

# Comparison of different cesarean delivery techniques: A systematic review and meta-analysis

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## ABSTRACT

**Background:** The purpose of this systematic review and meta-analysis study was to compare various caesarean delivery methods.

**Methods:** A search for available articles published since January 2023 was accomplished in PubMed, Medline, Embase, and Cochrane literature databases. The search method that encompassed all pertinent publications was developed using terms from the medical subject headings thesaurus and keywords from related literature. We also used the PICO method (where P is population, I is intervention, C is comparator/control, and O is outcome for our study) to establish research question. Whereas Cochrane handbook of “systematic reviews of interventions” was used for risk of bias assessment.

**Results:** The results showed a significant difference in patient gratification between the gentle/natural/skin-to-skin contact caesarean and the traditional/conventional/standard caesarean. In assessing the satisfaction with delivery mode, the mean variance for these studies similarly revealed a significant difference between the natural caesarean and the conventional one. A skin-to-skin contact caesarean delivery takes less time to start nursing than a conventional delivery, according to the results of the study on the time of breastfeeding initiation after a natural caesarean. There was a low-risk bias among the selected studies.

**Conclusions:** As a result of greater satisfaction with delivering experience the natural caesarean delivery was most preferred method. The enhanced skin-to-skin contact and breastfeeding suggested that natural caesarean is beneficial over the conventional method.

**Keywords:** caesarean delivery, medical subject headings thesaurus, natural delivery, skin-to-skin contact, standard caesarean delivery

## INTRODUCTION

20% of all births worldwide, or one of the most prevalent surgical operations, include caesarean deliveries [1]. Vaginal and caesarean births have different maternal outcomes. Caesarean deliveries have been associated with lower levels of overall satisfaction, as well as delays in mother-newborn interactions, skin-to-skin contact, and the start of nursing [1-3]. In order to enhance the birthing process, numerous hospitals have adopted a family-centered caesarean delivery strategy that mimics a vaginal delivery. Only a few studies have examined the family-centered caesarean separately or contrasted it to the standard caesarean delivery, which is referred described as a gentle, natural, skin-to-skin, or Charité caesarean [2, 4-10]. The skin-to-skin caesarean sections differ significantly from standard caesarean sections in that the surgical drape is dropped before the newborn is carefully delivered, facing the parents so they may see the birth process. After that, the surgeon hands the newborn to the mother, allowing them to have immediate skin-to-skin contact.

Higher parental satisfaction, a better infant outcome since physiological auto resuscitation is mimicked during this technique, greater bonding, and higher breastfeeding success rates are all claimed advantages of the skin-to-skin caesarean section [11, 12]. The previous studies and case series have identified an improved patient satisfaction [4, 9] and higher breastfeeding rates, [4, 6, 9] moreover there is no difference in maternal outcomes or complication rates with family-centered caesarean deliveries [2, 4-7]. In contrast to the majority of research [3, 10, 13], one found a decrease in admissions to newborn critical care units and suspected neonatal infections [8]. Breaking the sterile barrier has possible dangers in addition to the caesarean section, such as a higher risk of surgical site infections [14, 15]. In the recent years, a community hospital setting that contains a family medicine residency training program has developed and implemented a mild caesarean program. Despite the fact that these methods have not yet been fully assessed within the framework of an empirical trial, our preliminary findings indicate that this strategy may be promising and calls for additional investigation. Keeping in view, this systematic review and meta-analysis study was designed to compare different caesarean delivery techniques.

