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REVIEW ARTICLE

Pelvic floor: vaginal or caesarean delivery? A review of systematic reviews

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Abstract

Introduction and hypothesis In recent years the number of caesarean sections has increased worldwide for different reasons. to review the scientific evidence relating to the impact of the type of delivery on pelvic floor disorders (PFDs) such as urinary and faecal incontinence and pelvic organ prolapse.

Methods A review of systematic reviews and meta-analysis, drawn from the following databases: MEDLINE (via PubMed), Scopus, Web of Science, The Cochrane Library and LILACS (Literatura Latinoamericana y del Caribe en Ciencias de la Salud/ Latin American and Caribbean Health Sciences Literature) prior to January 2019. The directives of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses were used in assessing article quality.

Results Eleven systematic reviews were evaluated, 6 of which found a significantly decreased risk of urinary incontinence associated with caesarean section and 3 meta-analyses showed a significant reduction in POP for caesarean section, compared with vaginal delivery. Of 5 reviews that examined delivery type and faecal incontinence, only one indicated a lower incidence of faecal incontinence associated with caesarean delivery. However, most of the studies included in these reviews were not adjusted for important confounding factors and the risk of PFDs was not analysed by category of caesarean delivery (elective or urgent).

Conclusion When compared with vaginal delivery, caesarean is associated with a reduced risk of urinary incontinence and pelvic organ prolapse. These results should be interpreted with caution and do not help to address the question of whether elective caesareans are protective of the maternal pelvic floor.

Keywords Pelvic floor · Parturition · Delivery · Obstetric · Cesarean section · Urinary incontinence · Fecal incontinence

Introduction

Pelvic floor disorders (PFDs) include stress urinary incontinence (SUI), urge urinary incontinence (UUI), pelvic organ prolapse (POP) and faecal or anal incontinence (FI, AI) [1]. These disorders are frequently experienced by women around the world [2, 3]. These pathological conditions, which often co-exist [3], make it difficult for patients to carry out day-to-day tasks, affect their social and sexual relations, and cause a significant decrease in their quality of life, often leading to social isolation and depression [4]. In addition, given how widespread they are, PFDs generate high health costs [5] because of the need for absorbent products and the need for treatment through medication or surgery [6]. The US Census Bureau population projections estimate that the total number of women who will undergo surgery for POP from 2010 to 2050 is likely to increase by 48.2% over these four decades [7].

Pregnancy and vaginal delivery, especially if forceps or other instruments such as spatulas or vacuums are used [8],

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have been the modifiable risk factors most closely associated with the development of PFDs [9]. Additionally, other risk factors related to the development of PFDs, such as the presence of incontinence prior to the first pregnancy, obesity, diabetes, age, menopause, being multiparous, smoking, chronic constipation and abdominopelvic surgery have also been linked to the prevalence of PFDs [10].

Compared with vaginal delivery, caesarean delivery is associated with higher maternal and infant mortality, higher levels of complications in subsequent pregnancies, increased perinatal mortality, placenta praevia, or ectopic pregnancy, as well as higher health costs [11]; hence, its recommendation, on the basis of its potential protective effect on the pelvic floor, is controversial and continues to arouse scientific debate.

The rate of caesarean sections around the world is increasing [12]. Between 1990 and 2014, the global caesarean section rate increased by 12.4%, with the largest overall increases occurring in Latin America and the Caribbean (19.4%, from 22.8% to 42.2%), followed by Asia (15.1%, from 4.4% to 19.5%), Oceania (14.1%, from 18.5% to 32.6%), Europe (13.8%, from 11.2% to 25%), North America (10%, from 22.3% to 32.3%) and Africa (4.5%, from 2.9% to 7.4%) [13]. There are multiple and complex reasons for the increase in the number of caesarean sections. Changes in maternal characteristics, professional practice styles, economic, social and cultural factors have all been implicated [14]. The fear of a possible PFD could be one reason for maternal request or professional advice regarding a planned caesarean section [15].

This systematic review of reviews analyses current evidence as to the effect of the type of birth on urinary incontinence (UI), FI and POP, so that the informed and joint decisions arrived at by patient and medical practitioner relating to the type of delivery are based on the best scientific knowledge available.

