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Review Article

Optimizing Antenatal Care: A Systematic Review and Meta-Analysis on How Scheduling Influences Fetal Outcomes

Reem Alraya, Amal AlZahrani, Ghufran Alruwaili, Ruba Alruwaithi, Rabab Alnakhli, Lina Bazeeb, Afrah Alreshidi, Bayan Aldeligan, Saja Farhan, Turki Shafi, Mashael Farhan, Gadeer Alshmmari, Ahmed Alruwaili, Mujtaba Mohammed, Dhya Alnahawi

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Abstract

Introduction: Maternal and neonatal health outcomes are significantly influenced by the presence or absence of prenatal care. This meta-analysis aims to comprehensively evaluate the impact of booked and unbooked pregnancies on fetal outcomes, addressing existing gaps in the literature. Despite extensive research on this topic, no prior meta-analysis has systematically examined this association. By synthesizing data from 23 studies encompassing 34,908 patients, this study provides novel insights into the relationship between prenatal booking status and fetal health outcomes. **Methods:** The meta-analysis adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and was registered in PROSPERO. PubMed and Google Scholar were searched for relevant literature comparing outcomes between booked and unbooked pregnancies. Inclusion criteria encompassed primary and multigravida pregnancies, singleton and multiple gestations, and both vaginal and Cesarean deliveries. Data extraction and quality assessment were performed using established tools. Statistical analyses, including forest plot approaches and sensitivity analyses, were conducted to assess overall effect sizes and address heterogeneity. **Results:** A total of 23 studies were included, with a combined sample size of 34,908 patients. Significant associations were observed between booked pregnancies and reduced risks of mortality, intrauterine fetal death, stillbirth, early neonatal death, and asphyxia. Booked pregnancies also exhibited a lower incidence of neonatal sepsis. However, heterogeneity and potential publication bias were noted, highlighting the need for cautious interpretation of results. **Conclusion:** This meta-analysis provides robust evidence supporting the positive impact of prenatal booking on maternal and fetal health outcomes. The findings underscore the importance of timely prenatal care in reducing adverse perinatal outcomes and improving neonatal well-being. Further research is warranted to address heterogeneity and potential biases, informing clinical practice and policy interventions aimed at optimizing maternal and fetal health globally.

Keywords: Pregnancy planning, Antenatal care, Fetal health outcomes, Neonatal well-being

Reem Alraya. Department of Pharmaceutical Care,First Health cluster in Eastern Province, King Fahad specialist hospital, Dammam,Saudi Arabia Ralriyaa@moh.gov.sa
Amal AlZahrani. Department of Pharmaceutical Care, First Health cluster in Eastern Province, King Fahad specialist hospital, Dammam,Saudi Arabia aalzahrani760@moh.gov.sa
Ghufran Alruwaili. Department of medicine, Aljouf university ,Skaka ,Kingdom of Saudi Arabia, Dr.ghufran23@gmail.com
Ruba Alruwaithi. College of Medicine, Taibah University, Medina, Kingdom of Saudi Arabia. Rubaalruwaithi@gmail.com
Rabab Alnakhli. Intern at King Saud bin Abdulziz university for health sciences, Jeddah, Kingdom of Saudi Arabia Rabab.qur@gmail.com
Lina Bazeeb. Intern at King Saud bin Abdulziz university for health sciences, Jeddah, Kingdom of Saudi Arabia Linabadheeb@gmail.com
Afrah Alreshidi. Public health Intern at university of Hail, Hail, Saudi Arabia afrahh1260@gmail.com
Bayan Aldeligan. Royal College of Surgeons in Ireland -Dublin. Riyadh, Kingdom of Saudi Arabia. Bayanaldu089@gmail.com
Saja Farhan. Department of Pharmacy, College of Pharmacy, Northern Border University, Kingdom of Saudi Arabia , Rafha. narapp0192@gmail.com
Turki Shafi. Department of Pharmacy, College of Pharmacy, Northern Border University, Kingdom of Saudi Arabia , Rafha. Turkisf7@gmail.com
Mashael Farhan. Department of Pharmacy, College of Pharmacy, Northern Border University, Kingdom of Saudi Arabia , Rafha mashaelalshammari14@gmail.com
Gadeer Alshmmari. Department of Nursing, Rafha specialized dental center, Northern Boarder Cluster, Saudi Arabia. Galshmmari@moh.gov.sa
Ahmed Alruwaili. Dental radiology department ,Rafha specialized dental center, Northern boarders of Saudi Arabia, Rafha ahbalrwaili@moh.gov.sa
Mujtaba Mohammed. Pediatric dentistry department, Rafha Specialized Dental Center, Northern Boarder Cluster, Saudi Arabia mmalabdullatif@moh.gov.sa
Dhya Alnahawi. Endodontic Department, Rafha specialized dental center, Northern Boarder Cluster, Saudi Arabia. Dalnahawi@moh.gov.sa

INTRODUCTION

Maternal mortality is defined as the mother's death either during her pregnancy or in the first 42 days following giving birth. The term "neonatal mortality" refers to a live birth that occurs within 28 days of birth. In low- and middle-income nations, the rates of newborn deaths are sometimes 10 times higher than in high-income nations. The death rates in many low-income countries now are comparable to those in high-

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income nations from the turn of the 20th century[1]. Few of the common elements of contemporary prenatal care have undergone rigorous evaluation since its beginning, and the relative benefits, risks, and expenses of various care packages are not well supported by data. Alternative schedules for the number of prenatal care appointments, the time between visits, and the topics covered at each session have not been thoroughly compared in the past. It is sense to presume that prenatal care has some positive effects on health, even though the exact mechanism of action may be intricate and multifaceted[2].

Lack of prenatal care can result in low birth weight, early pregnancy, intrauterine development retardation, and infections throughout the perinatal and postnatal stages, which can cause death in both mothers and children[3]. This shows that women should receive health education and counselling about the importance of prenatal care. In this manner, some of the tragedies that are often attributed to births by unbooked mothers might be avoided[4]. Important fetal issues span a wide range, including congenital defects, perinatal death, low birth weight (LBW), preterm delivery, and intrauterine growth restriction (IUGR). These results have broad ramifications for long-term health, neurodevelopment, and general quality of life in addition to reflecting the fetus's current state of health.

We want to offer a more comprehensive and nuanced view of the influence of prenatal care on fetal problems by using a meta-analytical approach that considers potential sources of bias and heterogeneity across studies. This summary will guide future research efforts focused on optimizing maternal and fetal health outcomes across varied communities, in addition to informing clinical practice and policymaking. The goal of this meta-analysis is to clarify the differences in fetal outcomes between pregnancies that are booked and those that are not, therefore illuminating the intricate relationship that exists between the use of prenatal care, mother traits, and pregnancy outcomes. We aim to provide insights that are crucial in forming evidence-based treatments and strategies to support optimum maternal and fetal health internationally by synthesizing the available data.

METHODOLOGY

This meta-analysis was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines[5]. Additionally, our meta-analysis has been registered in PROSPERO (ID: CRD42024524245) Figure 1.

Literature search strategy

We conducted electronic searches using PubMed and Google Scholar. To identify relevant literature comparing outcomes between booked or scheduled pregnancies and unbooked or unplanned pregnancies, the search strategy involves using variations of these terms. Specifically, combinations of "(booked OR scheduled)" and "(unbooked OR unplanned)" are employed, along with terms related to fetal health and outcomes such as "Fetal," "Fetal complications," and "fetal outcomes." This search is conducted across multiple iterations, ensuring comprehensive coverage of the topic.

Additionally, another aspect of the search strategy focuses on comparing outcomes between booked deliveries and unbooked deliveries, considering both fetal and maternal outcomes. This includes variations of terms such as "booked delivery," "Scheduled Delivery," "Planned birth," "unbooked delivery," "Unscheduled delivery," and "non-arranged delivery," along with terms related to fetal and maternal health outcomes like "fetal outcome," "pregnancy outcome," "complications," and "maternal Complications." Furthermore, to refine the search,

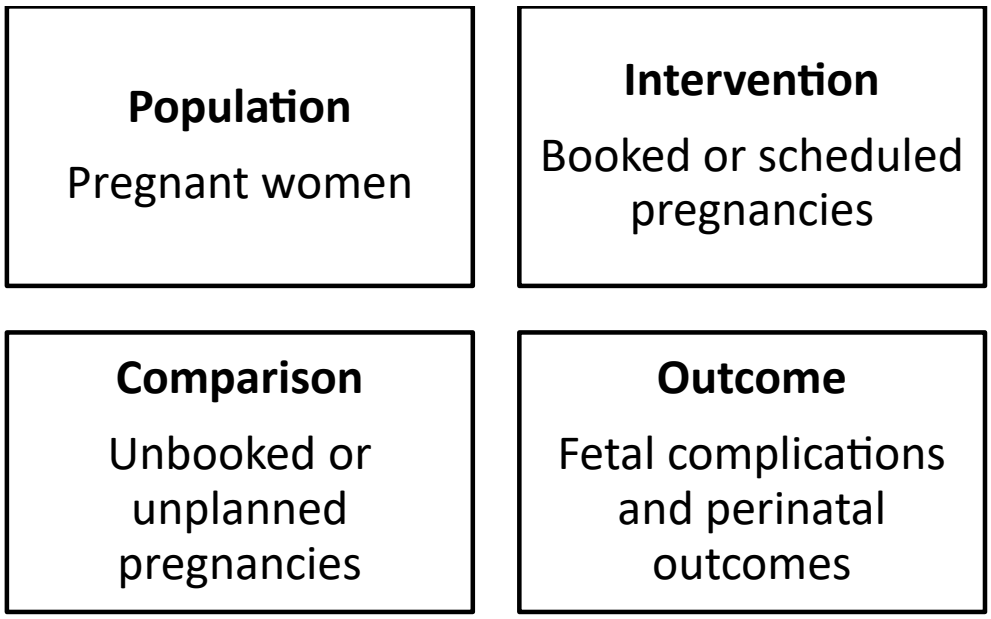

Figure 1. Basic Block List showing PICO elements for the study.

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terms like "Spontaneous Vaginal Birth" and "Vaginal Delivery" are added to capture specific delivery methods within the context of the comparison.

Selection criteria

The inclusion criteria encompass various factors to ensure a comprehensive analysis. Eligible studies must involve both primary and multigravida pregnancies, encompassing both singleton and multiple gestations. Both vaginal and Cesarean deliveries are considered, with the requirement that the studies are published in English between the years 2005 and 2023. Only primary articles reporting on fetal outcomes are included. Conversely, certain studies are excluded from the analysis to maintain focus and relevance. Long-term (chronic) complications are excluded, as are case reports, case series, and review articles. Additionally, studies focusing solely on delivery outcomes or maternal outcomes are not within the scope of this meta-analysis.

Data extraction and critical appraisal

Information was gathered from the articles' texts, tables, and figures. Two researchers separately examined each article, and any differences were settled through discussion and agreement with a third reviewer. The Newcastle–Ottawa Quality Assessment Tool[6] was used for the quality assessment of the included studies. This involved evaluating factors such as representativeness of cases, sample size, non-response rate, ascertainment of the screening tool, investigation of potential confounders, assessment of outcomes, and statistical tests used.

Statistical Analysis

A meta-analysis was conducted for each outcome of interest using a forest plot approach. This involved pooling data from multiple studies to estimate overall effect sizes and assess statistical significance. Risk ratios (RRs) with corresponding 95% confidence intervals (CIs) were calculated to quantify the association between booked and unbooked pregnancies and each outcome. Heterogeneity among studies was assessed using the I^2 statistic.

