals (OR=0.80, 95% CI 0.69 to 0.93), as did studies with mothers from groups 6 and 7 (OR=0.30, 95% CI 0.16 to 0.58). Conversely, studies using all Robson subgroups had higher odds of CS (OR=4.95, 95% CI 4.82 to 5.09). There was also variation in OR with studies including different fetal presentation, where studies with any fetal presentation showed no difference (OR=1.04, 95% CI 0.50 to 2.14), studies including breach presentation showed lower odds of CS (OR=0.30, 95% CI 0.16 to 0.58) and odds of 0.88 were observed for cephalic presentation (95% CI, 0.75 to 1.04). Studies with high (1.57, 95% CI 0.39 to 6.32) and low (1.15, 95% CI 0.79 to 1.69) QUIPS confounding showed no significant difference in odds, while studies with moderate risk of confounding had lower odds of CS (0.73, 95% CI 0.69 to 0.78).

In secondary outcome analysis (figure 3), CS in university hospitals was 1.36 times as likely as compared with non-teaching hospitals, although the difference was not significant (95% CI 0.80 to 2.32, $\tau2$=0.208), and 0.50 times as likely in comparison with other teaching hospitals (95% CI 0.35 to 0.71). In comparison with unspecified hospitals, there was again no significant difference (OR=1.01, 95% CI 0.86 to 1.17) with low heterogeneity between studies ($\tau2$=0.019). CS was 1.28 times as likely in other teaching hospitals compared with non-teaching hospitals (95% CI 1.11 to 1.46) with no relevant heterogeneity between studies ($\tau2$=0.009). Our unadjusted

Table 1 Characteristics of included studies

Study	Year	Country	Study design	Number of cases	Number of hospital units	Year of data collection	Period of data collection	Population by Robson groups	Sampling	Type of CS analysed
University versus non-teaching hospital										
Murray[48]	2000	Chile	Prospective	504	3	1995–1997	Before 2000	All	Random	Any
Garcia *et al*[50]	2001	USA	Retrospective	51 009	36	1996	Before 2000	All	Consecutive	Any
Zhang *et al*[58]	2010	USA	Retrospective	132 667	19	2002–2008	2000 and after	Multiple	Consecutive	Any
University versus other teaching hospital										
Hoxha *et al*[18]	2019	Kosovo	Prospective	859	5	2015	2000 and after	1–4	Consecutive	Any
University versus unspecified hospital										
David *et al*[49]	2001	France	Retrospective	40 512	149	1994–1998	Before 2000	Multiple	Consecutive	Any
Carayol *et al*[53]	2007	France and Belgium	Prospective	6091	174	2001–2002	2000 and after	Multiple	Random	Planned
Snyder *et al*[60]	2011	USA	Retrospective	244 464	129	2006–2007	2000 and after	Multiple	Consecutive	Any
Oner *et al*[66]	2016	Tukey	Prospective	214	4	2012	2000 and after	Multiple	Random	Any
Faisal-Cury *et al*[67]	2017	Brazil	Prospective	757	10	2005–2006	2000 and after	Multiple	Random	Any
Other teaching versus non-teaching hospital										
Garcia *et al*[50]	2001	USA	Retrospective	58 771	36	1996	Before 2000	All	Consecutive	Any
Zhang *et al*[58]	2010	USA	Retrospective	81 339	19	2002–2008	2000 and after	Multiple	Consecutive	Any
Unspecified teaching hospital versus non-teaching hospital										
Sanchez-Ramos *et al*[44]	1994	USA	Prospective	945 707	236	1992	Before 2000	All	Random	Any
Braveman *et al*[45]	1995	USA	Retrospective	217 461	Not reported	1990–1991	Before 2000	Multiple	Consecutive	Any
Irwin *et al*[46]	1996	USA	Retrospective	3603	75	1987–1989	Before 2000	Multiple	Consecutive	Any
Chanrachakul *et al*[47]	2000	Thailand	Retrospective	1 073 403	227	1999	Before 2000	All	Random	Any
Korst *et al*[51]	2005	USA	Retrospective	443 532	288	1995	Before 2000	Multiple	Consecutive	Any
Linton *et al*[52]	2005	USA	Retrospective	53 215	66	2002	2000 and after	All	Consecutive	Any
Tamim[54]	2007	Lebanon	Retrospective	18 837	9	2001–2002	2000 and after	Multiple	Consecutive	Any
Xirasagar *et al*[55]	2007	Taiwan	Retrospective	739 531	942	1997–2000	Before 2000	Multiple	Consecutive	Planned
Chen *et al*[56]	2008	Taiwan	Retrospective	200 207	Not reported	2004	2000 and after	Multiple	Consecutive	Any
Liu *et al*[57]	2008	Taiwan	Retrospective	247 751	Not reported	1998–2002	Before and after 2000	Multiple	Consecutive	Any
Taljaard *et al*[59]	2009	South America	Prospective	95 164	119	2004–2005	2000 and after	Multiple	Random	Any
Aman *et al*[61]	2014	Ethiopia	Retrospective	17 761	6	2011	2000 and after	All	Consecutive	Any
Stivanello *et al*[62]	2014	Italy	Retrospective	213 539	36	2005–2010	2000 and after	All	Consecutive	Any