**Table 1.** A systematic review & meta-analysis inclusion & exclusion standards for research

| PICO components    | Inclusion criteria                                                                                                                                           | Exclusion criteria                                                                                                       |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Population         | Women with caesarean delivery                                                                                                                                | Women non-caesarean delivery                                                                                             |
|                    | Studies on gentle, natural, skin-to-skin, family-centered, & Charité caesarean delivery                                                                      | Anything not including listed topics regarding caesarean delivery                                                        |
| Intervention       | Peer reviewed research with all types of study designs (such as quantitative, qualitative, & mixed methods)                                                  | Anything other than peer-reviewed articles & literature such as reviews, blogs, books chapters, websites content, & more |
|                    | Original article                                                                                                                                             | Reviews                                                                                                                  |
|                    | Randomized control trials                                                                                                                                    | Meta-analysis/systemic reviews                                                                                           |
|                    | English language research                                                                                                                                    | Publications in languages other than English                                                                             |
| Comparator/control | Gentle/natural/skin-to-skin contact/Charité caesarean/family centered caesarean delivery versus traditional/conventional/standard caesarean delivery methods | Study without any control group                                                                                          |
| Outcome            | Birth satisfaction & breastfeeding initiation                                                                                                                | Studies reporting no outcome                                                                                             |

## METHODS

### Search Strategy

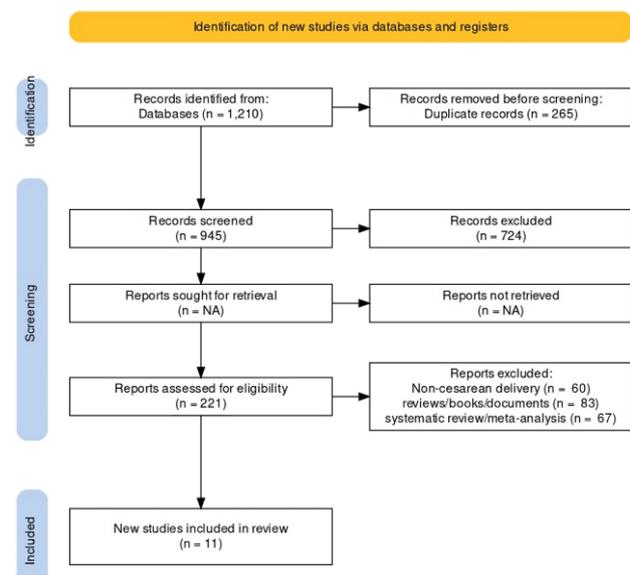
A search for relevant English-language full-text articles published since January 2023 was effectuated in online literature databases including PubMed, Medline, Embase, and Cochrane. PICO format was followed to design the research question as it is the recommended method by Cochrane and PRISMA guidelines. A search approach that incorporates all pertinent articles was developed using terms from the MeSH (subject headings thesaurus) and keywords from pertinent literature. Search parameters were [caesarean section OR caesarean birth] AND [gentle OR natural OR skin-to-skin OR family-centered OR Charité caesarean]. A cross-reference was done to locate more relevant studies in the reference lists of the papers that were included. This investigation was carried out in accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines [16]. The scientists separately decided whether or not to include the titles and abstracts. The risk of bias of included studies was assessed by using an assessment tool of “Cochrane handbook for systematic reviews of interventions version” with critical appraisal for medical and health sciences checklist for systematic review.

### Inclusion and Exclusion Criteria

Only studies that satisfied the inclusion criteria were deemed eligible after being located utilizing the PRISMA technique and critical appraisal tools (<https://jbi.global/critical-appraisal-tools>). The authors independently examined the titles and abstracts to identify articles that would be possibly appropriate for full text examination. The same process was followed throughout the whole text review. Finally, personally checking reference lists from included papers to find other, perhaps suitable studies. The authors independently assessed the study abstracts and full texts to determine which papers to include based on the inclusion and exclusion criteria after removing any plainly extraneous information (Table 1).

### Quality Assessment

The assessment tool covers seven domains: random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias),



**Figure 1.** PRISMA flow chart of literature selection for systematic literature review & meta-analysis (Source: Authors' own elaboration)

selective reporting (reporting bias), and other biases. Bias was assessed as “low risk,” “high risk,” or “unclear risk.”

### Data Extraction and Analysis

The authors independently gathered information on the author, publication year, country, number of participants, mode of distribution, and fines. The two reviewers resolved discrepancies in data gathering using the original publications as a reference, or if no consensus could be reached, they were referred to a third reviewer. A meta-analysis was not performed due to the heterogeneity of the measures and results.