Sensitivity Analysis

Sensitivity analyses were performed to explore the impact of individual studies on overall results and to address heterogeneity. This involved excluding specific studies to assess their influence on the pooled effect size and heterogeneity.

RESULTS

Literature Search

The flowchart (Figure 2) illustrates the searching and screening procedure. Twenty-three studies involved a total of 34,908 patients were included (7–29). There were a total of 13,099 patients in the booked pregnant case group and 6542 patients in the unbooked pregnancy case group, respectively. Table

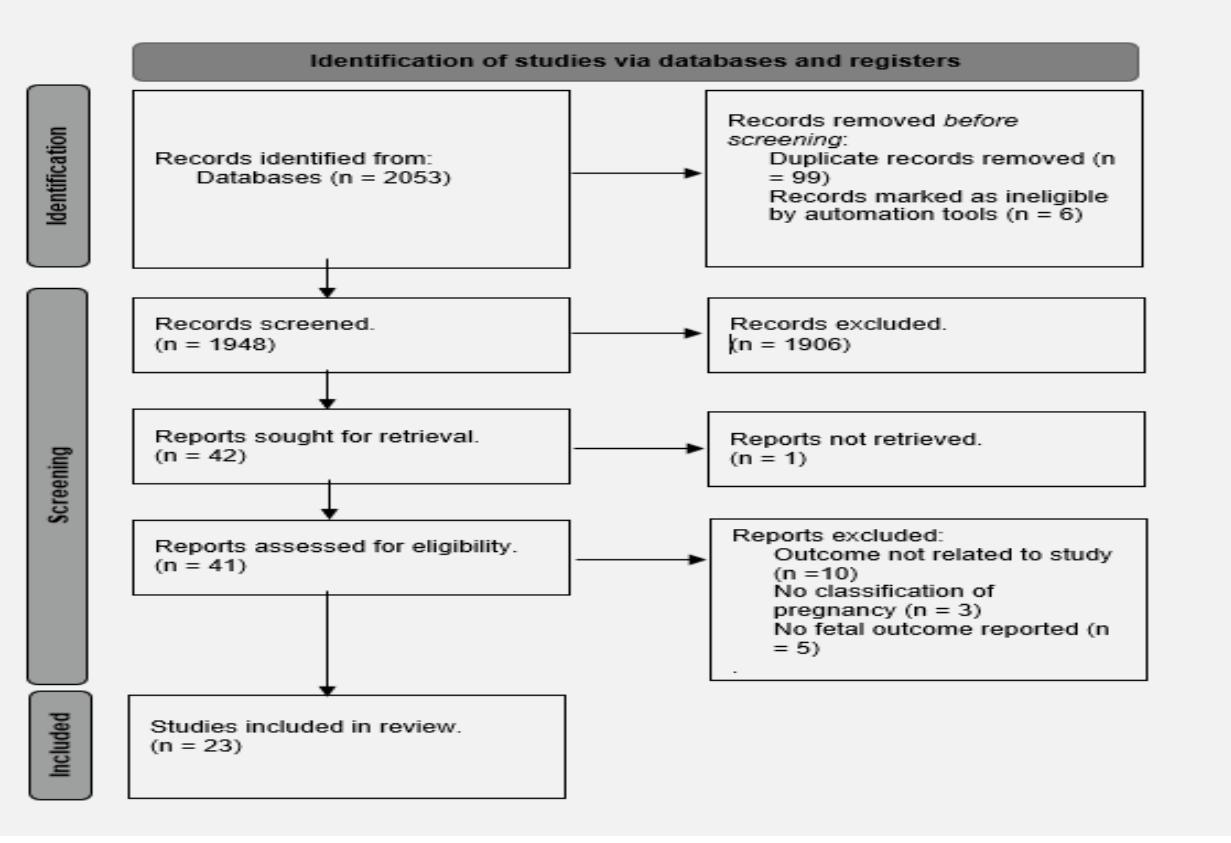

Figure 2. PRISMA flow chart showing study selection procedure.

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1 shows a summary of outcomes reported in the included studies.

Assessment of study quality and risk of bias

The Newcastle OTAWA Scale (6) was used to assess the studies, accounting for factors such as inadequate outcome data, participation blinding, random sequence generation, assessing outcomes, and other related validity issues. Every study variable was assigned to one of three risk categories: low, uncertain, or high. Table 2 includes the quality assessment of the included studies.

Outcomes Assessed

The present study aimed to assess various outcomes associated with booked and unbooked pregnancies through a comprehensive analysis of existing literature. Focusing on fetal health, the outcomes evaluated included low birth weight, macrosomia, NICU/SNCU admission, APGAR score less than 7 at 5 minutes, mortality, and asphyxia. The outcomes and their corresponding significance are depicted in the flowchart provided in Figure 2. In addition to the tabulated outcomes, a graphical representation of these results has been developed

Table 1. Risk of Bias Assessment of Included Studies

Author/Year	Country	Study Design	Total no. of participants included.	Booked	Unbooked	Gestational Age during Delivery	Fetal Outcomes and Complications
			(n)	(n)	(n)		
Rachita 2020	India	retrospective	2518	854	1664	NR	IUD, Still Birth, Anomalous babies, SNCU admission
B. Chigbu 2009	Nigeria	retrospective	3734	3100	634	NR	Apgar Score, Birth weight, IUD, Early neonatal death, birth asphyxia
Okojie 2022	Nigeria	cross-sectional	390	260	130	>28 weeks	Birth weight, IUFD, Neonatal jaundice, Birth asphyxia, MAS, seizures, Neonatal sepsis, Early neonatal death
Olusola 2003	Nigeria	Case-control	96	66	30	>28 weeks	Fetal weight, Apgar Score, Perinatal deaths, Birth injuries, Cord prolapse, Arrest of aftercoming head
A.O. Sule-Odu 2020	Nigeria	Retrospective and cross-sectional	1664	1037	627	>28 weeks	Apgar Score, Birth Weight, Head Circumference, Length, Abdominal Circumference, Alive, Dead, Early neonatal death
Dr. Sunakshi 2020	India	Prospective Observational	400	200	200	>28 weeks	IUD, Neonatal death
Charlotte 2023	Nigeria	Retrospective and Cross-sectional	434	282	152	<37 weeks (preterm) and full term	IUFD, Asphyxia, Low Birth Weight, Preterm Delivery, Poor Perinatal Outcomes
Owolabi 2008	Nigeria	prospective	1154	654	240	<37 weeks (preterm) and full term	Apgar Score, IUFD, Early Neonatal Death
Sapna 2016	India	prospective	800	400	400	>28 weeks	Respiratory Distress Syndrome, Birth asphyxia, Congenital malformation, IUGR, MAS, Neonatal sepsis, Convulsion, Jaundice, IUD, stillbirth, Early neonatal death
Oshodi 2016	Nigeria	retrospective	No exact size (14, 344)	49	74	>28 weeks	Apgar Score, Perinatal death
Okonta 2007	Nigeria	Retrospective	271	4/271	11/271	NR	Still Births
Onyema et al. 2019	Nigeria	Retrospective case-control	623	404	219	>28 weeks but < 37 weeks	Birth Weight, Alive at discharge, died before discharge
Ogumu et al. 2022	Nigeria	Retrospective Case-Control	22	16	6	>28 weeks	Birth Weight, Apgar Score, Live births, admission in SNCU, Perinatal death
Nida Zaki 2019	Pakistan	Comparative Cross-Sectional	235	114	121	>28 weeks	Apgar Score, Early Neonatal death, IUD, stillbirth, Alive
Innocent O 2009	Nigeria	Prospective Cross-Sectional	88	8	80	>28 weeks	Birth Asphyxia, Respiratory distress syndrome, Prematurity, Sepsis, Jaundice, Birth weight
Iklaki 2011	Nigeria	Case-Control	644	399	245	NR	Live birth, Early neonatal death, Fresh stillbirth, Macerated stillbirth

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Deeba 2015	Pakistan	Prospective cross-sectional	2000	1160	840	NR	Birth Asphyxia, Low Apgar Score, Low Birth Weight, Septicemia, Neonatal Jaundice, Perinatal Mortality, Fresh stillborn, IUFD, Neonatal deaths
Adenaya 2022	Nigeria	retrospective	2232	1997	235	>28 weeks	Birth weight, Apgar Score, IUFD, early neonatal death
Nidhi 2019	India	Prospective Cohort	1000	500	500	>28 weeks	Live birth, stillbirth, prematurity, MAS, NICU admission, Congenital anomalies, Early neonatal death
Dr. Digita 2021	India	Prospective observational	1500	1000	500	NR	Apgar Score, MSL, Congenital anomaly, IUD, Early neonatal death
Alisha 2010	UK	Retrospective Cohort	273	182	91	NR	Apgar Score, Low birth weight, IUFD
Mandu S. 2011	Nigeria	Retrospective cohort	362	330	32	NR	Alive and well, IUFD
Kate E. 2017	USA	Retrospective cohort	124	83	41	>30 weeks	Birth weight, Apgar Score, Respiratory Distress Syndrome, Surfactant administration, Neonatal length of stay

Table 2. includes the quality assessment of the included studies.

First Author Name	Representativeness of the cases	Sample size	Non-Response rate	Ascertainment of the screening tool	Potential confounders were investigated by subgroup analysis or multivariable analysis	Assessment of the outcome	Statistical test	Score
Okojie OH	*			*		**	*	05-Sep
B. Chigbu	*	*		*		**	*	06-Sep
A.O Sule-Odu	*	*		*		**	*	06-Sep
Rachita Tukaram Bangera	*	*		*		**	*	06-Sep
Charlotte Blanche Oguejiofor	*			*		**	*	05-Sep
Owolabi A T, Fatusi A O,	*	*		*	*	**	*	07-Sep
Sapna Chourasia1	*	*		*		**		05-Sep
Oshodi Yusuf Abisowo	*			*		**	*	05-Sep
P. I. Okonta,	*			*		**	*	05-Sep
Sunakshi Setia	*			*		**	*	05-Sep
Kate E. Pettit	*	*		*		**	*	06-Sep
Mandu S. Ekpenyong	*	*		*	*	**	*	07-Sep
Alisha Tucker	*	*		*		**	*	06-Sep
Dr. Digita Rathod	*	*		*		**	*	06-Sep
Adenaya OR	*	*		*		**	*	06-Sep
Deeba Kalim	*			*		**	*	05-Sep
Malachy Chizoba Onyema	*	*		*		**	*	06-Sep
Emmanuel I Ogumu	*	*		*	*	**	*	07-Sep
Nida Zaki	*			*		**	*	05-Sep
Olusola B	*			*		**	*	05-Sep
Innocent O. George	*			*		**	*	05-Sep
C. U. Iklaki	*	*		*		**	*	06-Sep

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to provide a visual summary of the comparative neonatal outcomes between booked and unbooked pregnancies. The graph serves as a valuable visual aid to enhance the presentation and interpretation of the findings, offering a comprehensive overview of the pooled results (Figure 3).