Materials and methods

Design

We carried out a review of systematic reviews on the link between type of birth and UI and/or FI and POP.

Data sources

Data were obtained from direct online access to and searches of the following biomedical bibliographic databases: MEDLINE (via PubMed), Scopus, Web of Science, Cochrane Library and LILACS (Literatura Latinoamericana y del Caribe en Ciencias de la Salud/Latin American and Caribbean Health Sciences Literature).

Information processing

The following were used to define the search terms: Medical Subject Headings (MeSH), the controlled medical vocabulary Thesaurus developed by the US National Library of Medicine, with the following terms considered appropriate: "Delivery, obstetric"; "Urinary Incontinence"; "Pelvic Organ Prolapse"; "Pelvic Floor Disorders" and "Faecal Incontinence". The equation for the final search was developed for use in the MEDLINE database, via PubMed, using Boolean connectors, resulting in the following:

("Delivery, Obstetric"[Mesh] OR "Delivery, Obstetric"[Title/Abstract] OR "Obstetric Delivery"[Title/Abstract]) AND ("Urinary Incontinence"[Mesh] OR "Urinary risk Incontinence"[Title/Abstract] OR "Pelvic Organ Prolapse"[Mesh] OR "Pelvic Organ Prolapse"[Title/Abstract] OR "Pelvic Floor Disorders"[Mesh] OR "Pelvic Floor Disorders"[Title/Abstract] OR "Faecal Incontinence"[Mesh] OR "Faecal Incontinence"[Title/Abstract]).

The following filters were used (limits): "Humans"; "Female"; "Systematic Reviews" and/or "Meta-Analysis".

The same strategy was adapted to the characteristics of the other databases consulted. The search was carried out from the first available date, in accordance with the characteristics of each database, until January 2019 and was completed with an assessment of the bibliographic list of the articles selected, including in the analysis studies that had been identified, but had not been detected in the digital search.

Article selection

Systematic reviews with or without meta-analysis were selected. These had to fulfil the following inclusion criteria: correspond to the search objectives (the question of a causal relationship between caesarean delivery and UI, FI and POP), be published in peer-reviewed journals, and the full text had to be retrievable. Studies were excluded if they were not based on humans or did not include an empirical result directly related to UI, FI and POP.

The selection of relevant articles was carried out independently by three authors: ALL, LGP and ABR. In order to confirm the validity of the studies included it was established that the inter-rater agreement for the authors (using the Kappa index) should be higher than 80%. If this condition was met, possible discrepancies were resolved by consulting with the author MPV, with all authors subsequently reaching consensus [16].

Data extraction

The monitoring of information extracted from the publications under review was carried out by means of double tables that enabled error detection and their subsequent correction through further consultation of the original sources. The papers were grouped according to the study variables, with the aim of systematising and facilitating the results, taking the following factors into consideration: lead author of the bibliographic reference and year of publication, the number of patients, age, parity adjustment, population type and type of birth delivery, duration of postpartum care, and the presence of UI, FI or POP. To determine the currency of the papers the Burton–Kebler semi-period was calculated (the median age of the references) and the Price Index (percentage of documents published within the preceding 5 years) [17, 18].

Quality of reporting of the selected documents

To assess the quality of reporting of the selected documents, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement was used [19]; the checklist contains a list of 27 essential aspects that should be described in the publication of systematic reviews. One point was assigned for each item present (if not applicable, it was not scored). When an item was composed of several points, the points were assessed independently, giving the same value to each point and then averaging them (the final result of that item), so that in no case was it possible to score more than 1 point per item.

Finally, we revised our document attending the PRISMA guidelines (Appendix 1).

Results

In total, 279 references were found, 65 in MEDLINE, 97 in SCOPUS, 18 in the Cochrane Library, 5 in LILACS and 97 in the Web of Science, as well as one paper found through the manual search. After removing duplicates, applying inclusion and exclusion criteria, and consulting the bibliographic lists, 11 studies were selected for review and critical analysis (Fig. 1) [20–30]: 5 were systematic reviews [20, 23, 26, 27, 29] and 6 meta-analyses [21, 22, 24, 25, 28, 30]. All eligible studies were fully recovered. The inter-rater agreement for the selected studies was 96.0% ($p < 0.001$) according to the Kappa coefficient.