## RESULTS

A total of 1,210 articles were revealed after the original search, and 265 duplicate records were removed. Following an examination of the publications' titles and abstracts, 724 were eliminated from the study. The remaining 221 papers underwent thorough examination and further screening based on research. The study included 11 articles with investigations on caesarean delivery techniques that were found to be eligible (Figure 1).

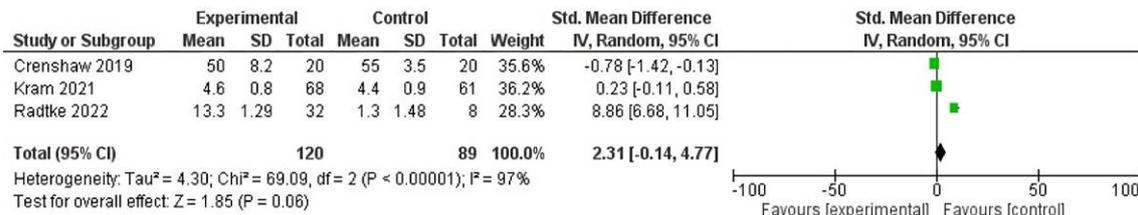
**Table 2.** Characteristics of studies related to different cesarean delivery techniques

| Article | Country     | n   | Methods                                                                          | Findings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | EB  |
|---------|-------------|-----|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| [1]     | Spain       | NA  | Skin-to-skin contact                                                             | Professionals consented to this because of health advantages given & because mothers voiced their satisfaction, especially if they had previously undergone a cesarean without skin-to-skin contact. This requires alterations to health care team's normal work procedures.                                                                                                                                                                                                                                                                                                                                                                                     | Yes |
| [7]     | Netherlands | 650 | Conventional cesarean section vs. a "natural" or "skin-to-skin" cesarean section | According to this study, compared to traditional cesarean delivery, poor maternal, & newborn outcomes were not enhanced after a skin-to-skin cesarean.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Yes |
| [8]     | Netherlands | 163 | Family centered cesarean sections vs. standard cesarean sections                 | Compared to routine cesarean sections, unplanned admissions happened more frequently following family-centered cesareans (21 vs. 7%; p=0.03); this is likely because of peripheral oxygen saturation monitoring. Respiratory pathology did not increase (eight vs. 6%, ns). During or after a family-centered cesarean, one-third of infants were taken away from their mother.                                                                                                                                                                                                                                                                                  | NA  |
| [9]     | USA         | 320 | Skin-to-skin contact                                                             | In contrast to these same women's prior experiences of cesarean birth without use of skin-to-skin contact, quality improvement study evaluated women's views of skin-to-skin contact following cesarean birth. The women talked about how skin-to-skin contact after a cesarean having had numerous advantages. Postpartum experience for many women & babies could be improved by this kind of project, which is applicable to labor & delivery units in all kinds of institutions. It can also open up opportunities for further research that can clarify & confirm beneficial effects of skin-to-skin contact on patient satisfaction & breastfeeding rates. | Yes |
| [17]    | China       | 679 | Skin-to-skin contact                                                             | It's findings revealed that early breastfeeding in Chinese hospitals that are favorable to infants depends on skin-to-skin contact. After a cesarean section, skin-to-skin contact should be used to encourage breastfeeding & longer skin-to-skin contact is encouraged to get full benefit. If longer skin-to-skin contact is not possible, at least 30 minutes of skin-to-skin contact could improve early breastfeeding initiation & exclusive breastfeeding at discharge.                                                                                                                                                                                   | Yes |
| [18]    | Germany     | 110 | Charité vs. conventional cesarean delivery                                       | Neonatal hospitalization rates, umbilical cord characteristics, maternal blood loss, & surgery time did not substantially differ between Charité & traditional cesarean delivery groups. Women who had a Charité cesarean delivery were substantially happier with their birthing experience than those who had a standard cesarean delivery. Following birth, postnatal depression, breastfeeding, or bonding factors did not significantly differ from one another.                                                                                                                                                                                            | NA  |
| [19]    | China       | 280 | Skin-to-skin contact                                                             | Skin-to-skin contact has a high clinical application & promotion value & can effectively treat postpartum depression in uterine parturient, promote lactation, increase blood flow restriction, facilitate uterine involution, & relieve chronic uterine inflammation & postpartum pain.                                                                                                                                                                                                                                                                                                                                                                         | Yes |
| [20]    | USA         | 129 | Family-centered cesarean delivery vs. traditional cesarean delivery              | There was no difference in satisfaction that this study could identify (4.6 method 1 vs. 4.4 method 2; p=.27). Mean time to skin-to-skin contact, however, varied greatly. Skin-to-skin contact was made by patients in method 1 on average 11.2 minutes earlier than it was by patients in method 2 (5.1 vs. 16.3; p<.01). There were no other variations in maternal & neonatal outcomes found.                                                                                                                                                                                                                                                                | Yes |
| [21]    | Egypt       | 100 | Skin-to-skin contact & a control group                                           | Duration of third stage of labor and beginning of breastfeeding were both positively impacted by early mother baby skin-to-skin contact after birth, according to this study.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Yes |
| [22]    | USA         | 40  | Skin-to-skin care                                                                | Skin-to-skin contact for group 1 started on average 0.89 minutes after birth & persisted for an average of 300 minutes, whereas it took 46 minutes on average for group 2 to start & 126 minutes on average to finish. Women who started skin-to-skin contact during surgery reported higher degrees of satisfaction with procedure (p=0.015) & lower cumulative levels of salivary cortisol (p=0.003). There were no adverse reactions on physiologic stability of mother or newborn, & there was no variation in rates of exclusive breastfeeding at discharge.                                                                                                | Yes |
| [23]    | Canada      | 21  | "Standard" cesarean section vs. "gentle" section                                 | Women in typical group felt less involved in childbirth, according to this study. However, considering potential future pregnancies, both groups continued to choose vaginal delivery. After giving birth, participants in "gentle" section group displayed less dread of childbirth than they had earlier.                                                                                                                                                                                                                                                                                                                                                      | NA  |