1. Low Birth Weight

A comprehensive evaluation of fetal complications associated with low birth weight was conducted utilizing data from 10 out of 23 selected studies. The analysis yielded noteworthy findings indicating a significant correlation between low birth weight and booked pregnancies, contrasting with outcomes observed in unbooked pregnancies. The collective analysis utilizing a forest plot approach exhibited a highly significant result ($p < 0.00001$), revealing a risk ratio of 0.47 (95% CI: 0.36-0.61). Despite the observed statistical significance, substantial heterogeneity was noted across the studies ($I^2 = 87\%$). These findings underscore the importance of further exploration to elucidate the factors contributing to low birth weight and its ramifications on fetal health within the context of both booked and unbooked pregnancies. (Figure 5)

2. Macrosomia

The evaluation of macrosomia incidence across 3 of the 23 studies did not demonstrate a significant association with either booked or unbooked case group pregnancies. The forest plot analysis yielded a non-significant result ($p = 0.23$), with a risk ratio of 0.98 (95% CI: 0.55-1.76), indicating comparable occurrences of macrosomia between the two groups. Moderate heterogeneity was initially observed among the studies ($I^2 = 32\%$). However, sensitivity analysis identified the "Okojie et al." study[7] as the primary source of this heterogeneity. These findings underscore the need for cautious interpretation of the results and further investigation into the potential influence of individual studies on overall outcomes. (Figure 6)

3. NICU/SNCU Admission

The assessment of admission in NICU or SNCU encompassed data from 3 out of 23 studies. Notably, the analyses did not unveil a significant association between NICU/SNCU admission and either booked or unbooked pregnancies. Intriguingly, despite the lack of significance in individual studies, the meta-analysis produced a highly significant result ($p < 0.00001$), yielding a risk ratio of 1.02 (95% CI: 0.71-1.45). However, substantial heterogeneity among the studies was evident ($I^2 = 92\%$). To address this high level of heterogeneity, sensitivity analysis was conducted, revealing that the study conducted by "Rathod et al"[20] was the primary source of heterogeneity in this outcome. These findings emphasize the importance of thorough examination and consideration of individual study contributions to overall results when interpreting meta-analytical findings. (Figure 7)

4. APGAR Score Less Than 7 at 5 mins

The evaluation of the APGAR score at 5 minutes included data from 6 out of 23 studies. Significantly, the analysis revealed a

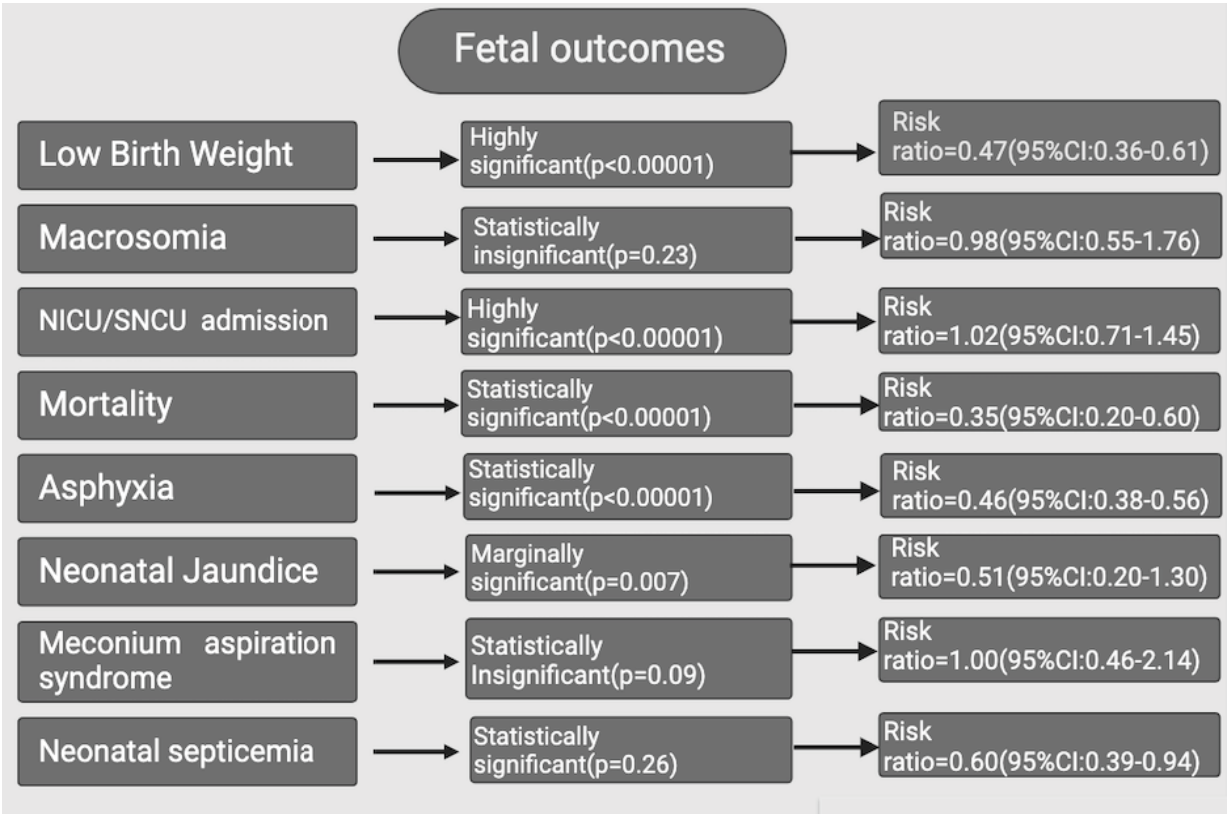

Figure 3. Outcomes and their corresponding significance.

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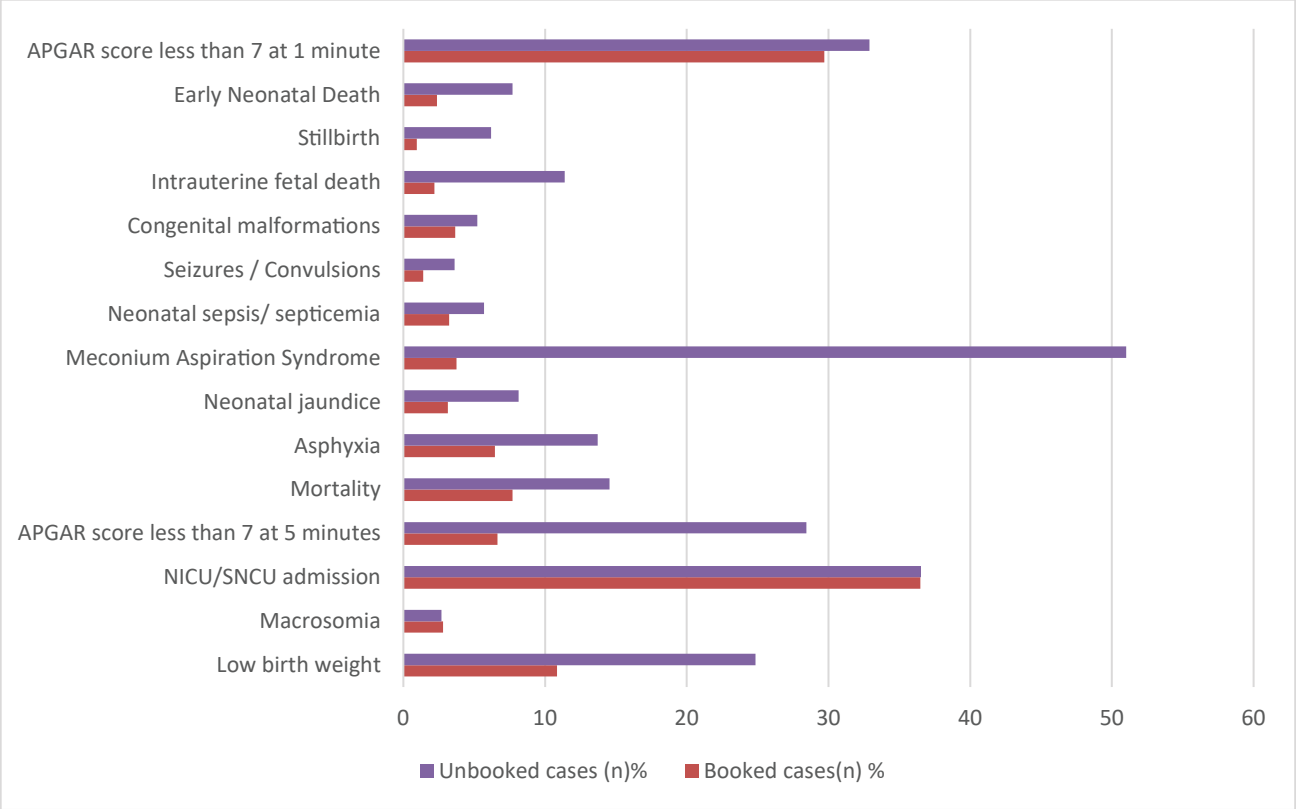

Figure 4. Analysis of Outcomes between Booked and Unbooked Pregnancies: A Pooled Result.

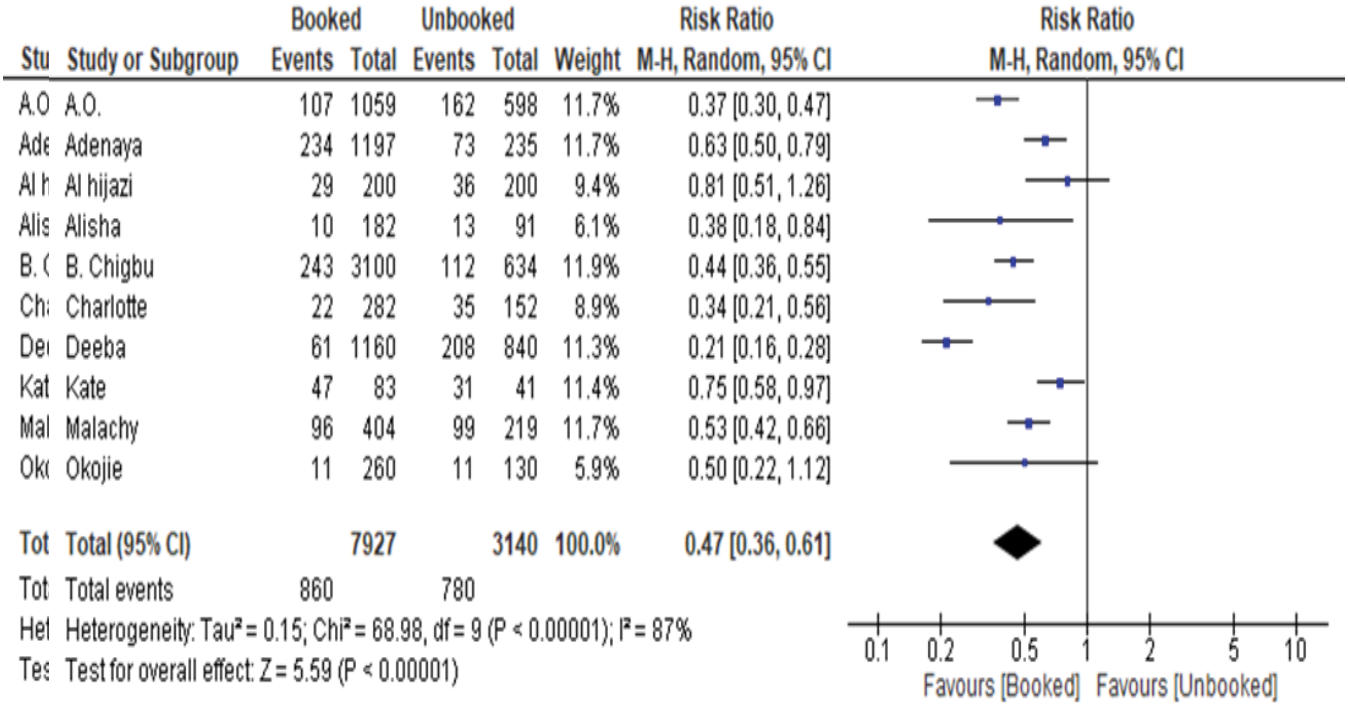

Figure 5. Forest plot demonstrating significant association of low birth weight with booked pregnancies rather than with unbooked pregnancies along with considerable high heterogeneity.