Continued

Table 1 Continued

Study	Year	Country	Study design	Number of cases	Number of hospital units	Year of data collection	Period of data collection	Population by Robson groups	Sampling	Type of CS analysed
Bommarito *et al*[63]	2016	USA	Retrospective	8 485 034	1051	1998–2010	Before and after 2000	All	Random	Emergency
Kim *et al*[64]	2016	Korea	Retrospective	1 289 989	674	2011–2014	2000 and after	All	Consecutive	Any
Lorthe *et al*[68]	2017	France	Prospective	528	546	2011	2000 and after	6 and 7	Consecutive	Any
Clapp *et al*[69]	2018	USA	Retrospective	1 657 495	1206	2013	2000 and after	1–4	Consecutive	Any
Zimmo *et al*[72]	18	Palestine	Prospective	18 908	3	2016–2017	2000 and after	All	Consecutive	Any
Zimmo *et al*[71]	2018	Palestine	Prospective	9567	2	2015–2016	2000 and after	Multiple	Consecutive	Emergency
del Carmen *et al*[73]	2019	USA	Retrospective	1 855 675	Not reported	2006–2010	2000 and after	1 and 3	Consecutive	Emergency
Unspecified teaching hospital versus unspecified hospital										
Oleske *et al*[27]	1991	USA	Retrospective	130 249	198	1986	Before 2000	Multiple	Consecutive	Planned
Meda *et al*[65]	2016	Burkina Faso	Retrospective	668	66	2009–2010	2000 and after	All	Random	Any
Lorthe *et al*[68]	2017	France	Prospective	347	546	2011	2000 and after	6 and 7	Consecutive	Any
Zbiri *et al*[70]	2018	France	Retrospective	291 449	11	2008–2014	2000 and after	All	Consecutive	Any

CS, caesarean section.