In Table 1, the principal characteristics of the reviews and meta-analyses are described in relation to the type of delivery and their relationship with UI, FI and POP. Most of the reviews included, to a lesser or greater degree, prospective and retrospective cohort studies, cross-sectional studies, case–control studies, and 5 papers [20, 23–26] included a controlled clinical trial [31–33]. Of the reviews evaluated, 9 included statistical populations selected from both population registers and case histories [21–25, 27–30]. Only 1 review had a population selected solely from population registers [26], whereas 1 meta-analysis did not provide information on the benchmark population [20]. Significant variability was observed between the different studies in terms of follow-up time, from 6 weeks to 21 years, with a median of 12 months, and an interquartile range of 21.

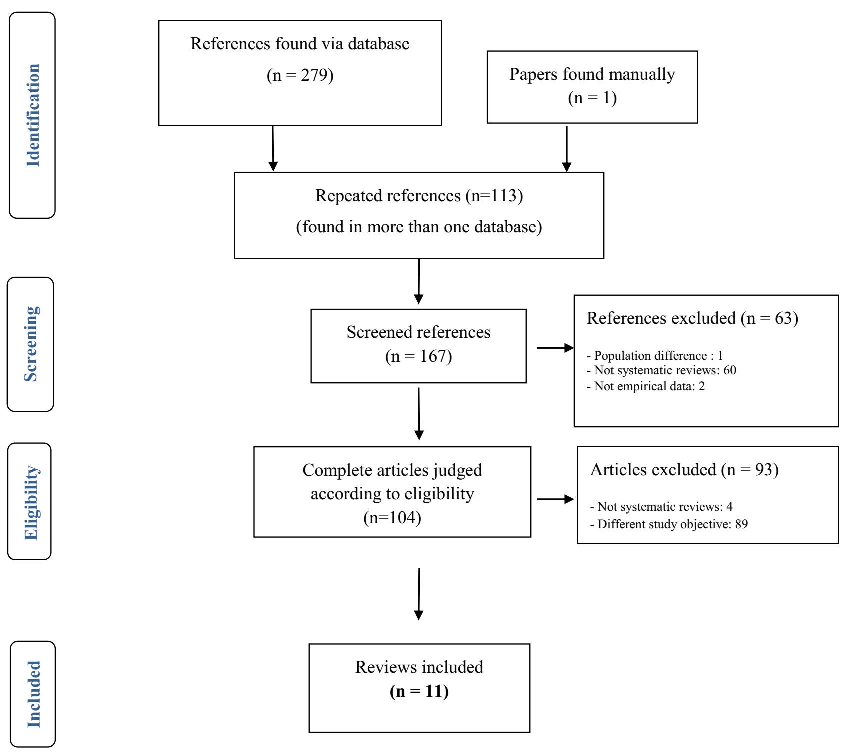

Fig. 1 Flow diagram of identification and article selection

Of the papers analysed, 7 included maternal age-adjusted studies [21–25, 28, 30] whereas the remaining 4 did not provide information as to whether they had adjusted for maternal age or not. Nelson et al. [23, 25], Azam et al. [20], Press et al. [26] and Thom et al. [29] included studies adjusted for parity.

Table 2 describes the quality of reporting of each study according to the PRISMA statement. Points ranged from a high of 27 and a low of 14 (median 18; interquartile range 9) (Table 2). The semi-period of the Burton–Kebler Index was 6 years and the Price Index was 37.5%.

Urinary incontinence

There were 6 systematic reviews [20, 21, 26, 28–30] (including 3 meta-analyses [21, 28, 30]) that studied the effect of vaginal delivery compared with caesarean delivery in relation to UI. These studies included a collective sample size of 217.545 women from 92 articles but with an estimated overlap between the 6 systematic reviews included, which ranged from 6.25% to 44.4%. The reporting quality of these systematic reviews and meta-analyses ranged from 14 to 26 according to PRISMA criteria (Table 2).

The 6 systematic reviews [20, 21, 26, 28–30] identified an inverse significant association between caesarean delivery and urinary incontinence compared with vaginal delivery, with significant variability in follow-up monitoring, which ranged from 3 months to 21 years, with the most frequent period being 1 year.