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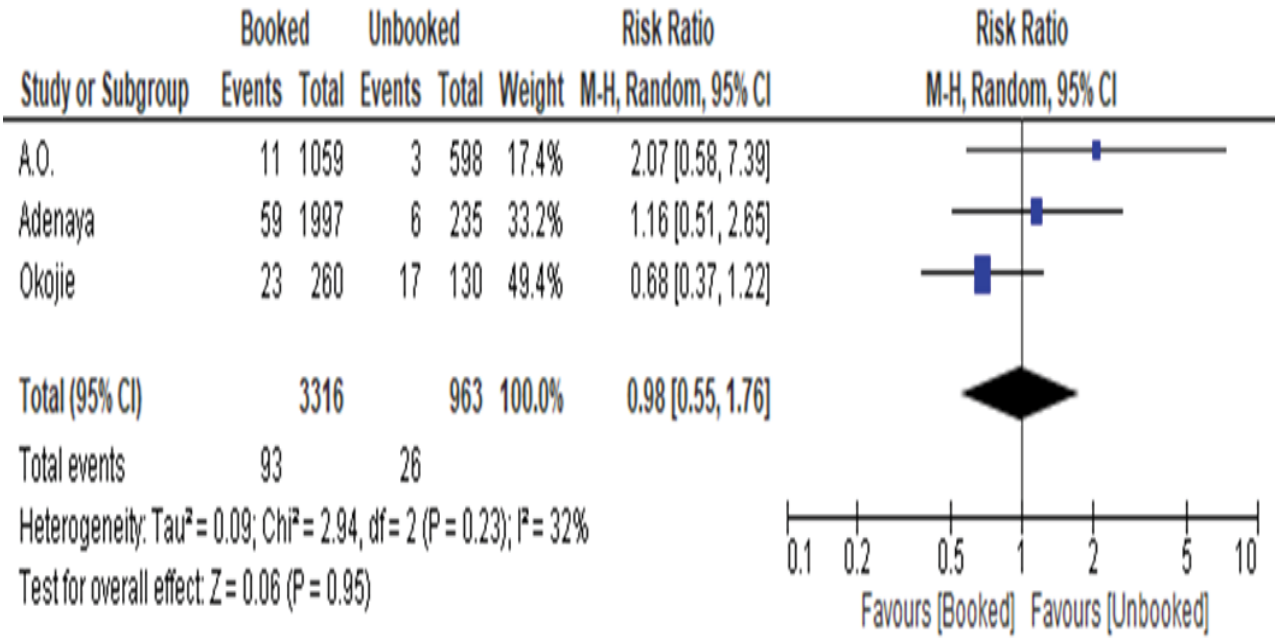

Figure 6. Forest plot showing no significant association of macrosomia in either group.

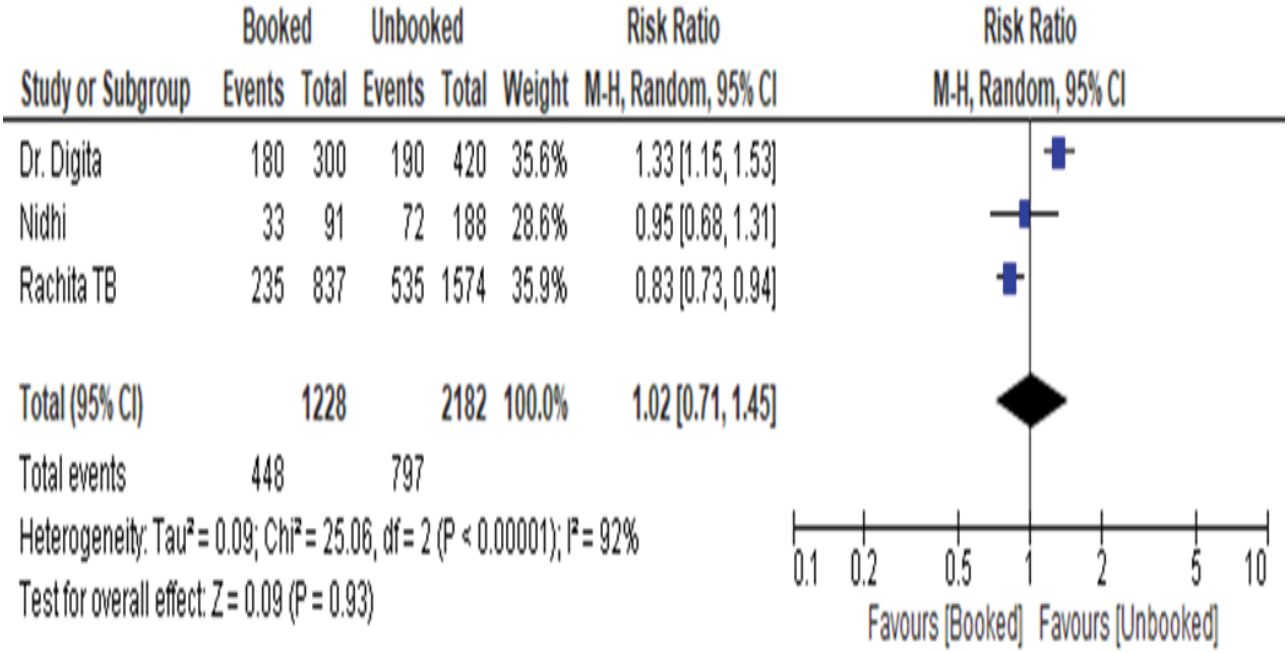

Figure 7. Forest plot showing no significant association of NICU/SNCU admission with any group.

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notable association of APGAR scores less than 7 at 5 minutes in booked pregnancies compared to unbooked pregnancies, despite substantial heterogeneity. The forest plot exhibited highly significant results ($p < 0.00001$), with a risk ratio of 0.36 (95% CI: 0.16-0.82), underscoring the heightened risk in booked pregnancies. However, it is crucial to note the substantial heterogeneity observed among the studies ($I^2 = 97\%$). These findings highlight the importance of further exploration into factors contributing to APGAR score discrepancies between booked and unbooked pregnancies to enhance perinatal care strategies. (Figure 8)

5. Mortality

Mortality trends were comprehensively examined across all 23 included studies. Strikingly, the analysis demonstrated a significant association of mortality with booked pregnancies in comparison to unbooked case groups. The meta-analysis yielded highly significant results ($p < 0.0001$), revealing a risk ratio of 0.35 (95% CI: 0.20-0.60), indicating a notably reduced risk of mortality in booked pregnancies. However, it is noteworthy that substantial heterogeneity was evident among the studies ($I^2 = 97\%$). These findings emphasize the critical need for further investigation into the factors underlying mortality outcomes in both booked and unbooked pregnancies to inform more effective intervention strategies and improve maternal and neonatal health outcomes. (Figure 9)

6. Asphyxia

The incidence of asphyxia was assessed across 6 out of the 23 included studies. Notably, the forest plot exhibited a significant association of birth with booked cases compared to unbooked cases of pregnancies. The meta-analysis unveiled highly significant results ($p < 0.00001$), with no observed heterogeneity among the studies ($I^2 = 0\%$). The risk ratio was estimated at 0.46 (95% CI: approximately 0.38-0.56), indicating a substantially reduced risk of asphyxia in booked pregnancies. These findings underscore the importance of timely prenatal care in mitigating the risk of adverse perinatal outcomes, such as asphyxia. (Figure 10)

7. Neonatal Jaundice

The occurrence of neonatal jaundice was examined in 4 out of the 23 included studies. Notably, the forest plot displayed no significant association of neonatal jaundice with either the booked or unbooked case groups of pregnancies. However, the meta-analysis yielded marginally significant results ($p = 0.007$), with moderate heterogeneity observed among the studies ($I^2 = 75\%$). The risk ratio was estimated at approximately 0.51 (95% CI: 0.20-1.30), suggesting a potential but not definitive reduction in the risk of neonatal jaundice in certain cases. Sensitivity analysis pinpointed studies by "Ghafoor et al" and "Chourasia et al"[13] as the primary sources of heterogeneity. These findings emphasize the need for further investigation to elucidate the factors contributing to neonatal jaundice outcomes and to refine clinical management strategies accordingly. (Figure 11)

8. Meconium Aspiration Syndrome

The incidence of meconium aspiration syndrome was assessed utilizing data from 4 out of 23 included studies. The meta-analysis did not yield statistically significant results ($p = 0.09$), despite moderate heterogeneity observed among the studies

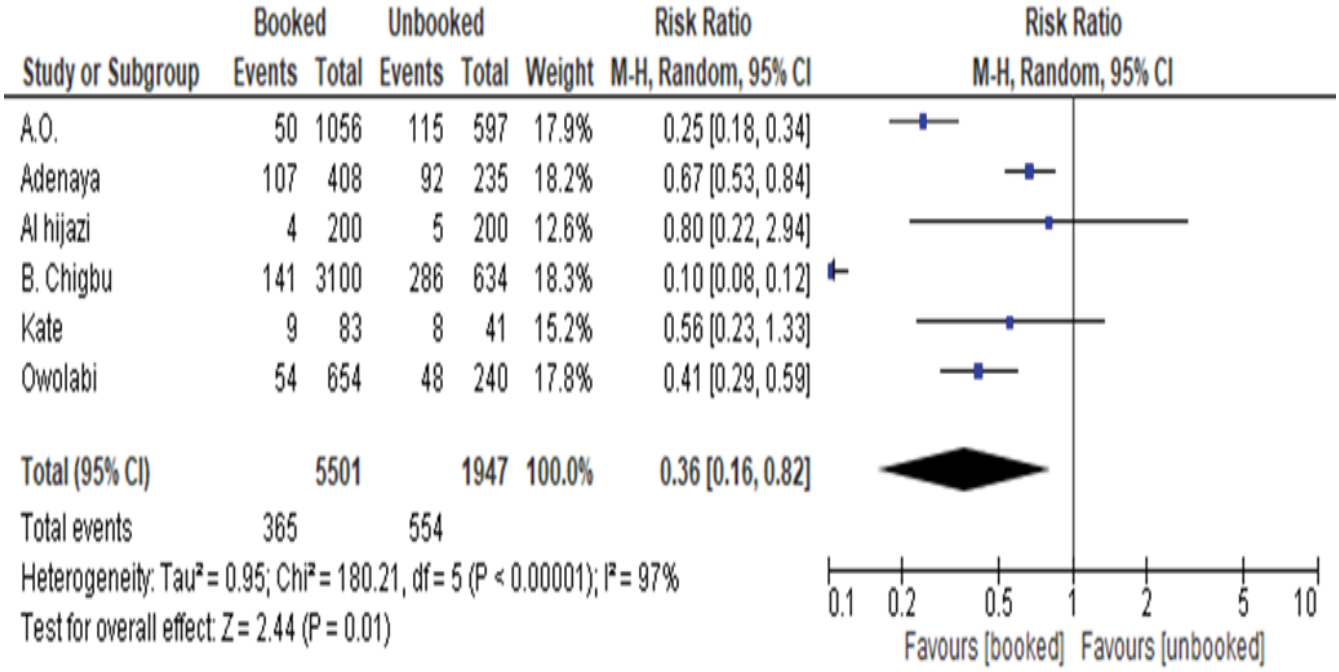

Figure 8. Forest plot showing significant association of less than 7 APGAR score at 5 minutes in booked cases rather than in booked.