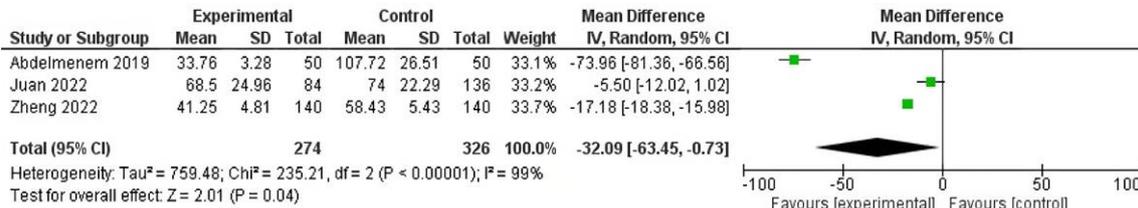
Note. n: Number of study participants & EB: Encouraged breastfeeding & skin-to-skin contact

**Table 2** lists the features of the selected studies. The 2,492 women who undergo cesarean sections are included in the chosen studies for this systematic review. The findings revealed that three studies were carried out in the United States, two in China, and two in the Netherlands. In contrast, studies were carried out in Germany, Egypt, Spain, Canada, and Spain. All chosen studies contrast gentle, natural, skin-to-skin contact, Charité, and family-centered cesarean approaches with conventional, traditional, and standard cesarean techniques. Six of the chosen studies were eligible for the meta-analysis.