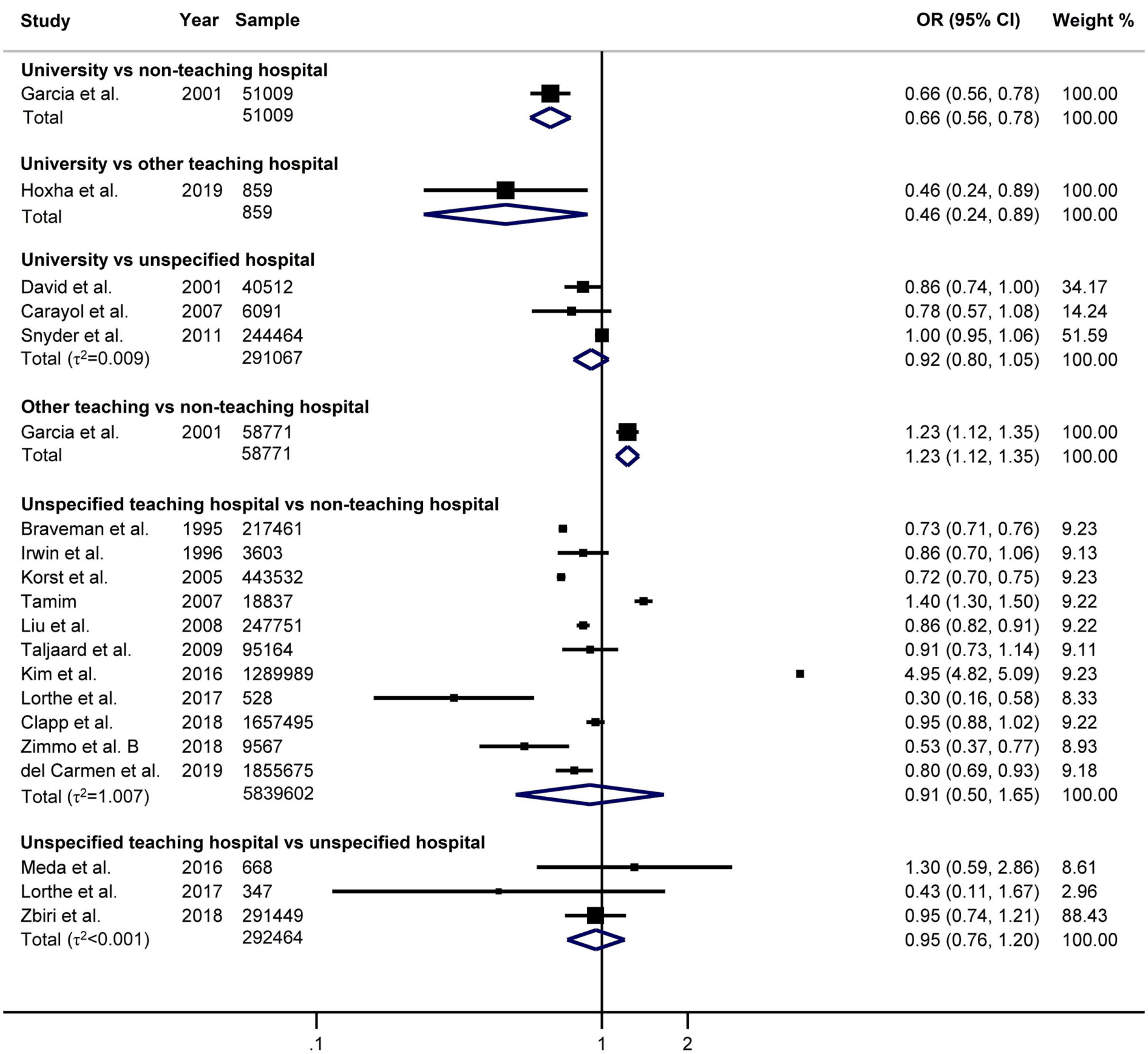

Figure 2 Adjusted ORs of caesarean section.

comparisons of unspecified types of teaching hospital with non-teaching hospitals and unspecified hospitals reflected the results of the adjusted analysis, with no significant difference observed. In the case of non-teaching hospitals, CS was 1.01 times as likely (95% CI 0.63 to 1.61) with high heterogeneity between studies ($\tau2$=0.859). For unspecified teaching hospitals, in comparison with unspecified hospitals, there was no significant difference in the odds of CS (OR=0.96, 95% CI 0.85 to 1.09) with no relevant heterogeneity between studies ($\tau2$=0.006).

DISCUSSION

In more clearly defined hospital comparison groups, we see lowering effect of teaching hospitals as compared with non-teaching hospitals. But samples and number of studies are small. In most of the studies and largest sample size, we see no overall significant difference between teaching and non-teaching hospitals in adjusted and subgroup analyses. Subgroup analyses showed varied estimates.