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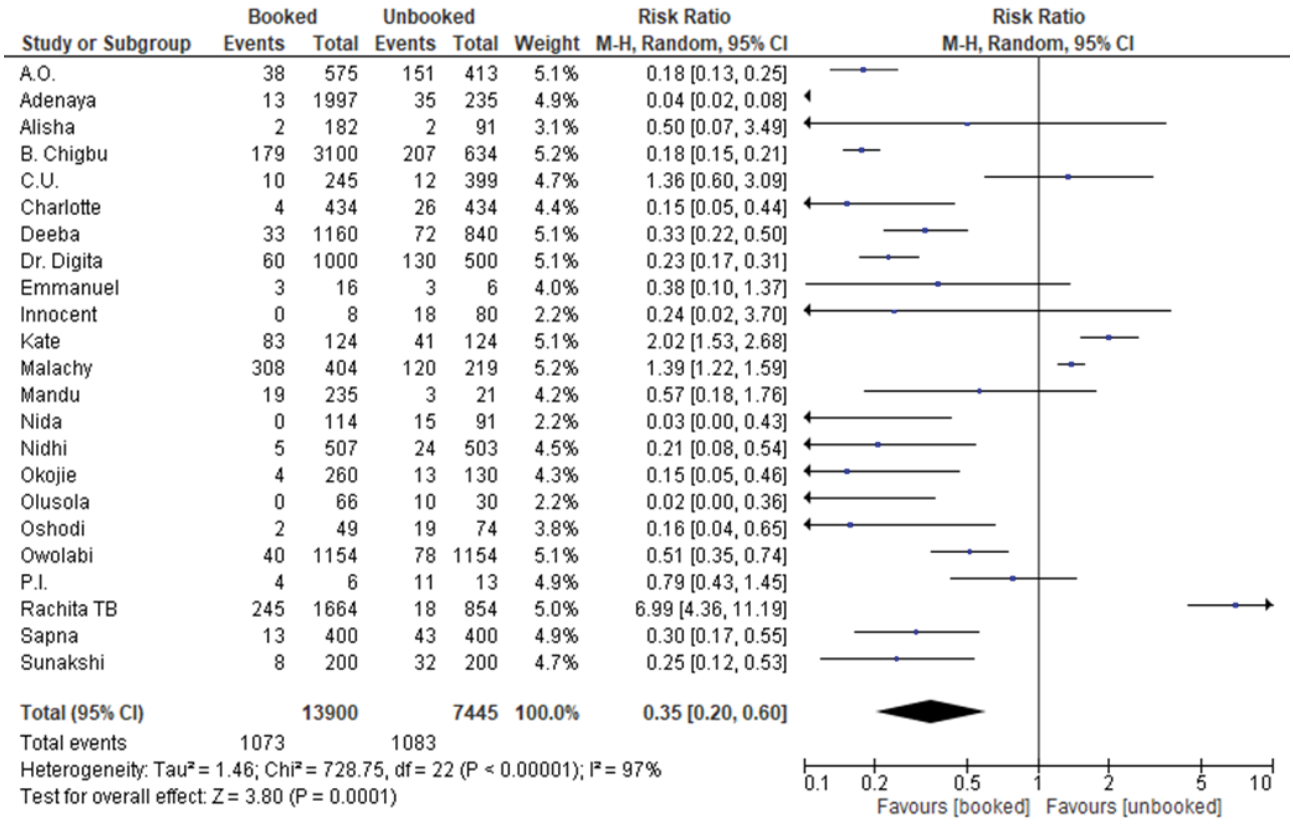

Figure 9. Forest plot showing significant association of mortality with booked cases with considerable high heterogeneity.

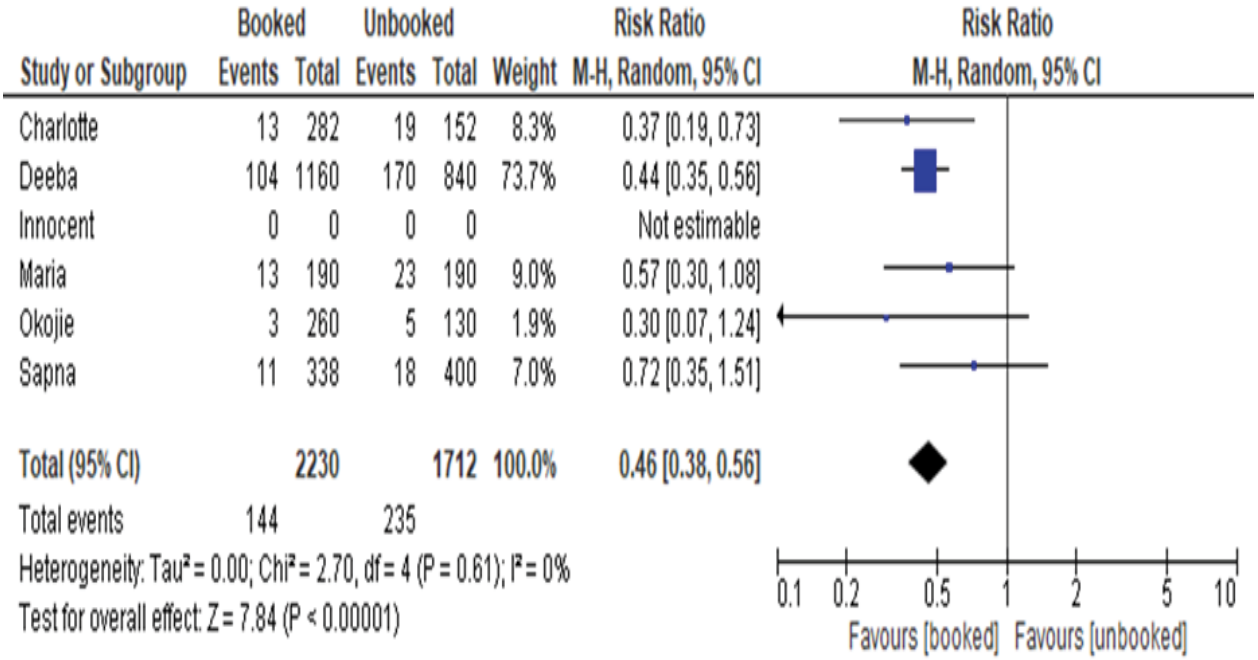

Figure 10. Forest plot showing significant association of birth asphyxia with booked cases with no heterogeneity.

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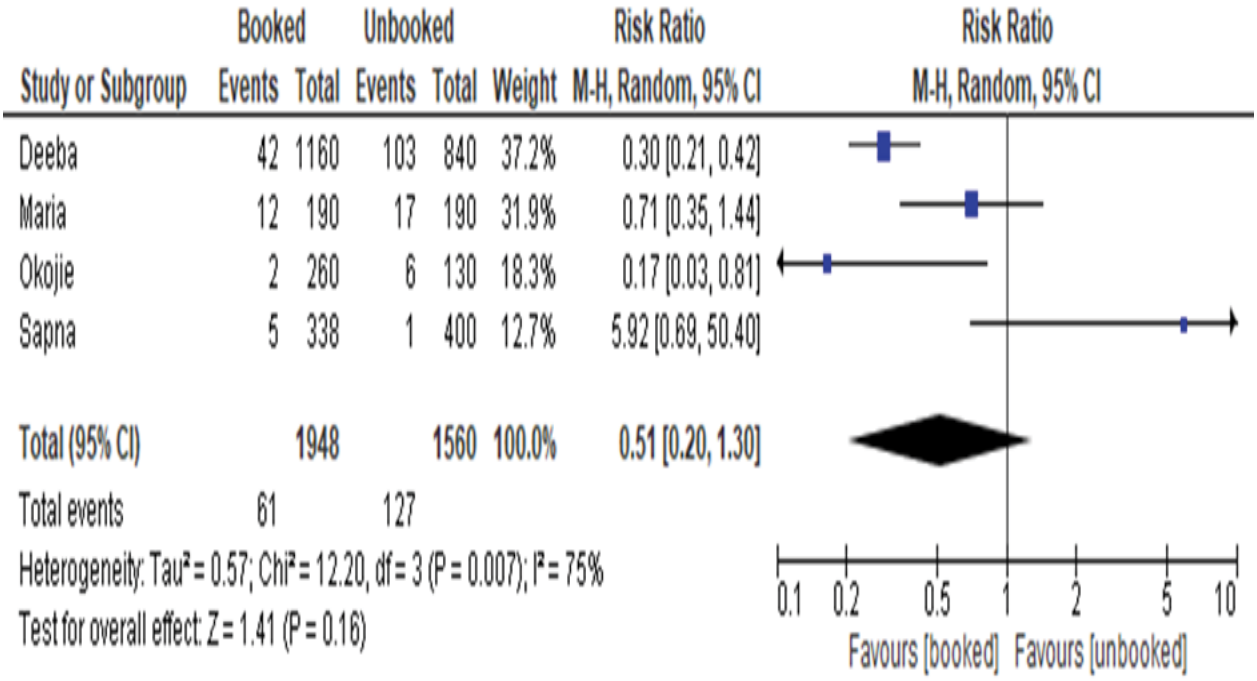

Figure 11. Forest plot demonstrating no significant association of neonatal jaundice with either group with moderate heterogeneity.

(I^2 = 54%). The risk ratio was estimated at 1.00 (95% CI: approximately 0.46-2.14), indicating no significant association of meconium aspiration with either group. Notably, the forest plot also depicted no significant association, with moderate heterogeneity present. Sensitivity analysis identified the study conducted by "Chourasia et al"[13] as the primary source of heterogeneity. These findings underscore the importance of further investigation into the factors influencing meconium aspiration syndrome outcomes to guide clinical management effectively. (Figure 12)

9. Neonatal sepsis/septicemia

The incidence of neonatal sepsis/ septicemia was evaluated based on data from 4 out of 23 included studies. These studies reported a reduction in the incidence of neonatal sepsis in the booked cases group (3.23 %, 63 out of 1948) compared to the unbooked cases group (5.70%, 89 out of 1560). The result was statistically significant (RR 0.60, 95% CI 0.39-0.94, P =0.03) with mild heterogeneity detected. (I2 25%, P =0.26). Sensitivity analysis identified "Deeba" as the source of this heterogeneity. (Figure 13)

10. Seizures/ convulsions:

A significant difference was found between the booked and unbooked groups concerning seizures and convulsions (1.39% vs 3.61%, RR 0.36, 95% CI 0.15-0.88, P=0.03) reported in 3 out of 23 included studies. There was mild heterogeneity noted (I2 19%, P =0.29). Sensitivity analysis revealed "Okojie et al"[7] to be the source of heterogeneity in this outcome. (Figure 14)

11. Congenital malformations:

While results for congenital malformations reported in both groups were not statistically significant, a higher percentage of patients with booked cases had congenital malformations when compared to the unbooked cases (6.35% vs 5.21%, RR 1.08, 95% CI 0.58-2.01, I2 60%, p= 0.80). This outcome was reported in only 4 studies suggesting that the lack of statistical significance may be due to the small sample size. Moderate heterogeneity was observed, and sensitivity analysis indicated that the study by "Rathod et al"[20] was the source of this heterogeneity. (Figure 15)

12. Intrauterine fetal death:

Assessment of intrauterine fetal deaths, based on data from 6 out of 23 included studies, revealed a lower incidence of intrauterine fetal deaths in booked cases (2.18%, 98 out of 4493) compared to unbooked cases (11.38%, 287 out of 2520). This difference was statistically significant (RR 0.11, 95% CI 0.04-0.35, P = 0.0002) with high heterogeneity (I2 70%, P = 0.01). Sensitivity analysis identified "Tukaram Bangera et al."[10] as the source of this heterogeneity. (Figure 16)

