

Maternal and Neonatal Health Risks of Adolescent Pregnancy: A Systematic Review and Meta-Analysis

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Abstract: Adolescent pregnancy and its negative effects on maternal and neonatal health are a global public health concern. This systematic review aimed to examine the effects of adolescent pregnancy on maternal and neonatal health. Researchers scoured three electronic databases (PubMed, Cochrane Library, and Google Scholar) for relevant articles between January 2015 and October 2021. We used an individual random-effects model to estimate pooled outcomes and assess the impact of adolescent pregnancy on maternal and neonatal health. After examining the eligibility criteria, we assessed 12 articles for qualitative evaluation and then selected eight for quantitative analysis. The pooled results of the study demonstrated that the prevalence of pre-eclampsia and anaemia was higher, and the prevalence of gestational diabetes, placental disruption, cesarean delivery, and premature rupture of the fetal membrane was lower among adolescent mothers compared with adult mothers. Nevertheless, no significant ($P > 0.05$) differences existed across the groups. Adolescents had a significantly ($P < 0.05$) higher prevalence of having a premature baby, whereas no significant ($P > 0.05$) difference was observed in the prevalence of low birth weight and postpartum haemorrhage. Hence, this study suggests that adolescent pregnancy might have a potential effect on maternal and neonatal health.

Keywords: Adolescence, adolescent pregnancy, maternal health, neonatal health, pre-eclampsia, Anaemia.

1. Introduction

Adolescents (10-19 years old) are an important demographic target for the World Health Organization because of their potential impact on public health worldwide (Organization, 2017). The adolescent population is increasing in both industrialized and developing nations, with better mother and child health. Still, they have not improved their health to the same extent as the rest of the population (Lassi et al., 2015).

Except for infancy, adolescence is a lifetime of speedy bodily, mental, intellectual, and behavioural growth that prepares a person for the responsibilities of adulthood (Patton et al., 2016). Adolescent growth spurts necessitate rapid tissue expansion and specialized dietary requirements, including amino acids for striated muscle formation and calcium and vitamin D for bone development. Energy and nourishment must also meet adolescents' needs, as they usually participate in physical activity that supports striated muscle mass enlargement. However, girls are predisposed to anaemia and other adverse outcomes with the onset of menstruation. Ultimately, these factors make the adolescent group, especially girls, nutritionally vulnerable

(Organization, 2007). However, they frequently remain an underappreciated group of nutritionally vulnerable people. Augmented demand, along with inadequate nutrition in adolescence, can retard growth and sexual maturation as well as can affect their current health. This could lead to chronic health risks. In addition, physiological situations like pregnancy and breastfeeding exacerbate the nutritional and health hazards for teenage girls (Goli et al., 2015).

The teenage years are the transitional age between childhood and maturity. When a female reaches this age and gets pregnant, it is referred to as adolescent pregnancy (WHO, 2018). A projected 21 million females aged 15 to 19 in developing nations become pregnant every year, with 12 million having given birth (Darroch et al., 2016). An estimated 2.5 million females under 16 give birth every year (Neal et al., 2012). According to UNFPA, Asia-Pacific accounted for 55 per cent of the world's adolescents (Loaiza & Liang, 2013). Around 95% of adolescent births occur in middle- and lower-income nations (Organization, 2016).

In 2016, problems in pregnancy and delivery remained the top reasons for death among 15- to 19-year-old girls globally, even though the number of fatalities associated with complications in pregnancy as well as delivery among adolescents has fallen dramatically since 2000 (Svanemyr, 2020). Every year, tens of thousands of adolescents die from problems related to pregnancy and delivery (Organization, 2017). Problems throughout the

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Received: September, 2024

Accepted: November, 2025

Published: September, 2026

pregnancy period and delivery are the other foremost reason for mortality for females aged 15 to 19 throughout the world (Morris & Rushwan, 2015; Organization, 2017). According to several studies, it is a key contributor to death and morbidity among mothers and infants, as well as to cycles of poor health and poverty. Adolescent mothers who are biologically immature are vulnerable to increased risk of maternal complications relative to adult women, such as anaemia, cesarean delivery, low maternal weight gain, halted physical growth, cephalopelvic imbalance, reproductive tract infection, and hypertension (Althabe et al., 2015).