Strengths and weaknesses

The major strengths of our systematic review and meta-analysis include a broad literature search, data extraction performed by more than one reviewer, an exploration of study characteristics as a potential source of variation between studies and quality assessment using QUIPS. Some additional strengths of this study are the very large sample size and the inclusion of many hospitals over broad geographic regions. Potential limitations which may have affected inconsistencies in the results relate to differences in the characteristics of compared hospitals, study populations, type of data used, types of CS analysed and variables used for adjustment in statistical analyses across studies. The fact that most studies have not been as precise in definition of specific categories of teaching status of hospital is particularly limiting. Moreover, we lack information on hospital resources, infrastructure

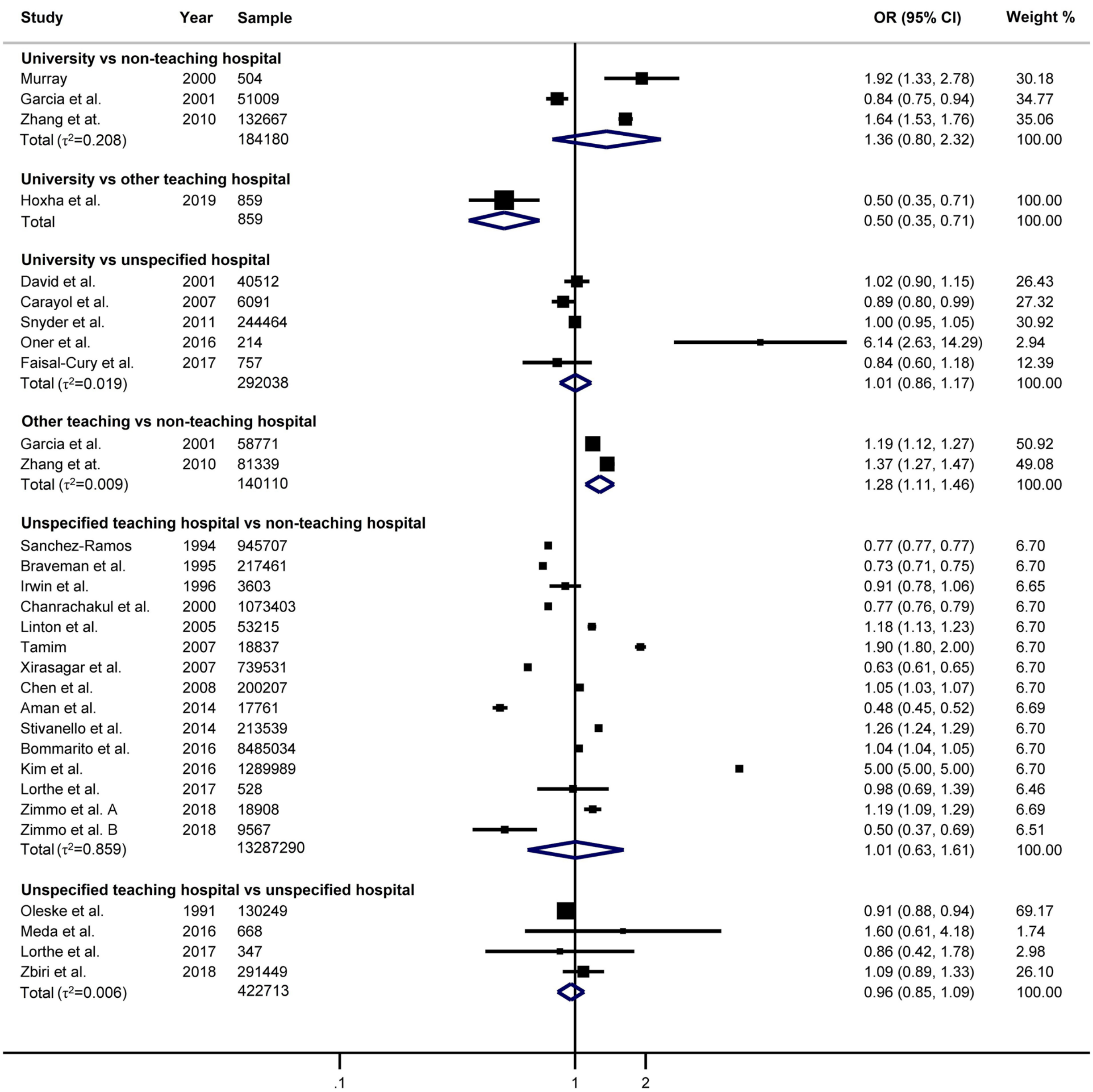

Figure 3 Crude ORs of caesarean section.