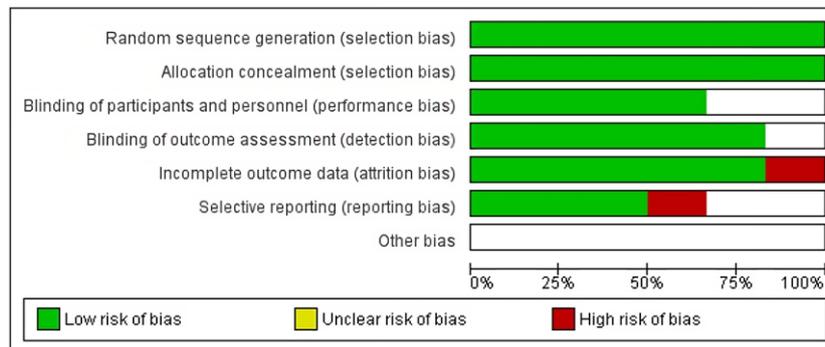
Three studies in forest plot compared satisfaction with gentle/natural/skin-to-skin contact/Charité cesarean/family centered cesarean delivery vs. traditional/conventional/standard cesarean delivery methods that showed significant difference (p<0.00001) with heterogeneity (I<sup>2</sup> value) of 97% among studies. Mean difference for these studies also showed significant difference among gentle/natural/skin-to-skin contact/Charité cesarean/family centered cesarean and traditional/conventional/standard cesarean delivery methods in describing satisfaction with delivery method (2.31; 95% CI, -0.14, 4.77) (**Figure 2**).



**Figure 2.** Forest plot for satisfaction with gentle/natural/skin-to-skin contact/Charité cesarean/family centered caesarean delivery versus traditional/conventional/standard cesarean delivery methods (Source: Authors’ own elaboration)



**Figure 3.** Forest plot for time of breastfeeding initiation with gentle/natural/skin-to-skin contact/Charité cesarean/family centered caesarean delivery versus traditional/conventional/standard cesarean delivery methods (Source: Authors’ own elaboration)



**Figure 4.** Quality assessment of included studies (Source: Authors’ own elaboration)

Similarly, three studies compared the time of breastfeeding initiation with the gentle/natural/skin-to-skin contact/Charité cesarean/family centered caesarean delivery versus traditional/conventional/standard cesarean delivery methods. There was a high degree of heterogeneity among the studies (I<sup>2</sup>=99%, p<0.00001). Whereas overall effect was also significant (p=0.04) with mean difference (-32.09; 95% CI, -63.45, -0.73) for these studies showing early initiation of breastfeeding with the gentle/natural/skin-to-skin contact/Charité cesarean/family centered caesarean delivery compared to the traditional/conventional/standard cesarean delivery methods (Figure 3).

**Risk Bias**

The assessment of the risk of bias is provided in Figure 4. The risk of bias assessment was done according to the guidelines of the Cochrane handbook for systematic reviews of interventions [24]. There was a low-risk bias among the selected studies.

**DISCUSSION**

The “natural caesarean” aims to incorporate natural birthing practices into caesarean delivery [3]. By removing the surgical drape during birth, allowing time for auto-

resuscitation, and encouraging early skin-to-skin contact, the “natural caesarean” allows for parental involvement in healthy women carrying singleton fetuses without deteriorated health conditions at term. In the years that followed, efforts to develop a “family-centered” or “gentle” caesarean birth technique mostly emphasized early skin-to-skin contact [2, 7, 25, 26]. Only limited information about birth experiences has been gathered, particularly outside of scheduled caesarean delivery [27].

One compared gentle/natural/skin-to-skin contact/Charité cesarean/family-centered caesarean delivery methods with traditional/conventional/standard caesarean delivery methods in the current systematic review and meta-analysis. In the current study, it was made the claim that early breastfeeding start in Chinese baby-friendly hospitals depends on skin-to-skin contact [17]. After a caesarean section, the skin-to-skin contact should be used to encourage breastfeeding, and longer skin-to-skin contact is encouraged to get the full benefit. If longer skin-to-skin contact is not possible, at least 30 minutes of skin-to-skin contact could improve early breastfeeding initiation and exclusive breastfeeding at discharge. The results of this study are consistent with those of earlier research and case studies, which found no differences in maternal outcomes and the majority of newborn outcomes [2, 4-7]. According to [18], there was no significant difference between Charité and traditional caesarean birth groups in

terms of infant hospitalization rates, umbilical cord parameters, maternal blood loss, or operation time. Women who had a Charité cesarean delivery were substantially happier with their birthing experience than those who had a standard cesarean delivery.

Following birth, postnatal depression, breastfeeding, or bonding factors did not differ significantly from one another. The “Charité cesarean birth” (CCB) is a modification of the “natural cesarean,” which was introduced by Prof. Henrich at the Charité Universitätsmedizin Berlin in 2012 and is now widely used. According to Armbrust, Hinkson [4], with the exception of cases with significant known maternal morbidities, the technique can be successfully carried out during the scheduled cesarean birth of healthy fetuses with a gestational time of >37 weeks.