The meta-analysis by Tähtinen et al. [28] showed a rise in urinary incontinence, both stress incontinence (OR 1.85, 95% CI (1.56, 2.19)) and urge incontinence (OR 1.30, 95% CI (1.02, 1.65)), in women who had vaginal births irrespective of parity, with follow-up monitoring ranging from 1 year to 10 years. The most recent meta-analysis [30] showed a higher risk of SUI for vaginal birth than for caesarean birth (OR 0.45, 95% CI (0.37, 0.55), $p < 0.00001$), although these results were not adjusted for parity.

Three of these reviews [21, 26, 28] aimed to perform stratified analyses by caesarean type (elective caesarean, or in labour caesarean) versus vaginal birth, but these analyses could not be carried out because of the paucity and heterogeneity of data between the individual studies.

Faecal incontinence

There were 5 systematic revisions [21, 23–25, 27] that assessed the effect of caesarean birth versus vaginal delivery on FI. These reviews included 89 studies with a collective sample size of 137,023 women. The estimated overlaps between reviews range from 6% to 66%. There was a remarkable variability in the follow-up monitoring period from 6 weeks to 21 years. The reporting quality of these reviews ranged from 15 to 27 (Table 2).

There was only a review published by Pretlove et al. [27] that showed a significant increase in the risk of FI versus forceps and eutocic vaginal delivery, although this review included the studies with the shortest follow-up monitoring period from 6 weeks to 1 year postpartum and did not report adjustment for age or parity. According to its results, women having any type of vaginal delivery had an increased risk of developing symptoms of solid, liquid or flatus FI compared with those undergoing a caesarean section. The risk varied with the mode of delivery ranging from a doubled risk with a forceps delivery (OR 2.01, 95% CI (1.47, 2.74), $p < 0.0001$) to a 30% increased risk of a spontaneous vaginal delivery (OR 1.32, 95% CI (1.04, 1.68), $p = 0.02$). Pretlove et al. also reported that instrumental deliveries resulted in more symptoms of FI compared with spontaneous vaginal delivery (OR 1.47, 95% CI (1.22, 1.78)). This was statistically significant for forceps deliveries alone (OR 1.5, 95% CI (1.19, 1.89), $p = 0.0006$) but not for ventouse deliveries (OR 1.31, 95% CI (0.97, 1.77), $p = 0.08$). When symptoms of solid and liquid FI alone were assessed, these trends persisted but were no longer statistically significant.

In the other 4 reviews [21, 23–25] (which included 3 meta-analyses [21, 24, 25]) no reduction in the incidence of FI was observed for women who had undergone caesarean deliveries compared with those who had vaginal deliveries (OR 1.04, 95% CI (0.73, 1.48) [21]; OR 0.91, 95% CI (0.74, 1.14) [25]; and OR 0.89, 95% CI (0.76, 1.05) [24]; $p = 0.005$).

Nelson et al. [23–25] presented a subgroup analysis adjusted according to the type of caesarean (urgent versus elective) and showed no statistically significant difference between type of caesarean and FI.

Pelvic organ prolapse

The incidence of POP associated with caesarean sections versus vaginal births was studied by 3 meta-analyses [21, 22, 30]. These studies included 25 articles with a collective sample size of 1,600,657 women, with an estimated overlap of 7.25%. The follow-up monitoring period ranged from 1 year to 24 years. The quality of reporting varied from 14 to 24 according to PRISMA criteria (Table 2). The results of the 3 meta-analyses showed a significant reduction in POP for caesarean section against vaginal delivery.

Discussion

The objective of this review of systematic reviews has been to identify and synthesise the scientific evidence published around the impact of the type of delivery on PFDs. The results of this review showed an increased risk of PFDs associated with vaginal birth compared with caesarean delivery. However, these results should be interpreted with caution as various possible

Table 1 Principal characteristics of the systematic reviews included, and associations between mode of delivery and pelvic floor disorders