Eclampsia, puerperal endometrial hyperplasia, and systemic illnesses are more prevalent in mothers aged 10–19 than in those aged 20–24 (WHO & Mathers, 2016). Both neonates and young mothers are in danger when infants are born at a young age. Infants with comparatively lower birth weights, births before 37 weeks of pregnancy, and severe neonatal complaints are much more prevalent in newborns of mothers younger than 20 (WHO & Mathers, 2016). In certain contexts, young moms are concerned about rapid, recurrent pregnancies since it offers significant health concerns for both the mother and the newborn (Organization, 2012).

Despite its significance, there is a dearth of research on the health concerns associated with early childbirth, especially in third-world nations. This review is aimed at investigating the effect of adolescent pregnancies on the well-being of mothers and newborns.

2. Methods

Protocol

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Guidelines pre-specified the protocol for systematic reviews and meta-analyses, which we utilized in this systematic review to evaluate the impacts of adolescent pregnancy on the mother and the child.

Searching Strategies

We combed through three electronic databases from 1 January 2015 to 15 October 2021, including PubMed, the Cochrane Library, and Google Scholar. The searches were conducted in English using an appropriate search technique. We searched the literature using Medical Subject Headings (MeSH terms) ("Adolescent Pregnancy" [All Fields] AND "Maternal and Neonatal Health" [All Fields]) for PubMed, and Title, Abstract, Keyword (Adolescent Pregnancy and Maternal and Neonatal Health) for Cochrane Library and Google Scholar.

We chose these three databases—PubMed and Cochrane for their superior indexing of clinical literature and Google Scholar for its extensive coverage of gray and open-access literature. Although additional databases like Scopus and EMBASE were evaluated, institutional access limitations precluded their inclusion. This attribute is recognized as a limitation.

Eligibility Criteria

The eligibility criteria were described following the definitions of PECO:

- **Population:** We included all studies considering adolescent girls as a population with standard definitions.
- **Exposure:** Adolescent girls who were pregnant or had a pregnancy during adolescence period.
- **Comparators:** Pregnant adult women were used as a comparator.
- **Outcomes:** The outcomes of interest were the effects of adolescent pregnancy on the health of the mother and their infants.

Categories of Effect Measures

We examined the impacts of adolescent pregnancy on numerous morbidities among mothers and their newborns and compared them to the consequences of pregnancy in young adult women. We had to calculate the odds ratio for the analysis because all the studies were retrospective cohort, cross-sectional, and case-control studies. For the meta-analysis of this study, we prioritized adjusted models over crude or partially adjusted models.

Data Extraction Procedure

Two independent researchers (MSI and AIC) retrieved statistical data from the included articles about study characteristics (authors, place of study, study year, population enrolled, exposure, outcomes) and study design. For both case-control studies and cross-sectional articles, JBI manual checklists were employed to analyze the methodological quality of the included articles (Aromataris & Munn, 2021). To mitigate selection bias, two independent reviewers (OH and KTA) evaluated and identified relevant studies. Discrepancies were reconciled through dialogue until consensus was achieved.

Statistical Analysis

The heterogeneity, given as I^2 (per cent residual variation attributable to heterogeneity) and τ^2 (technique of moments assessment of between-study variability) of the pooled estimate, was determined. The consequences of adolescent pregnancy on mother and newborn health were evaluated using a random-effects model. In a pooled study, a confidence interval of 95% was presented. Review Manager (RevMan) version 5.4 was used for all analyses; version 5.3 of RevMan was previously used in other published studies (Grønvik & Fossgard Sandøy, 2018; Karaçam et al., 2021b).

A random-effects model was employed due to the expected variability in research sites, demographics, and outcome measures. This approach yields more cautious estimates and facilitates enhanced generalizability compared to a fixed-effects model.