13. Stillbirth

This forest plot demonstrates a significant association of stillbirth with booked cases compared to unbooked cases (0.95% vs 6.19%, RR 0.19, 95% CI 0.6-0.61, P = 0.005). Despite the relatively lower percentage of booked cases experiencing stillbirth, the RR and statistical significance demonstrate the importance of prenatal care (booking) in reducing the risk

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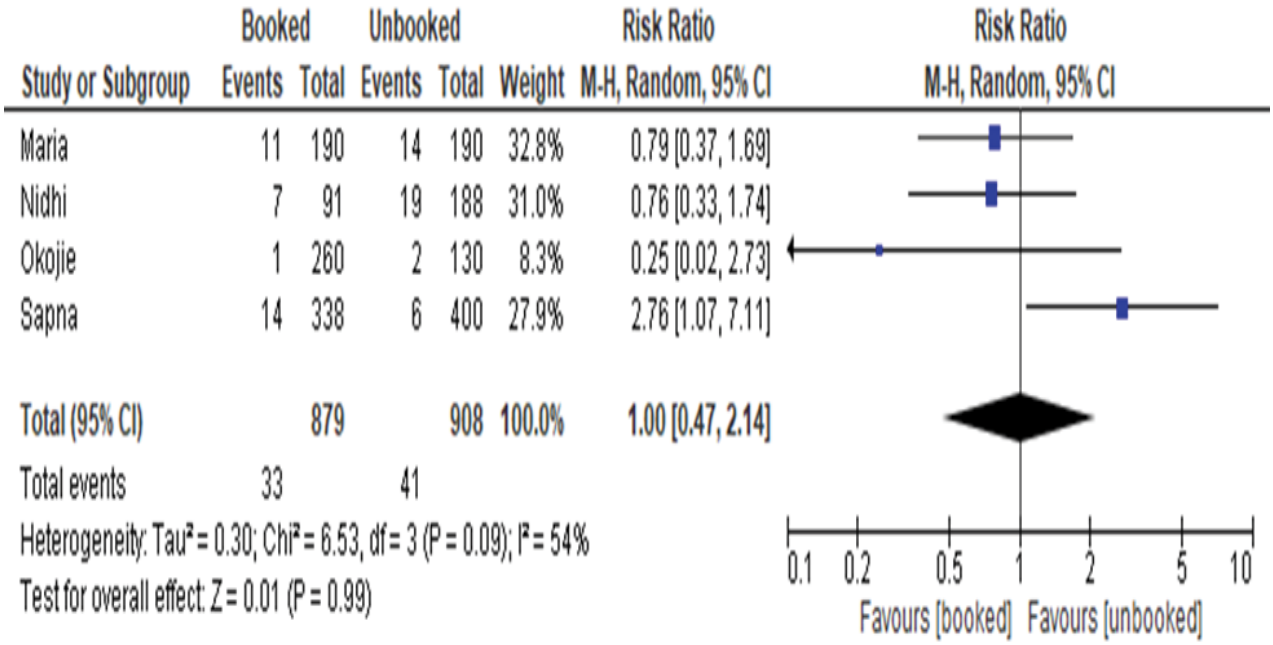

Figure 12. Forest plot showing no significant association of meconium aspiration with either group with moderate heterogeneity.

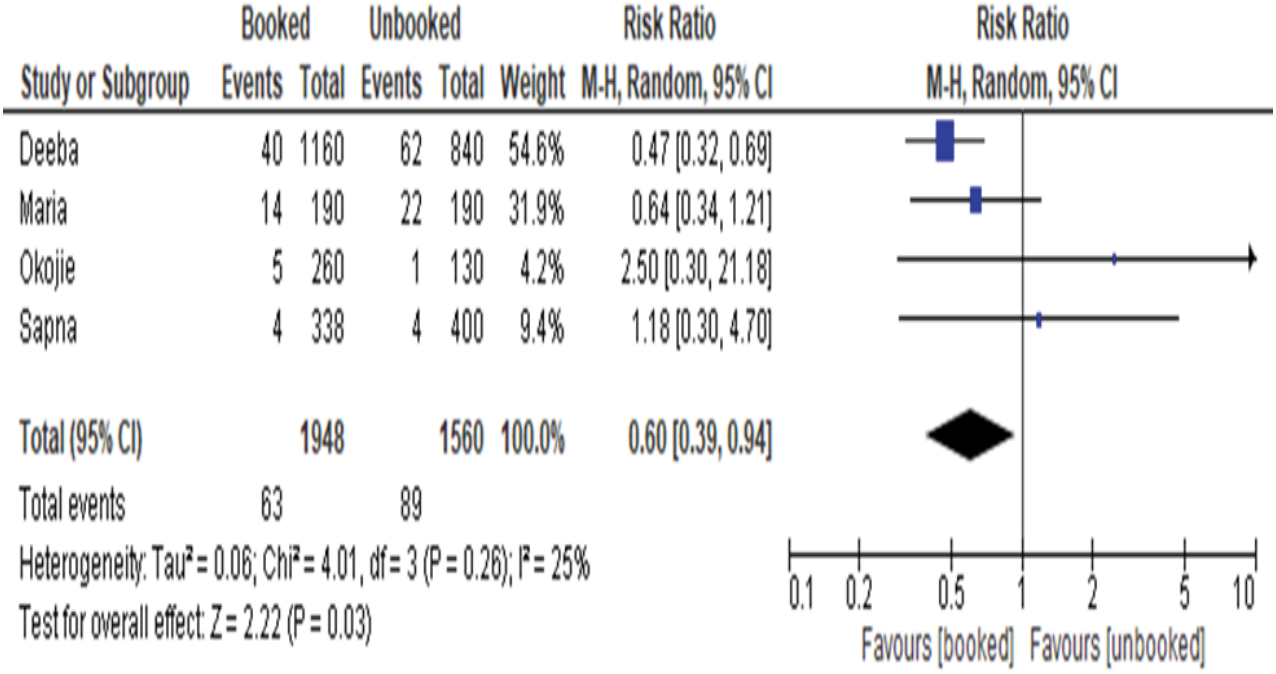

Figure 13. Forest plot displays a significant association of neonatal sepsis/ septicemia with booked cases with mild heterogeneity.

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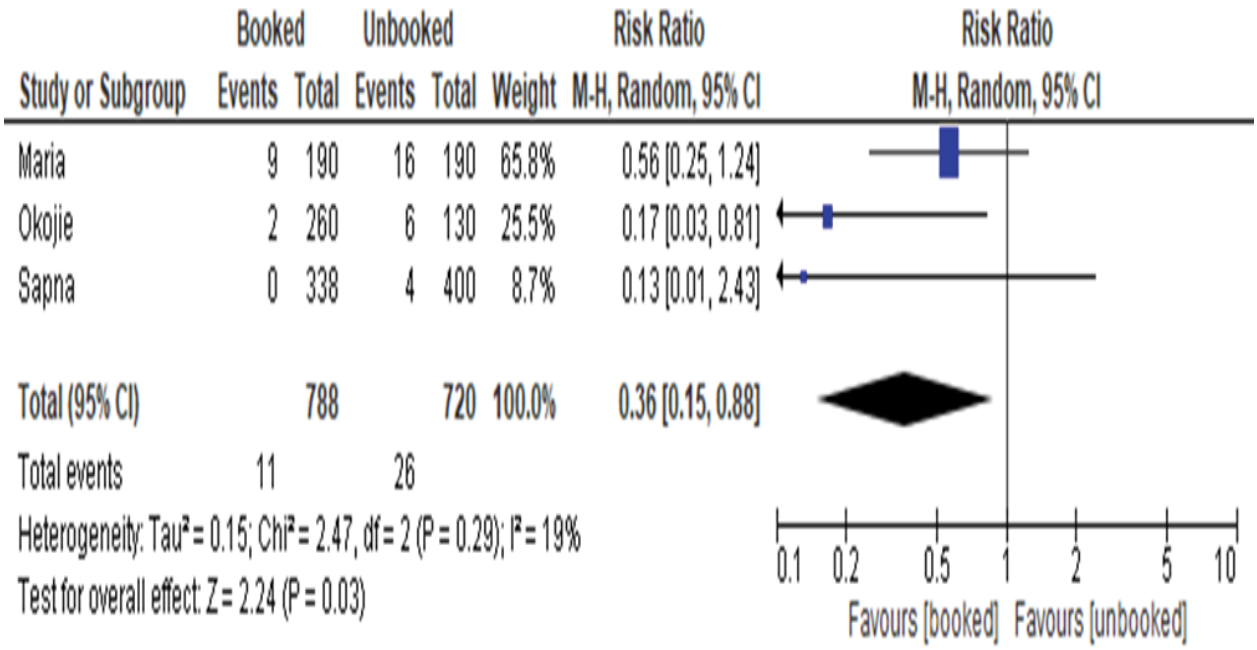

Figure 14. Forest plot displays a significant association of seizures with booked cases with mild heterogeneity.

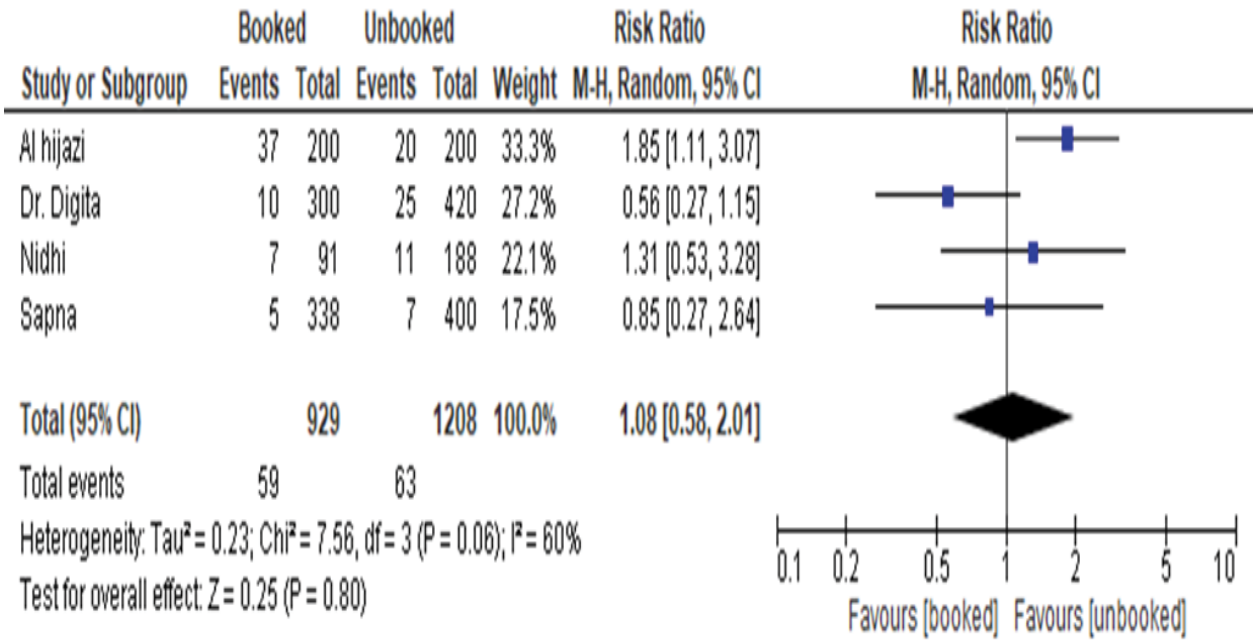

Figure 15. Forest plot shows no significant association of congenital malformation with either group with moderate heterogeneity.