Systematic review	Type of study	Maternal age	Parity	Population type	Mode of delivery	EC vs CL	Postpartum follow-up	Effect on pelvic floor disorders: Urinary incontinence	Faecal incontinence	Pelvic organ prolapse
Nelson et al. [25], meta--analysis	Cohort, cross-sectional, and case–control studies, and RCT, $N = 50–4,032$	Adjusted	Adjusted	Based on population register/-based on hospital register	CS vs VD	Analysed	4 months to 6 years	Not included	**Faecal incontinence**: OR 0.91, 95% CI (0.74, 1.14), $p = \text{NR}$	Not included
Press et al. [26], systematic review	Cross-sectional, $N = 408–11.96-8$. Cohort, $N = 202–1,472$	Not includ-ed	Adjusted	Based on population register	CS vs VD	Planned to stratify but not analysed because of the paucity and heterogeneity of the data	3 months to 4 years	Cross/sectional: Stress UI: Primiparae: OR 0.59, 95% CI (0.40, 0.87) Multiparae: OR 0.51, 95% CI (0.36, 0.71) Urge UI: Primiparae: OR 1.46, 95% CI (0.84, 2.56) Multiparae: OR 0.53, 95% CI (0.26, 1.28) Cohorts Stress UI: Primiparae: OR 0.40, 95% CI (0.29, 0.54) Multiparae: OR 0.58, 95% CI (0.44, 0.77) Urge UI: Primiparae: OR 0.46, 95% CI (0.25, 0.86) Multiparae: OR 0.44, 95% CI (0.21, 0.93)	Not included	Not included
Pretlove et al. [27], systematic review	Observational, $N = 107–7,275$	Not includ-ed	Not ad-justed	Based on population register/-based on hospital register	VD vs CS	Not analysed	6 weeks to 1 year	Not included	Forceps delivery vs caesarean OR 2.01, 95% CI (1.47,2.74), $p < 0.001$; eutocic vaginal birth vs caesarean OR 1.32, 95% CI (1.04, 1.68), $p = 0.02$	Not included
Thom et al. [29], systematic review	Cross-sectional, $N = 114–3,405$	Not includ-ed	Adjusted	Based on population register/-based on hospital register	CS vs VD	Not analysed	3 months to 1 year	Median prevalence: all births: 33%, 95% CI (31.5, 36.3); vaginal birth: 35.4%, 95% CI (33.4, 38.6); caesarean: 14.6%, 95% CI (11.4, 17.9)	Not included	Not included
Nelson et al. [23], systematic review	Cohort, cross-sectional, and case–control studies, and	Adjusted	Adjusted	Based on population register/-based on	CS vs VD	Analysed	3 months to 6 years	Not included	No differences found between caesarean and vaginal birth	Not included

Table 1 (continued)

Systematic review	Type of study	Maternal age	Parity	Population type	Mode of delivery	EC vs CL	Postpartum follow-up	Effect on pelvic floor disorders: Urinary incontinence	Faecal incontinence	Pelvic organ prolapse
	RCT, $N = 50–23,337$			hospital register						
Azam et al. [20], systematic review	RCT, $N = 2,088$. Cohorts, $N = 12,679$	Not included	Adjusted	Not included	CS vs VD	Not analysed	3 months to 6 months	RCT: Elective caesarean in primiparae: after 3 months RR 0.62, 95% CI (0.41, 0.93), $p = 0.02$ Elective caesarean in primiparae: after 2 years RR 0.81, 95% CI (0.63–1.06), $p = 0.35$; Cohort in primiparae: after 6 months RR 0.33, 95% CI (0.25, 0.43), $p = NR$	Not included	Not included
Tähtinen et al. [28], meta-analysis	Cohort and cross-sectional studies, $N = 307–19,024$	Adjusted	Adjusted	Based on population register/based on hospital register	VD vs CS	Planned to stratify but not analysed because of the paucity and heterogeneity of the data	1 year to 20 years	All UIs: HR 2.9, 95% CI (2.4, 3.6) Stress UI: AOR 1.85, 95% CI (1.56, 2.19), $p = 0.003$ compared with elective caesarean: AOR 3.53, 95% CI (2.55, 4.90), $p = 0.82$ Urge UI: AOR 1.30, 95% CI (1.02, 1.65), $p = 0.14$	Not included	Not included
Keag et al. [21], meta-analysis	Cohort and cross-sectional studies, $N = 1,507–52,498$	Adjusted	Adjusted	Based on population register/based on hospital register	CS vs VD	Planned to stratify but not analysed because of the paucity and heterogeneity of the data	1 year to 20 years	All UIs: OR 0.56, 95% CI (0.47, 0.66), $p < 0.001$	Faecal incontinence: OR 1.04, 95% CI (0.73, 1.48), $p = 0.82$	Pelvic organ prolapse: OR 0.29, 95% CI (0.17, 0.41), $p = 0.005$
Leng et al. [22], meta-analysis	Cohort and cross-sectional studies, RCTs, $N = 449–1,444,548$	Adjusted	Adjusted	Based on population register/based on hospital register	VD vs CS	Not analysed	1 year to 24 years	Not included	Not included	Pelvic organ prolapse: OR 2.22, 95% CI (1.72, 2.87), $p = 0.00$
Yang and Sun [30], meta-analysis	RCT or cohorts, $N = 61–2,428$	Adjusted	Not adjusted	Based on population register/based on	CS vs VD	Not analysed	Not included	SUI: OR 0.45, 95% CI (0.37, 0.55), $p < 0.00001$	Not included	Pelvic organ prolapse: OR 0.59, 95% CI