3. Result

Selection of Studies

During the preliminary search, 1027 studies were retrieved from the relevant databases. Based on the inclusion and exclusion criteria, 12 studies were considered for this review (**Figure 1**). Eight of the original 12 papers were considered to be included in the meta-analysis.

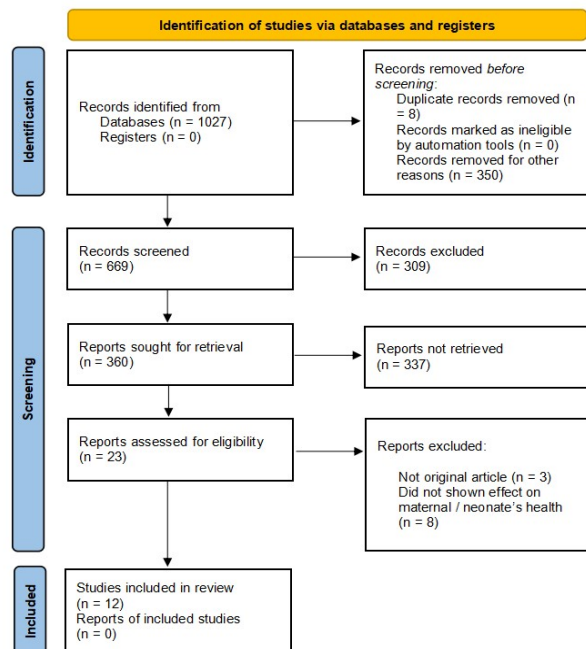


Figure 1. PRISMA Flow Diagram.

Features of The Included Studies

In the present study, most of the selected articles were cross-sectional studies (five studies) and retrospective cohort studies (four studies), while three studies were case-control studies. All others defined adolescent and adult groups. Just eight of the studies compared the effects of early pregnancy with those of adult women. All of the studies examined the consequences of early pregnancy that compounded adverse impacts on the health of the mother and their newborn. The features of the studies that were considered for inclusion are outlined in

Table 1. Descriptive Features of the Research Considered

Author, year	Place of study	Study design	Subjects enrolled (case/control)	Defined adolescent (years)	Findings	Defined comparator (years)
(Kawakita et al., 2016)	USA	Retrospective cohort	14,703/27,645	16-19.9	- Adolescent pregnancy increased the likelihood of anemia, premature delivery, and blood transfusion - Decreased the risk of cesarean delivery and perineal laceration	20-24.9
(Ergen et al., 2017)	Turkey	Cross-sectional	1800/1585	13-19	- Higher rates of PROM and preterm birth were observed in adolescent mothers - Higher rate of unplanned pregnancy in adolescent group	20-21
(Çift et al., 2017)	Turkey	Retrospective cohort	243/2738	14-18	Antenatal complications, including preeclampsia, fetal growth restriction, and premature rupture of membranes, were significantly higher in adolescent pregnancy	19-36
(Aung, 2017)	Myanmar	Retrospective case-control	60/202	15-19	Adolescent mothers had a higher rate of anemia, PROM, eclampsia, and cesarean delivery	20-34

(Khader et al., 2019)	Jordan	Cross-sectional	1311/17360	<20	• Adolescent women are more likely to have premature delivery • No significant differences observed in LBW and neonatal death between adolescent and adult women	20-35
(Karataşlı et al., 2019)	Turkey	Retrospective cohort	3611/13501	15-19	• Threat of abortion and preeclampsia was higher in adolescents	25-30
(Youseflu et al., 2019)	Iran	Cross-sectional	133/696	13-19	• Adolescents had a higher risk of induced vaginal delivery, episiotomy, and dystocia	20-30
(Ogawa et al., 2019)	Japan	Cross-sectional	3985/26846	≤19	• Adolescent women had a higher risk of preterm birth, LBW, and low Apgar score	20-24
(Rexhepi et al., 2019)	Macedonia	Retrospective cohort	115/817	15-19	• Higher urinary tract infection, anemia, preterm birth, and a smaller age at gestation were seen in adolescent mothers compared with adult mothers.	20-24
(Maki, 2020)	Iraq	Case-control	61/80	15-19	• Adolescent pregnancy had higher adverse outcomes and more medical complications	≥20
(Zhang et al., 2020)	China	Cross-sectional	4125/250522	10-19	• Premature birth, miscarriage, neonatal mortality, and a low gestational age were all more common among adolescent mothers • But cesarean delivery and gestational diabetes mellitus were less common	20-34
(Sharoni & Konneh, 2020)	Liberia	Retrospective case-control	540/725	11-19	• The prevalence of eclampsia, hemorrhage, and intrauterine growth restriction was higher among adolescent mothers	≥20