According to reports, women who undergo a Charité cesarean section have a much better birthing experience than those who undergo a traditional cesarean section. With the study [4] only stating that earlier skin-to-skin contact was achieved in 72% of cases and the study [5] only stating that the median time to first skin-to-skin contact was three minutes with the family-centered method, it is our understanding that no prior studies have described the difference in time for skin-to-skin contact between methods. Among a few research, it was revealed that skin-to-skin contact might significantly reduce chronic uterine inflammation and postpartum discomfort, promote lactation, enhance blood flow restriction, and decrease postpartum depression in uterine parturient [19].

After birth, the skin-to-skin contact between the mother and the infant is a good strategy to increase breastfeeding start and duration [11, 28-30]. It is advised to encourage the skin-to-skin contact as soon as possible after delivery because this is when the baby is most likely to follow his or her natural inclinations to discover and latch onto the breast before beginning to nurse.

An immediate skin-to-skin contact following a normal vaginal birth is a desirable technique that encourages breastfeeding success. It is commonly established that the skin-to-skin contact improves nursing results. In the current investigation, a high degree of heterogeneity was found in the meta-analysis results of the time to breastfeeding beginning in natural cesarean birth and conventional cesarean delivery ( $I^2=99%$ ,  $p<0.00001$ ). Comparing the gentle/natural/skin-to-skin contact/Charité cesarean/family-centered cesarean delivery techniques to the conventional/standard/traditional cesarean delivery methods, the overall impact was likewise significant ( $p=0.04$ ) with a mean difference (-32.09; 95% CI, -63.45, -0.73). It was shown in a comprehensive review that the skin-to-skin contact enhanced breastfeeding results after a typical vaginal delivery, which is consistent with our findings [11].

In order to improve the mother’s and child’s health, breastfeeding is essential. The breastfeeding has been shown to offer considerable benefits for neonates’ survival, development, and growth [31]. According to reports, nursing helps guard against childhood illnesses and malocclusions, boost IQ, and lower the chance of developing diabetes and being overweight. Breastfeeding has been demonstrated to protect nursing mothers from ovarian cancer, breast cancer, and type 2 diabetes [31].

According to [26], introducing the skin-to-skin contact within an hour of cesarean birth increased breastfeeding rates

from 8% to 19%. The body temperature recovery of the two groups of preterm infants was not significantly different, and subsequent development indicators showed that SSC preterm infants had more advantages, according to [32], who performed skin-to-skin contact on 50 pre-term infants and compared them to pre-term infants receiving traditional care. According to [33], the skin-to-skin contact helps preterm newborns’ cognitive performance to some level in addition to stabilizing their fundamental physical indicators.

Family-centered caesareans should be adopted by healthcare systems as a caesarean delivery option and made available to low-risk patients who are scheduled for, or possibly even experiencing, an unplanned caesarean delivery [4, 8]. Due to the advantages they provide as well as the need for careful consideration of more family-centric approaches outside of the traditional caesarean delivery [34].

## CONCLUSIONS

The results of the current systematic review and meta-analysis revealed a substantial difference in satisfaction between family-centered caesarean deliveries and traditional/conventional/standard caesarean deliveries. While the findings of the time it took for breastfeeding to start after a skin-to-skin contact caesarean delivery were likewise significantly different from those of a conventional delivery, it took less time for breastfeeding to start after a skin-to-skin contact caesarean delivery. As a result of superior satisfaction with their entire delivering experience, mother-newborn interactions, skin-to-skin contact, and early breastfeeding start, the results of the present systematic review and meta-analysis demonstrated that natural caesarean delivery is most desired.

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**Ethical statement:** Authors stated that the current analysis is a review study and discerns no breaches of ethical principles within the investigated context.

**Declaration of interest:** No conflict of interest is declared by authors.

**Data sharing statement:** Data supporting the findings and conclusions are available upon request from the corresponding author.

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