Table 1 (continued)

Systematic review	Type of study	Maternal age	Parity	Population type	Mode of delivery	EC vs CL	Postpartum follow-up	Effect on pelvic floor disorders		
								Urinary incontinence	Faecal incontinence	Pelvic organ prolapse
				hospital register						(0.50, 0.70), $p < 0.00001$
Nelson et al. [24], meta-analysis	RCT and cohorts, $N = 250$—no data	Adjusted	Adjusted	Based on population register/based on hospital register	CS vs VD	Analysed	6 months to 20 years	Not included	Combined anal incontinence (FI and GI): OR = 0.74 (0.54–1.02) FI: (OR = 0.89; 0.76–1.05) GI: (OR = 0.96; 0.79–1.18)	Not included

RCT randomized clinical trial, *RR* relative risk, *OR* odds ratio, *CI* confidence interval, *UI* urinary incontinence, *HR* hazard ratio, *AOR* adjusted odds ratio, *CS* caesarean section, *VD* vaginal delivery, *EC* elective caesarean, *CL* caesarean in labour, *UI* urinary incontinence, *SUI* stress urinary incontinence, *FI* faecal incontinence, *GI* gas incontinence

sources of bias and methodological weaknesses have to be taken into consideration. Moreover, the studies included in our review did not help to address the question of whether elective caesareans are protective of the maternal pelvic floor.

One important source of bias could be the observational nature of most of the studies in the reviews. In studying the link between PFDs and vaginal birth, the undertaking of randomised clinical trials is especially complex owing to the very nature of vaginal birth, which is a natural process but one whose progress and outcome is, a priori, unpredictable. Non-elective caesarean delivery entails urgent surgery carried out when there are complications in the process of giving birth or specific obstetric or medical circumstances that render it necessary, which in itself complicates the randomisation of patients. Of the studies reviewed, 5 included a randomised clinical trial (RCT) as part of their analysis [20, 21, 23, 25, 26].

Some of the reviews in the present study [20, 21, 23, 25, 26] incorporated The Term Breech Trial [31, 32] in which 2,088 women whose babies were in the breech position at term were randomised according to whether they had intended to have a caesarean or a vaginal delivery. The incidence of UI and FI was evaluated 3 months after giving birth and again after 2 years, identifying an increased risk of UI or IF for vaginal birth. Breech presentation itself has characteristics that complicate delivery, and make the involvement of instruments more likely; thus, this type of study has particular features that mean that its results are not comparable with those included in the reviews being considered. Hence, breech presentation studies were not included by other authors [28–30]. However, Nelson et al. [24] did include in their meta-analysis a second substantial RCT, published more recently by Hutton and colleagues [33], in which they randomised 2,305 mothers of twins. Giving birth to twins, like breech birth, has some distinctive characteristics regarding PFDs in terms of caesarean and vaginal delivery. Nelson et al. [24], despite defining it as an atypical value, included this study since it did not essentially alter the results of their analysis, as it represented less than 6.6% of the meta-analysis.

Unfortunately, the observational studies of both the risks and the benefits of caesarean and vaginal delivery are subject to multiple confounding factors too.