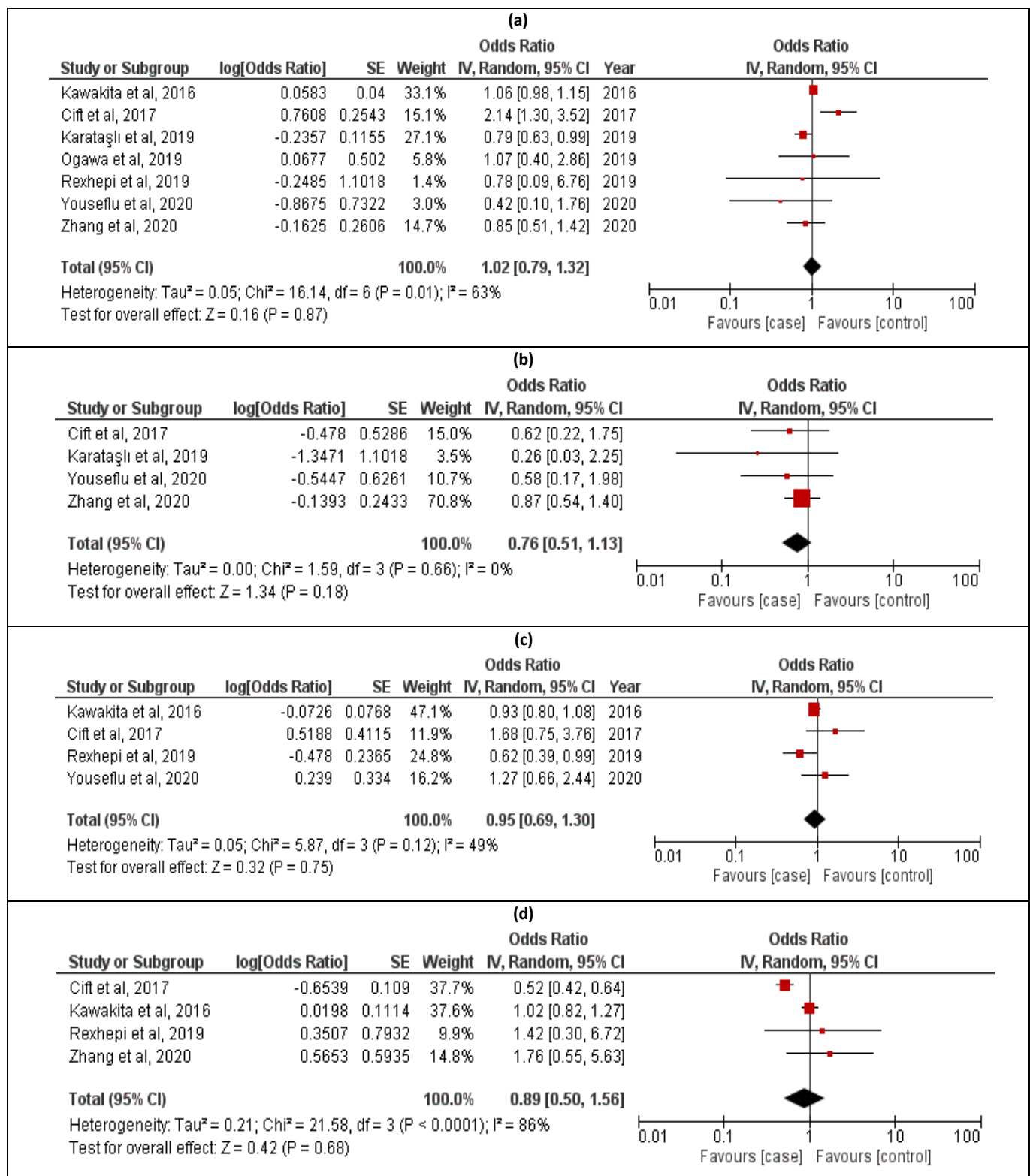
Measured Outcome

Effect on Maternal Health

Pregnancies among adolescents were compared to pregnancies in young adults to determine their impact on the mother's health. According to a meta-analysis of selected articles, the aggregated prevalence of preeclampsia, anaemia, and postpartum haemorrhage was greater among adolescent pregnant women,

with Odds of 1.02, I^2 63%; 1.11, I^2 76%; and 1.10, I^2 0%, respectively (**Figure 2**).

Adolescent pregnant women had a decreased chance of developing diabetes during pregnancy, PROM, placental disruption, and caesarean section (odds ratios of 0.76, I^2 = 0%; 0.95, I^2 = 49%; 0.89, I^2 = 86%; and 0.88, I^2 = 99%) (**Figure 2**).