and staffing, all of which could contribute to maternal outcomes and risk for CS.[7]

Context

The findings in this study demonstrate the complexity of the interactions of many factors. The role of health system factors in general and hospital factors in particular should not be ignored. Recent meta-analyses examining the effect of hospitals and financial factors[22 33 34] have found that CS was 1.41 times as likely in for-profit hospitals as compared with non-profit hospitals (95% CI 1.24 to 1.60),[22] 1.13 for privately insured women compared with women covered with public insurance (95% CI 1.07 to 1.18)[34] and 0.70 in uninsured as compared with privately and publicly insured women (95% CI 0.69 to 0.72).[33]

Interpretation

The findings in our group and subgroup analyses indicate that the effect of hospital teaching status varies between countries, study design and confounders considered in data analysis. Specific populations of mothers and particular type of CS are also important variables in examining the effect of hospital variation. Patient populations in teaching versus non-teaching hospitals are generally very different in terms of underlying medical conditions and obstetric risk, which would likely drive any differences observed in odds for CS. Hence, intuitively, we would expect that odds for CS are likely to be higher in teaching hospitals, where more complex cases are often taken. Our study does not show this, and in several groups and subgroups the opposite is observed. Variation in odds of CS in teaching hospitals for particular Robson groups hints at differences in implementation of clinical standards. Studies have suggested that the lower odds in teaching hospitals may be due to availability of resources,[44 74] access to technology,[75] closer supervision and care,[60] stronger accountability,[76] adherence to clinical standards[18 27 57 77 78] and professional consultation opportunities.[27]

Implications

Our study contributes to understanding of the role of hospital-related causes on the rates of CS. It may also provide an impetus for further research, particularly setting-specific studies, or even individual patient data meta-analysis. Such studies would allow a more precise and in-depth analysis of the characteristics of hospitals associated with teaching status, such as resource availability or adherence to clinical guidelines. In order to improve the quality of healthcare provision for deliveries, the interplay of factors related to teaching status of hospitals must be examined, in all outcomes of related to deliveries, including but not limited to overall CS, emergency and primary caesarean, vaginal birth after caesarean. Using classification by Robson groups or primary CS will help in understanding better the implications of results in future studies. Using variables with information such as infrastructure and other facets of hospital variation could be useful to elucidate more clearly the mechanism. Another way to understand the underlying factors related to hospital characteristics, which is being applied in Tuscany (Italy), is to put in place systematic and ongoing collection of Patient-Reported Experience Measures and Patient-Reported Outcome Measures[79] which could ensure continuous source of data to measure hospital performance outcomes.

CONCLUSION

With smaller sample of participants and studies, in clearly defined hospitals categories under comparison, we see that university hospitals have lower odds for caesarean. With larger sample size and number of studies, in less clearly defined categories of hospitals, we see no significant difference in the likelihood of CSs between teaching and non-teaching hospitals. Nevertheless, even in groups with no significant effect, teaching hospitals in many subgroups, have a lower likelihood of CSs. Lower or higher odds for CS among teaching hospitals hint at the effect of important aspects of healthcare delivery. Hence, further research would help to understand the interplay of underlying factors in individual settings which may provide useful insights for policy or medical practice efforts to ensure appropriate and efficient use of delivery care.

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Contributors IH conceived and designed the study. BK, JB, FS performed the screening of studies. IH, EZ, KG, BK, JB, FS performed the data extraction and preparation. IH and EZ performed quality assessment of studies. IH has analysed the data. DAL, MB and GL have contributed to the interpretation of findings. IH, EZ and RA drafted the paper, which was critically reviewed and approved by all authors.

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