First, the studies included in the systematic reviews evaluated derive from population-based surveys or from data obtained from hospital registers, or both. Population-based surveys have the advantage of including a wide range of sample patients, but their selection bias tendency is high, as those women who have suffered a degree of postpartum incontinence or prolapse are more likely to take part. Studies based on data obtained from clinical registers may also have a selection bias, as it is not infrequently the case that patients who continue to attend check-ups are those who have shown some level of incontinence, whereas those who experienced no alteration in the pelvic floor are lost to follow-up.

Table 2 Evaluation of the studies included according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for reporting in systematic reviews and meta-analyses

References	PRISMA items																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	T
Nelson et al. [25]	1	0	0	1	0	1	1	0	0	0	0	0	1	1	1	1	0	1	0	1	1	0	1	1	1	1	0	15
Press et al. [26]	1	0	1	0	0	1	1	1	1	1	1	0	1	1	0	0	0	1	0	1	NA	0	0	1	1	1	0	15
Pretlove et al. [27]	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	0	23
Thom et al. [29]	1	0	1	1	0	1	1	1	1	1	1	0	1	1	0	0	1	1	0	1	NA	0	0	1	1	1	1	18
Nelson et al. [23]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	27
Azam et al. [20]	1	0	0	0	0	1	1	0	0	1	1	1	1	1	0	0	1	1	1	1	1	0	0	1	1	1	0	16
Tähtinen et al. [28]	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	26
Keag et al. [21]	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	24
Leng et al. [22]	1	0	1	0	0	1	1	0	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	0	0	0	1	18
Nelson et al. [24]	1	0	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	24
Yang and Sun [30]	1	0	1	0	1	1	0	0	0	1	0	1	1	0	1	0	1	0	1	0	1	1	0	1	0	1	0	14

In general, these studies included few potential risk factor adjustments. The two factors for which results were most frequently adjusted in the reviews assessed were maternal age and parity.

In the more recent studies, BMI was also included among the adjustment factors [22, 24, 28], but important risk factors for the subsequent development of PFD, such as UI prior to pregnancy, ethnicity, age of first-time mothers, prior family history of PFDs, the use of instruments during delivery, or the weight at birth of the new-born [34] were not included in most of the studies analysed, or their inclusion was not homogeneous, leading us to consider that the results obtained in our review, despite being the best available evidence, should be treated with caution.

For UI, the 6 systematic reviews analysed indicate a greater risk of suffering SUI in patients who had vaginal delivery compared with patients who had caesarean sections [20, 21, 26, 28–30]. Although it is true that the reviews by Press et al. [26] and Thom et al. [29] include short follow-up periods (of under a year), the increased risk of SUI with vaginal delivery after the first year is also corroborated by more recent studies, such as Tähtinen et al. [28] or Kreag et al. [21], that exclude patients with a follow-up period of less than a year, opting to include monitoring periods of up to 20 years [21]. This is of great clinical relevance as although there is evidence that PFDs are more frequent during the first year postpartum for women who have vaginal births than for those who have caesarean deliveries [29], in many cases the disorder can be mild, transient and self-limiting, or it can be long-term, which makes awareness of the risk factors associated with permanent or more severe dysfunction particularly important. In this regard, awareness of incontinence prior to or during pregnancy could be considered particularly relevant, but this information is unfortunately lacking in the great majority of available studies [28].

The studies provide different estimates of the specific calculation of the risks of SUI associated with vaginal birth. The study by Tähtinen et al. [28] estimates the increased risk of moderate or severe SUI at 8%. It is worth noting that this result was conditioned by age and was lower for older cohorts. This could be due to the existence of aetiological factors unrelated to the mode of delivery but associated with the development of UI in older women, such as the menopause. The same study found that the higher risk was less evident for UUI, estimated at approximately 3% [28], either because there were other pre-existing aetiological factors or because the power of the studies included in the reviews has not yet proved sufficient to establish the level of risk put forward. Not forgetting that the data derive from observational studies, it is worth contextualising the results via the number needed to treat (NNT) set out by some studies. Kreag et al. [21] estimate that approximately 17 caesarean deliveries would be necessary to avoid a case of UI, but for every 1,500 caesarean deliveries carried out, there would be approximately 9 additional cases of infant asthma, and in subsequent pregnancies 166 women with infertility, 3 cases of placenta praevia, 2 women with uterine rupture, 21 miscarriages and 1 instance of stillbirth [21].