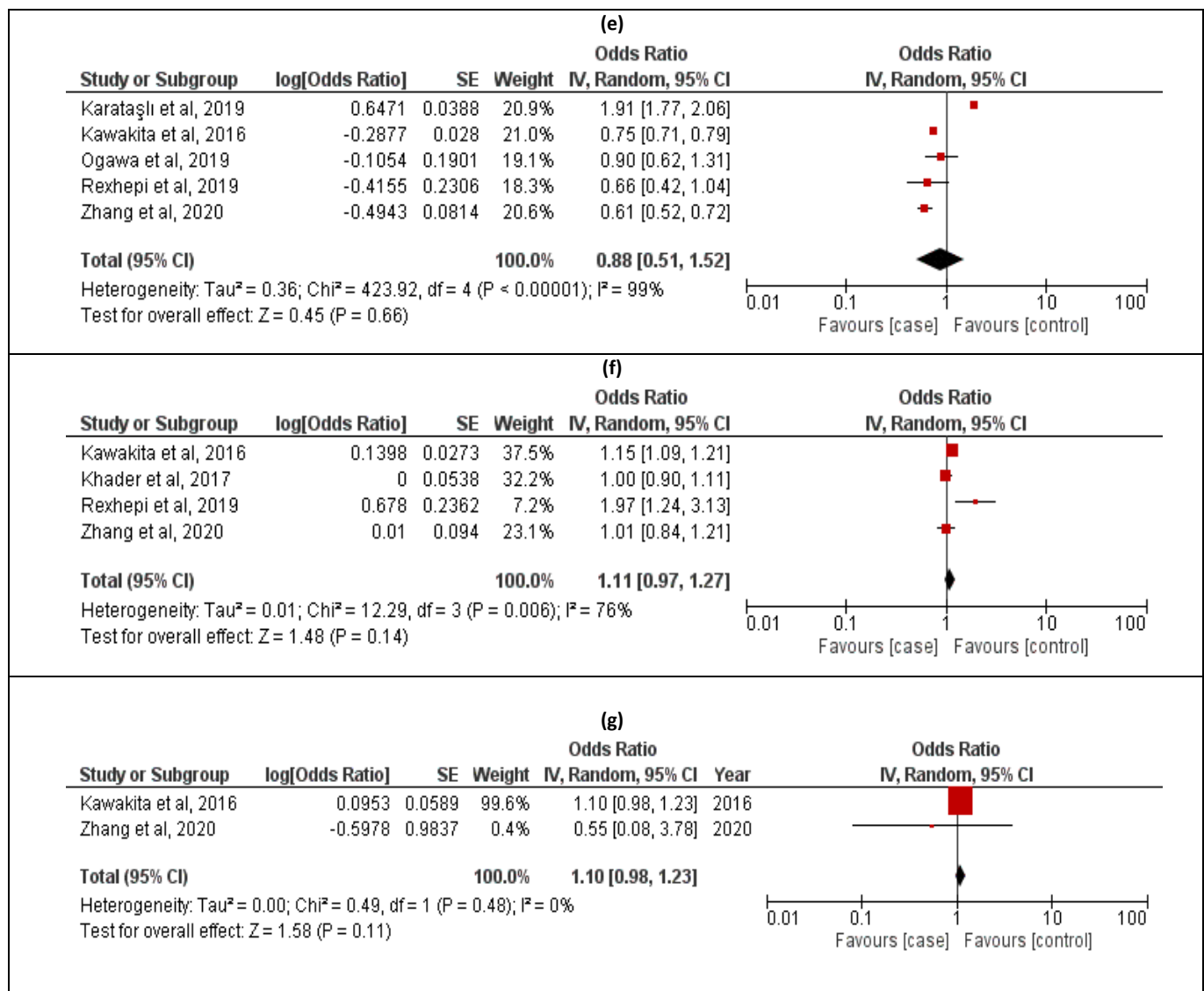


Figure 2. Forest plot reporting the impact of adolescent pregnancy on the danger of maternal health: (a) preeclampsia, (b) gestational diabetes, (c) premature rupture of fetal membrane, (d) placental disruption, (e) cesarean section, (f) anaemia, and (g) postpartum haemorrhage.

Effect on Neonatal Health

The impact of adolescent pregnancy on neonatal health demonstrated that the risk of preterm delivery (odds ratio: 1.72, confidence interval: 95%) and lower birth weight of the infant (odds ratio: 1.05, confidence interval: 95%) were greater in adolescent mothers than in adult women who were pregnant (Figure 3).