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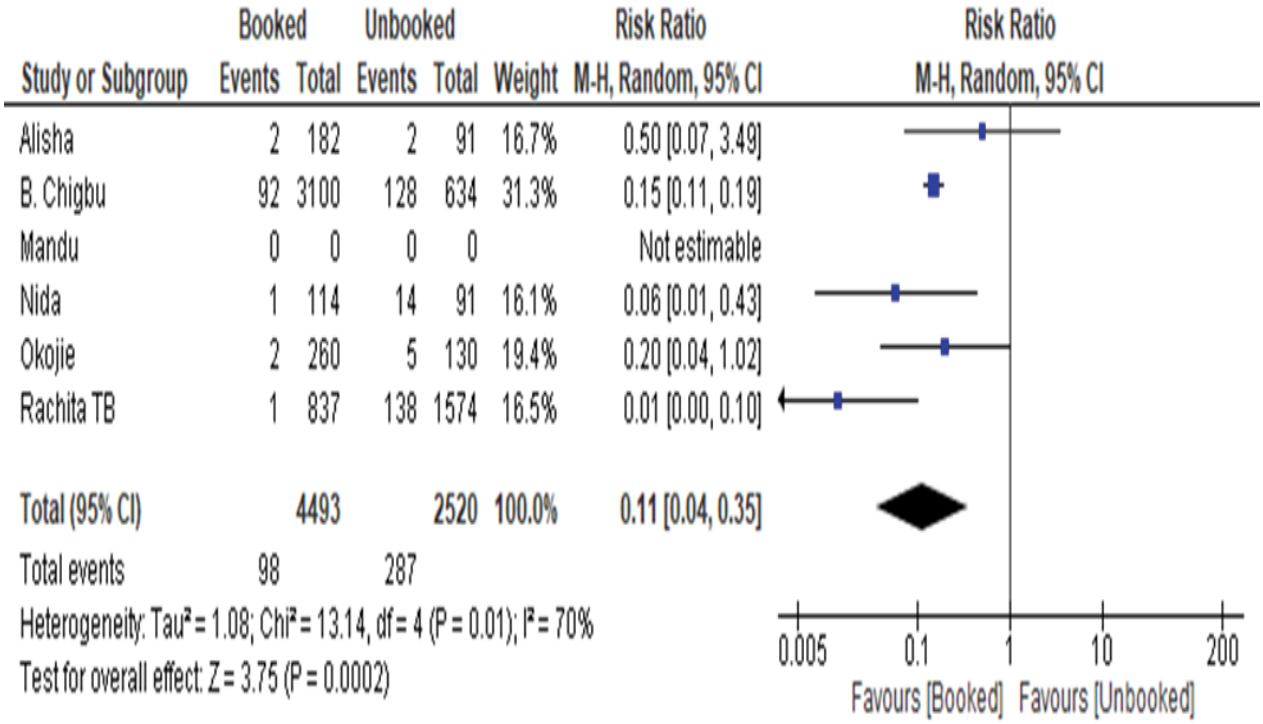

Figure 16. Forest plot displaying significant association of intrauterine fetal death with booked cases with high heterogeneity.

of stillbirth. However, the high heterogeneity observed (I^2 = 89%, P < 0.00001) warrants caution in interpreting these findings. Excluding "Okonta et al."[15] through sensitivity analysis reduced the heterogeneity from 89% to 75% for this outcome. (Figure 17)

14.Early neonatal death

Results from six studies reporting on early neonatal death showed statistical significance, indicating that the risk of having early neonatal death was lower in the booked cases compared to the unbooked cases. (2.37% vs 7.7%, RR 0.30, 95% CI 0.11-0.79, p= 0.02, I2 76%). Excluding the "Iklaki et al." study[27] through sensitivity analysis reduced the heterogeneity from 76% to 10% for this outcome. This suggests that the study by "Iklaki et al."[27] significantly contributed to the observed heterogeneity, emphasizing the importance of sensitivity analyses in meta-analytical interpretations. (Figure 18)

15.APGAR score less than 7 at 1 minute

The forest plot illustrates that there is no significant association between having an APGAR score less than 7 at 1 minute in either the booked or unbooked group (29.7% vs 32.9%, RR 0.76, 95% CI 0.43-1.34, p= 0.34, I2 92%). The high heterogeneity observed (I^2 = 92%) suggests substantial variability in the results among the included studies. However, upon conducting a sensitivity analysis and excluding the study conducted by Owolabi et al.[12], the heterogeneity reduced notably from 92% to 44%, indicating that this study significantly contributed to the observed variability. Further investigation may be warranted to better understand this outcome. (Figure 19)

Publication Bias

The funnel plot analysis for the two outcomes, low birth weight (involving 9 studies) and mortality (involving 23 studies), is included in the supplementary figures. The funnel plot for low birth weight exhibited some degree of asymmetry, suggesting possible publication bias or true heterogeneity among the included studies. Similarly, the funnel plot for mortality displayed a more widespread and asymmetrical pattern, raising concerns for potential publication bias. Sensitivity analysis has been conducted to better understand the sources of variability observed in these funnel plots (Figures 20 & 21)

DISCUSSION

This meta-analysis provides a comprehensive analysis of the fetal complications associated with booked and unbooked pregnancy cases. We included data from 23 studies, which had a combined sample size of around 34908 patients, which provides insight regarding our objectives.

Despite the frequent research on examining the impact of booked vs. unbooked pregnancies on fetal complications, no meta-analysis has been conducted to explore this association to date. Thus, we conducted the first-ever meta-analysis to examine and assess the effect of booked and unbooked pregnancy statuses on fetal outcomes.

Among the distinguished findings of our meta-analysis is a significant association of the booked cases with lower mortality (APGAR score less than seven in five minutes), a

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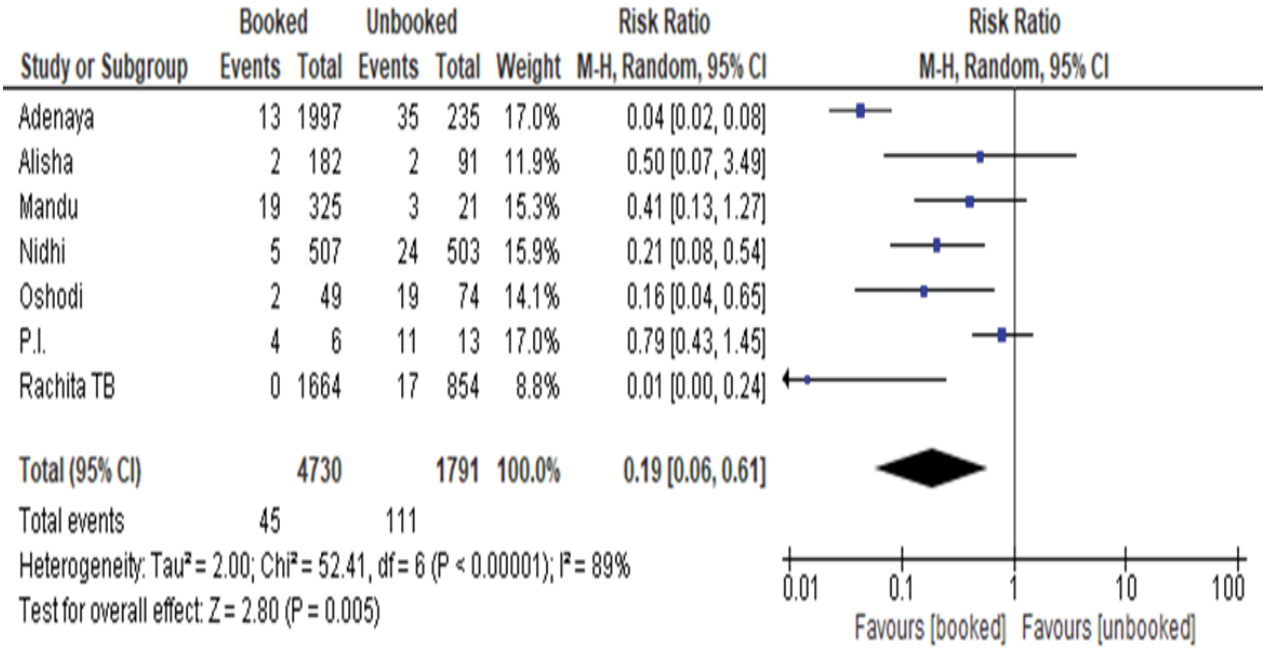

Figure 17. Forest plot displaying significant association of stillbirth with booked cases with high heterogeneity.

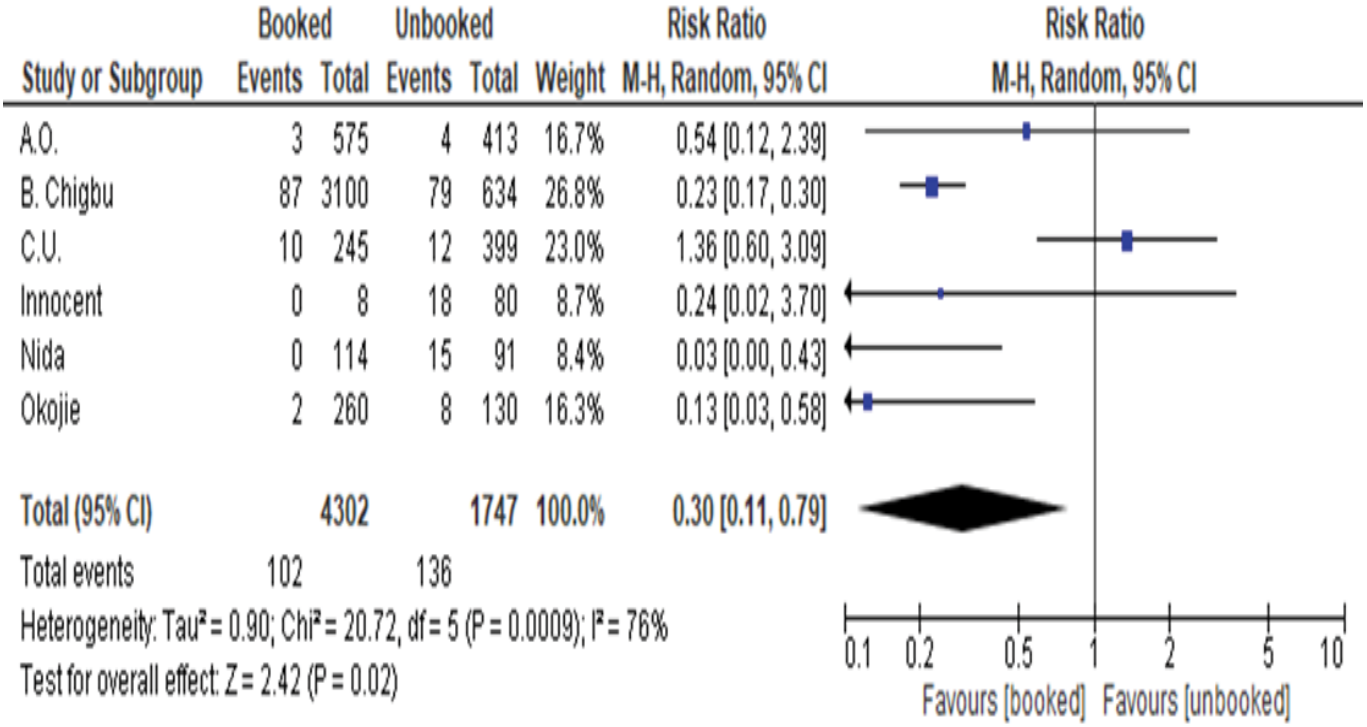

Figure 18. Forest plot displays a significant association of early neonatal death with booked cases with high heterogeneity.

