



## Association between maternal death and cesarean section in Latin America: A systematic literature review



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### ABSTRACT

**Background:** it is critically important to explore a possible relationship between cesarean section and maternal mortality in Latin America, where the highest cesarean section rates in the world are found. Our aim was to conduct a systematic literature review on the relationship between maternal death and cesarean section in Latin America.

**Methods:** we undertook a systematic review through six electronic databases. Studies that reported any association analysis between maternal mortality and the mode of delivery in Latin America were included. Papers that fulfilled the inclusion criteria were then read fully, and a quality assessment was conducted with the PROMPT tool.

**Results:** seven articles were identified for final analysis, all of which were observational studies. Most of the studies were retrospective (6) and one was prospective. Of the retrospective studies, 3 were case control and 3 were cross-sectional. Most of the publications on this topic suggest that there may be an increased risk of maternal mortality with cesarean section compared with vaginal birth (odds ratio ranging from 1.6 to 7.08). However, it is evident that there is a lack of studies with this subject, especially those that take into account the differences in risk between women delivered by cesarean section or by vaginal birth.

**Conclusions:** most of the articles showed that there may be an increased risk of maternal mortality with cesarean section compared with vaginal birth. However, it is clear that there is a limited number of studies published on this issue. Additional studies with a better methodological design should be conducted.

### Introduction

The maternal mortality ratio (defined as the number of maternal deaths per 100,000 live births) has shown large variations in different regions of the world. This rate is higher in developing regions (230) compared with developed regions (16). Latin America has a maternal mortality ratio of 85 (World Health Organization (WHO), 2014). It is currently known that the most important direct causes of maternal death are hypertensive disorders, hemorrhage, abortion, and sepsis (Khan et al., 2006; Filippi et al., 2016); however, the identification of other potentially novel risk factors might provide insights into other possible preventative approaches to maternal death.

Rates of cesarean section have increased in recent decades worldwide (Gibbons et al., 2010; Niino, 2011; Organization for Economic Co-operation and Development OECD, 2011). Recently, Betrán et al.

(2016) analyzed 90% of the total number of live births worldwide between 1990 and 2014, and found that cesarean section rate increased 12.4% in this period. The largest absolute increase occurred in Latin America and the Caribbean (19.4%, from 22.8% to 42.2%) (Betrán et al., 2016). According to the last official data available in Brazil (2012), this country has the highest cesarean section prevalence in the world - 55.6% (Sistema de Informações sobre Nascidos Vivos (SINASC)). Although it is well established that a correct indication of cesarean section is extremely important and can save the lives of mother and newborn, studies have shown that this mode of delivery may expose women to an increased risk of morbidity (Liu et al., 2007; Lumbiganon et al., 2010; Souza et al., 2010) and mortality (Lumbiganon et al., 2010; Souza et al., 2010).

The association between cesarean section and maternal death shows contradictory results in different countries (Althabe et al.,

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2006; Deneux-Tharaux et al., 2006; Clark et al., 2008; Volpe, 2011; O'Dwyer et al., 2012; Gonzales et al., 2013). While some studies have found no associations (Althabe et al., 2006; O'Dwyer et al., 2012; Volpe, 2011), most of the evidence has shown a positive association in different degrees (Deneux-Tharaux et al., 2006; Clark et al., 2008; Lumbiganon et al., 2010; Souza et al., 2010; Gonzales et al., 2013). Clark et al. (2008), in USA, found a maternal mortality ratio 10 times higher in cesarean section compared with vaginal birth; Deneux-Tharaux et al. (2006) in France, maternal mortality ratio 3.6 times higher; and Gonzales et al. (2013), in Peru, maternal mortality ratio 5.5 times higher.

Interestingly, in studies conducted in countries that have cesarean section rates lower than 15% and high mortality rates (e.g., Sub-Saharan African countries), cesarean section is associated with lower maternal mortality ratios, which demonstrates a protective effect of this procedure (Althabe et al., 2006; Betrán et al., 2007; Volpe, 2011; Zizza et al., 2011). On the other hand, countries with cesarean section rates of more than 30%, such as many in Latin America, cesarean section rates are associated with higher maternal mortality ratios (Villar et al., 2007; Gonzales et al., 2013). This suggests that other variables may be involved in the relationship between the mode of delivery and maternal mortality.

It is critically important to explore if there is a relationship between cesarean section and maternal mortality in a region where the rate of cesarean section is the highest in the world and has presented the highest increase in recent decades. The aim of this study was to conduct a literature review on the relationship between maternal mortality and cesarean section in Latin America.