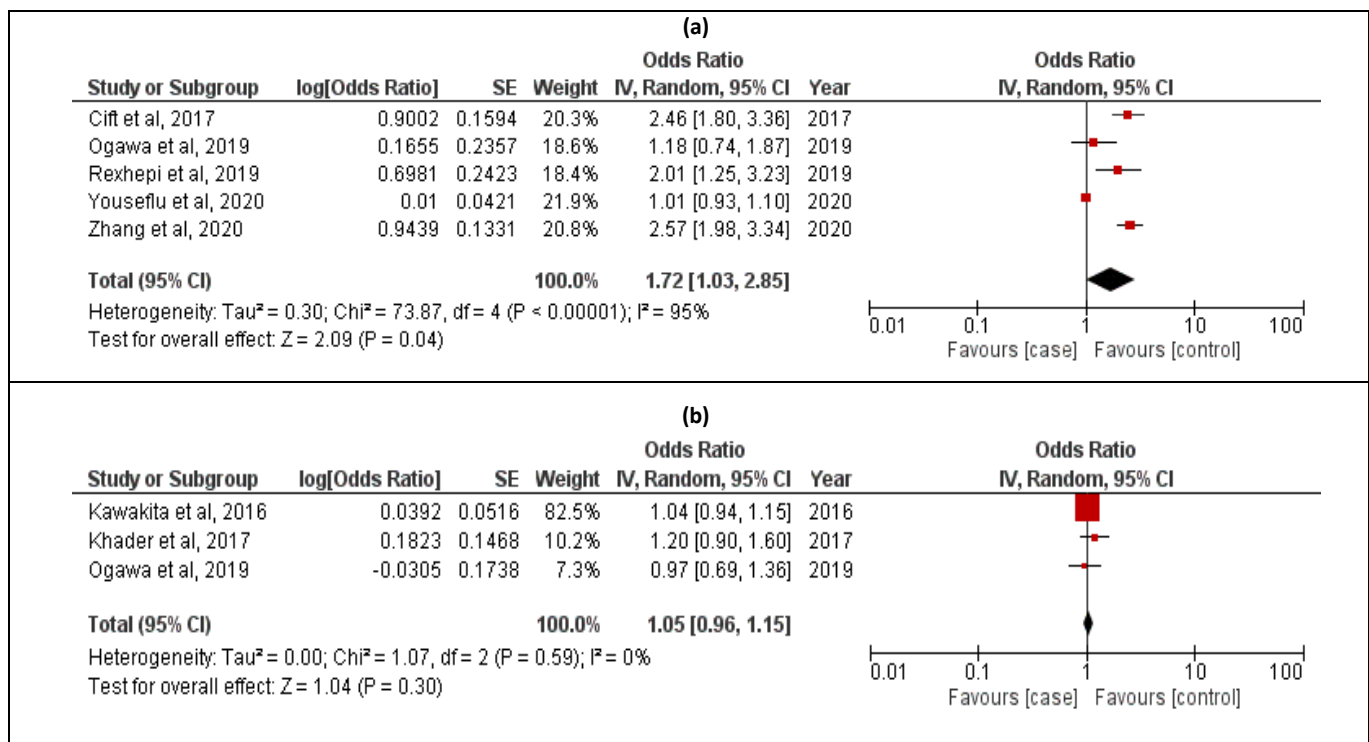


Figure 3. Forest plot reporting the impact of adolescent pregnancy on the danger of neonatal health: (a) preterm delivery and (b) low birth weight (LBW).

4. Discussion

The main aim of this systematic review was to ascertain whether or not adolescent pregnancy has consequences for numerous adverse health outcomes among mothers and their newborn children. We used the following metrics to assess the impact on the mother's health: preeclampsia, gestational diabetes, preterm rupture of fetal membranes, placental disruption, cesarean delivery, and anaemia. Concurrently, researchers utilized indicators such as birth before 37 weeks of pregnancy (i.e., preterm delivery) and lower birth weight (LBW) to evaluate the impacts of pregnancy among adolescents on the neonate's health.

Adolescent Pregnancy and Maternal Health

Adolescents were shown to have a significantly increased risk of developing preeclampsia (OR: 1.02, I^2 63%). Prior studies have demonstrated similar outcomes (Togoobaatar Ganchimeg et al., 2014; Grønvik & Fossgard Sandøy, 2018; Karataşlı et al., 2019). Other studies find similarities between pregnant adolescents and adult women (Karai et al., 2019; Korenčan et al., 2017). Nevertheless, other research shows the opposite (Baş et al., 2020). Eclampsia is forty times more likely to occur in moms aged 20–24, according to rigorous research (Moraes et al., 2018).

This research found that adolescent anaemia was significantly elevated (OR: 1.11, I^2 : 76%). Similarly, several studies have revealed that the incidence of anaemia among pregnant adolescents has increased (Korenčan et al., 2017). Adolescent mothers are at a significantly higher risk for anaemia caused by iron deficiency (Sekhar et al., 2016). According to Mahavarkar et al. (Mahavarkar et al., 2008) preeclampsia is twice as likely in