The results for FI are consistent in the 5 systematic reviews analysed [21, 23–25, 27]. The data available to date suggest that the preservation of anal continence should not be a factor in opting for an elective caesarean delivery instead of a vaginal delivery [23] as a higher level of risk has not been shown for FI resulting from vaginal birth than from caesarean birth. For the incidence of POP, the 3 studies analysed identified a decrease in the risk of POP relating to caesarean birth compared with vaginal birth [21, 22, 30].

Finally, some of the systematic reviews included in the present work aimed at assessing the risk of PFDs separately for each category of caesarean delivery, i.e. elective caesarean (planned) or caesarean in labour (urgent) versus vaginal birth. When the analysis could be carried out, (all of them focused on FI), the authors [23–25] found no difference between the two groups, but it is remarkable that others [21, 26, 28] could not in the end analyse this aspect, as most of the studies retrieved were either not designed to examine this relationship or had small sample sizes and lacked statistical power.

Limitations of the present review

The high rate of non-relevant articles (280) in relation to the final selection made (11) can be considered a possible limitation of this review. Scopus and Web of Science databases initially retrieved many works that were ultimately irrelevant, which could be due to the lack of indexing (the search was done in text format querying the title, abstract and keywords) and the impossibility of limiting the search by the type of article (restricted to systematic reviews). This high document "noise" was previously observed in other systematic reviews [17, 35]. Moreover, although a comprehensive search was performed, we cannot rule out the possibility that some studies were not identified by the bibliographic databases searched or the manual search.

Another limitation of the present review comes from the fact that we could not conduct a meta-analysis owing to clinical and methodological heterogeneity such as different study designs, significant variability in the postpartum follow-up periods, variability in adjustments for potential risk factors, and different statistical estimates. We therefore could not carry out a quantitative approach to the data and consequently make solid recommendations about the mode of delivery and its impact on PFDs.

Strengths

To our knowledge, this is the first review of systematic reviews about the impact of mode of delivery on PFDs. With the object of minimising publication bias, the database searches were exhaustive, with neither language nor date restrictions, with all systematic reviews fulfilling the search criteria being included, regardless of whether meta-analysis had been carried out or not. We attempted to minimise bias in the present review by adhering to the PRISMA guidelines [19].

Authors´ opinion

Despite intense research on this issue, a recommendation on mode of delivery with the only objective of the protection of the pelvic floor has to be made with caution. We believe that the risk of PFDs is significantly higher after caesarean in labour than after an elective caesarean. Unfortunately, despite our review showing a higher risk of UI and POP after vaginal birth as opposed to caesarean section, these results were mainly from studies that did not perform analyses for elective caesarean separately. Moreover, the evaluation of the systematic reviews and meta-analyses included in this paper leads us to underline the importance of identifying the factors that represent the highest risk of suffering PFDs. This is important, both for the design of future research and to inform patients, not only about the health impact of the delivery type but also to prescribe preventive measures to minimise risk factors for PFDs before and during pregnancy. In this context, studies along the lines of that by Wilson et al. [34], which is aimed at systematising the available information on risk factors that might be presented by a full-term pregnant woman and that can contribute to damage to the pelvic floor as a result of vaginal birth, can be of great assistance when it comes to providing the patient with the best possible information.

Efforts should be channelled towards the study of PFD risk factors and long-term health-related quality-of-life outcomes for both the mother and the baby. Maybe the question is not a straightforward choice between caesarean delivery and vaginal delivery, but rather assessing the extent to which the significant risks for mother and baby involved in caesarean delivery are an acceptable alternative to irreversible injury to the pelvic floor.

Conclusion

Despite the fact that the statistical results obtained in the studies analysed show an increased risk of urinary incontinence and pelvic organ prolapse related to vaginal delivery, recommending an elective caesarean section with the sole aim of preserving the maternal pelvic floor should be undertaken with caution, as there is a lack of direct evidence about the protective effect of planned caesarean section.

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Compliance with ethical standards

Conflicts of interest None.

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