## Methods

### *Inclusion and exclusion criteria*

#### *Inclusion criteria*

Searches were limited to publications relating to countries of Latin America (Argentina, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Uruguay), written in English, Spanish or Portuguese, published between the year 2000 and 31 December 2015.

#### *Exclusion criteria*

Articles that assess data from Latin America and other regions together, without differentiation; articles that do not allow for any type of comparison between the mode of delivery and maternal death; articles that used only descriptive analysis without an appropriate statistical analysis; articles whose data were collected before 1980.

### *Literature search strategy*

A systematic literature review on the relationship between maternal death and cesarean section in Latin America was carried out. The methodology of the systematic review involved an extensive search of all relevant published/unpublished data.

To ensure that the search terms already identified (maternal mortality, maternal death, cesarean section, vaginal birth and normal birth) were appropriate, as well as to discover others, an initial database search test was conducted in an exploratory manner. Terms added to the search strategy after this analysis were: caesarean, C-section, vaginal and normal delivery, mode, type and method of delivery. Moreover, an analysis was carried out to evaluate the feasibility of the study and to make adjustments, such as for the time period and geographic location.

Following the initial search, a wide range of electronic databases sources was used, accessed through PubMed, Global Health, Popline and the WHO library. Two important database of the Latin America

region were also used: the Scientific Electronic Library Online (SCIELO) and Literatura Latino-Americana e do Caribe em Ciências da Saúde (LILACS). SCIELO is an electronic virtual library that covers a selected collection of Latin American scientific journals. LILACS is the most important and comprehensive index of scientific and technical literature of Latin America and the Caribbean.

The database search was performed considering the literature published between the year 2000 and 31 December 2015. Three domains were identified in the search strategy (maternal mortality, mode of delivery and area of study). Within the domains, the Boolean Operator 'OR' was used to combine the search terms, whereas between the domains, the Boolean Operator 'AND' was used to combine the three domains (maternal mortality AND mode of delivery AND area of study).

Terms related to maternal mortality were 'maternal death' OR 'maternal mortality'. Terms related to mode of delivery were 'caesarean section' OR 'caesarean' OR 'cesarean' OR 'c-section' OR 'vaginal delivery' OR 'normal delivery' OR 'vaginal birth' OR 'mode of delivery' OR 'type of delivery' OR 'method of delivery'. Terms related to geographic location were 'Latin America' OR 'Central America' OR 'Argentina' OR 'Belize' OR 'Bolivia' OR 'Brazil' OR 'Chile' OR 'Colombia' OR 'Costa Rica' OR 'Ecuador' OR 'El Salvador' OR 'Guatemala' OR 'Guyana' OR 'Honduras' OR 'Mexico' OR 'Nicaragua' OR 'Panama' OR 'Paraguay' OR 'Peru' OR 'Suriname' OR 'Uruguay' OR 'Venezuela'. All of the words were translated into Spanish and Portuguese when searching the Latin America databases.

The specific details of the search results are demonstrated in Fig. 1. A large number of literature articles were generated by the initial searches (1344), many of which were excluded as being unrelated to the search by a review of the title alone or a quick review of the abstract. Following the review of these abstracts, 316 articles were identified for full text consideration before this number was narrowed down to 7 final articles that met the inclusion criteria for the review. Excluded articles ( $n = 309$ ) did not procedure any statistical association between the mode of delivery and maternal death, or assess data from Latin America and other regions together, without differentiation. Articles that evaluated data before 1980 were also excluded. In the final stage of the literature review, 7 final articles were selected.

Language restrictions were not applied in the search or in the selection process. Potentially eligible datasets included journal articles, registries, and published or unpublished information from government or other agencies, whether available in print or online. In addition, data from 'Grey literature' was also examined from contacted experts in the field.

Each title, abstract, full text, dissertation/thesis and grey literature was evaluated by the same author. Thus, 7 articles were considered in the final analysis.

### *Data extraction, synthesis and critical appraisal*

The papers that fulfilled the inclusion criteria were then read fully, and a quality assessment was conducted through critical appraisal by the author. The tool used for the evaluation was PROMPT, a structured approach to the critical evaluation of information (provenance, relevance, objectivity, method, presentation, timeliness (The Open University, 2014)).

Key findings on the association between maternal mortality and the mode of delivery in Latin America were noted as necessary factors to take into consideration, including logistic regression (odds ratio) and the relative risk. Moreover, information regarding whether maternal death was secondary to complications of cesarean section or to underlying conditions and the difference between the risk of maternal death associated with planned or elective cesarean section, emergency cesarean section or intrapartum cesarean section were analyzed. Particular attention was given to the articles with analysis adjusted for confounders such as low or high risk pregnancy.

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