adolescent pregnancies as it is in other pregnancies. Comparable research found that the frequency of preeclampsia among all pregnant adolescents was 7.3%, but it was around three times higher among those with iron deficiency anaemia (IDA) (Basbug & Sonmez, 2018).

The prevalence of gestational diabetes was lower among pregnant adolescents than among adult women (OR: 0.76, I^2 : 0%), according to the results of this research. Many previous studies have reported similar findings (Karataşlı et al., 2019; Wang et al., 2017). However, a Chinese study among 536 753 parturients reported in Wenzhou from 2015 to 2019 reported an 11.76% incidence rate in adolescent pregnant women, which is only 8.94% in the right-age pregnant women ($P < 0.05$) (YE et al., 2021).

There was almost a similar incidence of premature membrane rupture among pregnant adolescents and adults in our findings (OR: 0.95, I^2 49%). However, some previous studies have shown a higher risk of premature membrane rupture among pregnant adolescents (Medicine et al., 2019; Rupakala et al., 2013).

In our study, the prevalence of placental abruption and cesarean delivery was somewhat lower among pregnant adolescents (OR: 0.89, I^2 86% and 0.88, I^2 99%, respectively). However, the rate of placental abruption was found to be similar in another meta-analysis, which was conducted in Turkey (Karaçam et al., 2021a). In terms of cesarean section, the incidence rate was also found to be lower among pregnant adolescents in two other studies (Socolov et al., 2017; Wang et al., 2017). Caesarean section rates vary from country to country (WHO, 2018). Some studies have indicated that the cesarean section rate is greater among pregnant adolescents (Karataşlı et al., 2019; Ozdemirci et al., 2016). Karataşlı et al. found that adolescents aged 15 to 19 years

had a greater vaginal delivery rate than other age groups (Karataşlı et al., 2019). Another study, however, revealed no difference between adolescents and older women (Medhi et al., 2016).