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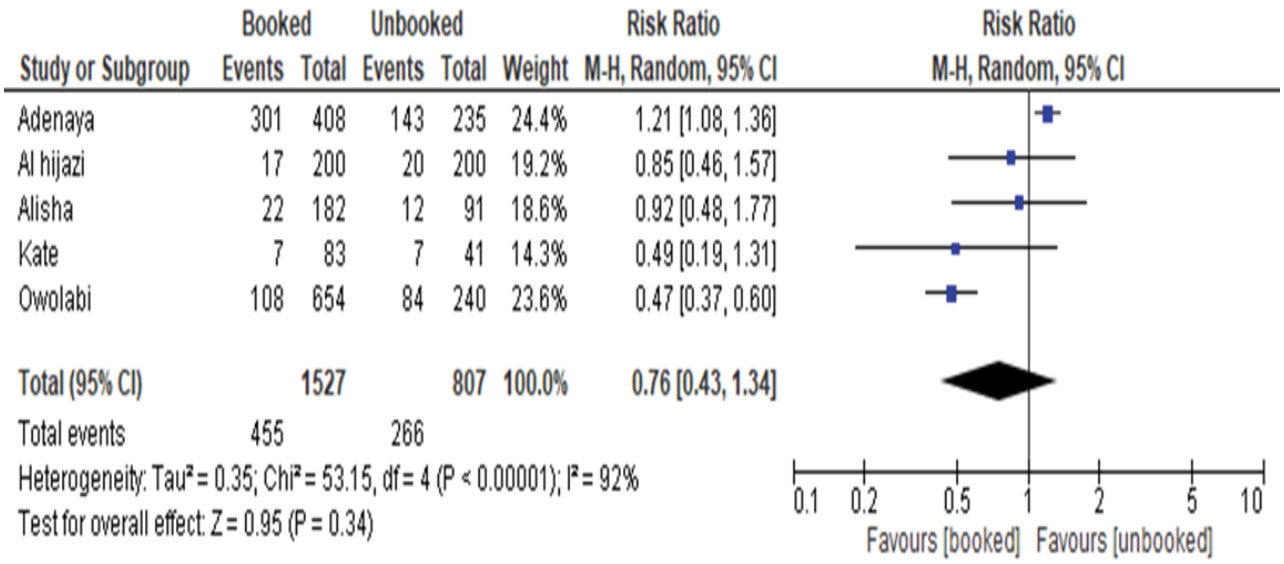

Figure 19. Forest plot displays no significant association of APGAR score less than 7 at 1 minute with either group with high heterogeneity.

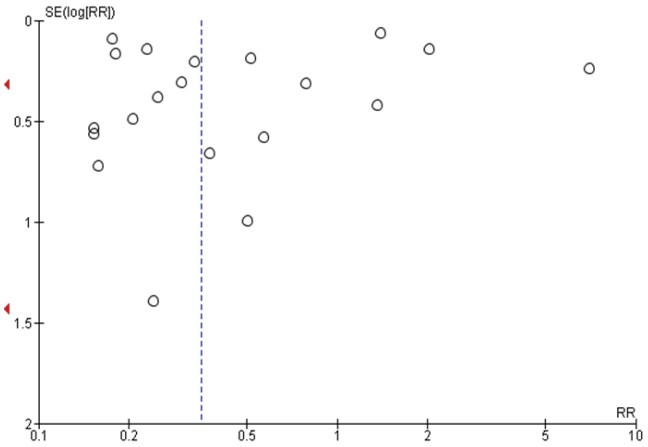

Figure 20. Funnel plot for mortality outcome.

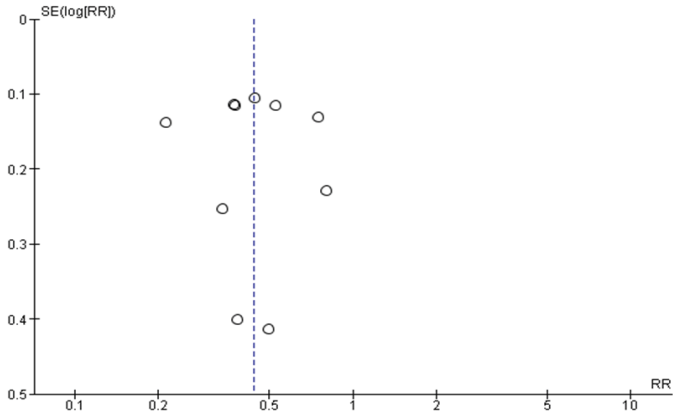

Figure 21. Funnel Plot for low birth weight.

lower incidence of intrauterine fetal deaths, stillbirth, and early neonatal death, and a reduced association with asphyxia. Not only this, diminished risk of neonatal sepsis and seizures were all observed to be statistically associated with booked cases of pregnancies. While the results for congenital malformations reported in both groups were not statistically significant, a higher percentage of patients with booked cases had congenital malformations when compared to the unbooked cases. This outcome was reported in only 4 studies, suggesting that the lack of statistical significance may be due to the small sample size.

On the contrary, whilst exploring additional fetal complications like APGAR score of less than seven at one minute, Meconium aspiration syndrome, neonatal jaundice, NICU/ SNCU admission, and macrosomia, there was no statistically significant relationship between the observed booked and unbooked cases.

The findings of this study have significant implications for clinical practice, healthcare policy, and public health initiatives. The significant association presented between low birth weight and booked pregnancies highlights the vital role that prenatal care plays in reducing unfavorable outcomes for the fetus. To detect and manage factors such as maternal nutrition, medical issues, and lifestyle factors that contribute to low birth weight, medical professionals should place a high priority on early and regular prenatal visits. The significant association between mortality rates and booked pregnancies emphasizes the lifesaving potential of prompt and thorough antenatal interventions. Early identification of high-risk pregnancies and the implementation of suitable healthcare strategies are necessary to lower the rates of neonatal mortality. Furthermore, the risk of complications such as asphyxia, neonatal sepsis, stillbirth, intrauterine fetal death, and early

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neonatal mortality was low, highlighting the vital need for prenatal care for expecting mothers and the significance of booking ahead of time. The lack of significant associations in certain complications, such as macrosomia, meconium aspiration syndrome, and newborn jaundice, emphasizes the complexities of perinatal health outcomes and the need for a more nuanced approach to treatment. Moreover, the finding of specific research studies that contribute to heterogeneity emphasizes how crucial it is to assess individual study contributions rigorously in meta-analytical interpretations. Policymakers and medical professionals can successfully lessen the burden of unfavorable fetal outcomes and enhance the health of mothers and newborns by placing a high priority on early and comprehensive prenatal care.

Fetal complications like mortality were found to be closely linked with unbooked cases, as reported by Rathod et al. and Kalim D[20,22]. Similarly, they also reported a higher prevalence of intrauterine deaths with unbooked cases, as highlighted by our analysis. Not only this, but increased risk of asphyxia reported by Blanche Oguejiofor et al and Ghafoor et al.[11], neonatal sepsis reported by Ghafoor et al. and Deeba[22] early neonatal death reported by Olusola B et al. Chourasia et al and Abisowo et al.[13,14,28], and seizures reported by Ghafoor et al., Chourasia et. al., Okonta et al.[13,15] were also found to be associated with unbooked cases, as further indicated by our results. Like our results, fetal complications like low birth weight were also previously associated with unbooked cases, as supported by studies of Blanche Oguejiofor et al., Tucker et al., Olusola B et al., and Rathod et al[11,19,20,28].

APGAR scores less than 7 at 5 minutes were previously reported with booked cases reported by Adenaya et al. and Owolabi A T et al.[12,21], as further emphasized by our analysis. Apgar score less than 7 at 1 minute, which was previously associated with booked cases reported by Adenaya et al., and Sule-Odu et al.[9,21]. This finding was, however, negated by our analysis, which showed no significant relationship between booked and unbooked cases. Similarly, meconium aspiration syndrome reported by Ghafoor et al.[30], NICU/SCN admission reported by Tukaram Bangera et al., Rathod et. al., Chourasia et. al.[10,13,20], and congenital malformation by Chourasia et. al., Rathod et al.[13,20] were previously observed to have a higher incidence with unbooked cases, but our pooled analysis reported that they hold no association with booked as well as unbooked cases. However, neonatal jaundice had previously shown a mixed trend to have an incidence with both groups reported by Ghafoor et al., Chourasia et al., and Okonta et. al.,[13,15] but our analysis clarified that it has no significant interrelationship with both groups.

Limitations

Although the inclusion of a large sample size and a comprehensive number of studies (a total of 23) strengthen this study's statistical reliability and provide insightful findings regarding the relationship between prenatal care and various perinatal outcomes, it is important to consider several limitations that may have an impact on how the results are interpreted. The great variability in patient baseline characteristics among the included studies makes it challenging to synthesize results. Some studies included only uncomplicated pregnancies, while others focused on patients with certain conditions, such as placenta accreta. The interpretation of results is further complicated and may be biased by variations in the definitions of booked and unbooked cases among studies. Some studies only included patients who underwent cesarean sections, whereas others included both cesarean sections and spontaneous vaginal delivery. The diversity in delivery methods may have an impact on the results that are reported and limit the extent to which the study's findings could be implemented. The included studies exhibit methodological heterogeneity due to their different study designs, which include prospective cross-sectional studies, retrospective cohort studies, and randomized cross-sectional studies. There are strengths and limitations specific to each study design that may affect the outcomes. Additionally, asymmetrical funnel plots indicate that unaccounted studies may have an impact on the overall results due to publication bias. Also, variations in the definition and assessment of outcomes among studies might worsen heterogeneity and impair the validity of pooled findings. Variability in outcome assessment methodologies and definitions of complications, such as neonatal jaundice or APGAR scores, may have an impact on the observed correlations between booked and unbooked women.

Our future research recommendations would include creating agreed-upon definitions for terminology such as "booked", and "unbooked" pregnancies will make research findings more consistent and make comparisons across studies easier. By tracking pregnant women from the time of booking to delivery, longitudinal studies may be able to shed light on how prenatal care affects fetal outcomes over time. It is important to ensure that the variations in socioeconomic status, access to healthcare, and demography that may have an impact on pregnancy outcomes are considered. Assessing how well various prenatal care delivery models—such as telemedicine-based treatment versus traditional clinic-based care—improve fetal outcomes, especially for underprivileged or rural populations. Examining which specific prenatal care interventions—such as dietary counseling, screening for maternal medical issues, or psychosocial support services—have the most impact on improving fetal outcomes.

Or which healthcare policies are working to improve perinatal outcomes and increase the use of prenatal care, especially in areas where unbooked pregnancy rates are high. Further trials should be carried out, and meta-analyses should be updated to consider the most recent data and evaluate how the association between fetal outcomes and prenatal care has changed over time. A future study can further our understanding of the intricate connection between prenatal care and fetal outcomes by addressing these research recommendations. This will ultimately help to shape evidence-based practices and policies that will enhance the health of mothers and children.

CONCLUSION

Prenatal care is crucial for improving fetal health and

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minimizing unfavorable perinatal outcomes, as observed in our meta-analysis. Early and comprehensive prenatal care is crucial for reducing low birth weight, mortality, stillbirth, and neonatal death. Timely and thorough prenatal interventions are essential for reducing adverse fetal outcomes and the risk of infant mortality. The goal of clinical practice, healthcare policy, and future research projects should be to optimize perinatal care approaches.

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