Our study found higher, but not statistically significant, odds of postpartum haemorrhage among pregnant adolescents compared with adult pregnant women (OR: 1.10, 95% CI: 0.98–1.23, $P = 0.11$; $I^2 = 0\%$). However, a Chinese study of 536,753 parturients conducted in Wenzhou between 2015 and 2019 reported a postpartum haemorrhage incidence of 3.19% among adolescent pregnant women, compared with 0.17% among pregnant women of appropriate reproductive age ($P < 0.05$) (YE et al., 2021).

Effect of Adolescent Pregnancy on Neonate's Health

In our study, the prevalence of preterm birth was observed to be greater (OR = 1.72, $I^2 = 95\%$) among adolescents who were pregnant. Birth cohorts from South Africa, Brazil, Guatemala, India, and the Philippines found that having an adolescent mother (19 years old) was related to preterm delivery (Fall et al., 2015). Results that were quite similar were discovered in a few more relevant experiments (T Ganchimeg et al., 2014; Karataşlı et al., 2019; Suzuki, 2019; Wang et al., 2017; WHO & Mathers, 2016; YE et al., 2021).

According to the findings of this meta-analysis, the prevalence (OR: 1.05, $I^2 = 0\%$) of low birth weight among the newborns of adolescent mothers was higher than that of the other group. This was determined by comparing the two groups' birth weights. Other studies have revealed comparable findings (Togoobaatar Ganchimeg et al., 2014; Moraes et al., 2018; WHO & Mathers, 2016; YE et al., 2021). This was found by Moraes et al. (Moraes et al., 2018) that pregnant adolescents gave birth to infants with a low birth weight. This was because the pregnant adolescents were in a biological development stage and needed to share nutrients with the baby.

Significant heterogeneity (e.g., $I^2 > 50\%$) in certain outcomes was expected due to variations in geographic location, healthcare infrastructure, and definitions of adolescence. Instead of aggregating results mechanically, we offered context-specific interpretations and emphasized outcomes with reduced heterogeneity for more reliable conclusions. Although few studies were from low- and middle-income countries (e.g., Myanmar, Liberia), the majority were conducted in middle- or high-income nations. Consequently, extrapolation to wider developing nation contexts must be approached with caution, since social variables, access to care, and cultural practices may vary considerably.

Notwithstanding stringent selection criteria, our review possesses certain limitations. The majority of studies emanated from Turkey, China, and many upper-middle-income nations, whereas regions such as Sub-Saharan Africa and Latin America were inadequately represented. This regional grouping may restrict generalizability. Moreover, recent studies (Maharaj, 2022; Mohammadian et al., 2023; Onuzo et al., 2024) may provide supplementary evidence from sub-Saharan Africa that might enhance comprehension, albeit they fall outside our specified

period range or criteria. Subsequent evaluations should strive to encompass greater geographic variety.

5. Conclusion

There are 300 million adolescents on the globe, and each year, 21 million of them get pregnant. The risk of maternal death is greatest among adolescents, and it rises with each pregnancy that an adolescent has. We must find a way to break the cycle of pregnancies among adolescents. The study provides evidence that adolescent pregnancy correlates with increased maternal and newborn health risks, including preeclampsia, anemia, and preterm delivery. The policy implications, including enhancing adolescent nutrition and reducing school dropouts, align with the findings while also embodying wider public health aims and interpretations. These proposals need more implementation studies and context-specific studies.

6. Acknowledgement

All adjustments indicated by the reviewer have been included in this revised work, including methodological clarification, title modification, extended discourse, and acknowledgment of limits.

7. Competing Interests

The authors declare no conflict of interest in conducting this study.

8. Funding

The authors of this study compensated for all of the study activities themselves.

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