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Global prevalence of constipation during pregnancy: a systematic review and meta-analysis

Nader Salari¹, Sakine Mohamadi², Mahvan Hemmati², Amirreza Fallahi², Shabnam Rasoulpoor³, Hosna Zarei², Shamarina Shohaimi⁴ and Masoud Mohammadi^{5*}

Abstract

Background Constipation is a common complication and an unpleasant experience during pregnancy. Due to hormonal factors, intestinal movements decrease during this time, causing the digestive system to malfunction. This study aims to explore the worldwide prevalence of constipation during pregnancy to prevent and minimize its complications.

Method Researchers conducted a meta-analysis of published data on the prevalence of constipation in pregnancy. The articles, which covered the period 1966 to 2024, were collected by searching Embase, PubMed, Scopus, Science Direct, Wos, and the Google Scholar search engine. The initial search was conducted on July 21, 2024, and the final update was made on August 10, 2024.

Results Thirteen studies were identified to determine the prevalence of constipation during pregnancy. The results show that the global prevalence of constipation throughout pregnancy is 32.4%, with the first trimester at 21.1%, the second trimester at 34%, and the third trimester at 30.3%.

Conclusion According to a study, constipation is most common during the second trimester of pregnancy and the least common during the first trimester. Further research on the causes of constipation and prevention methods can help decrease its prevalence during pregnancy. Therefore, it is important to provide educational interventions on nutrition and encourage moderate physical activity during pregnancy to reduce the occurrence of constipation.

Keywords Constipation, Pregnancy, Prevalence, Digestive system

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Background

Constipation is a common complication of the digestive system [1] that most women suffer from during pregnancy [2]. It is defined by the presence of at least two of the following six criteria: defecation less than three times a week, tough stools, Incomplete bowel emptying, difficulty in defecation along with straining, feeling of anorectal obstruction, and trying to expel feces manually [3]. Various causes are involved in the occurrence of constipation during pregnancy, such as the reduction of intestinal peristalsis due to the increase in progesterone hormone [2, 4], use of drugs such as magnesium sulfate



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to prevent premature birth [2] and antihistamines and anti-emetic medicines in pregnancy [5], use of low-fiber diet [6], presence of disease underlying conditions in pregnancy such as hypothyroidism [2], decrease in physical activity and exercise during pregnancy [7], decrease in gastrointestinal tract movements due to increased consumption of fat and protein to meet the nutritional needs of the fetus [7], reduction of fluid intake due to nausea and vomiting Pregnancy [2], the high level of anxiety and depression in pregnant women, which leads to a decrease in the movements of the digestive system and subsequently causes constipation [8].

In this context, it has been reported that 38% and 20% of women experienced constipation in the second and third trimesters, respectively [8]. It has also been stated that in a study of over 7000 pregnant women, primiparous women were less likely to suffer from constipation during pregnancy 35%, compared to multiparous women 39–42% [8].

In Mugie's study, the prevalence of constipation in the general population ranged from 0.7 to 79% and was, on average, 16%, which occurs more in women than men [9]. In a study conducted in Ireland on 7771 pregnant women, 37.5% of women had experienced constipation during pregnancy [10]. Constipation can occur at any time of pregnancy [11], but in general, it is most common in the first two months of pregnancy due to the increase in progesterone hormone [12]. The prevalence of constipation in multiparous women is more common than in primiparous women due to the possibility of damage to the pelvic floor muscles and the pudendal nerve [10, 13].

Several risk factors can increase the probability of constipation, such as old age [14], increased education level and higher job position [15], high body mass index (BMI) [16], increased consumption of spicy foods [12], a history of chronic constipation before pregnancy [13], stress, mental, and psychological factors [17], reduced physical activity [18], depression and anxiety [19], increased rest time during pregnancy [7], reduced water consumption [20], high parity and cesarean [10, 21, 22], threatened miscarriage [15].

Pregnant women have also had different experiences in pregnancy-related conditions due to the pandemic and recent global changes such as the COVID-19 epidemic [16]. This may be related to the physical limitations and emotional distress experienced during quarantine, which may initiate and exacerbate their constipated conditions [16].

The treatment for constipation depends on the severity of the symptoms. Lifestyle modifications, such as increasing fluid intake and consuming more dietary fiber, can resolve mild cases [23–25]. For severe cases, diagnostic and therapeutic evaluations are necessary [26]. Medicinal

treatments, such as digestive stimulant laxatives like lactulose [27] or the use of glucomannan, a medicinal plant, can stimulate intestinal peristalsis movements in pregnant women [28].

Constipation can lead to severe injuries in mother and baby [8]. Among the severe consequences of constipation, there is an increase in the prevalence of hemorrhoids after childbirth [15, 29], an increase in the risk of miscarriage and premature birth [8], an increase in the rate of cesarean Sect. [15], anemia in mothers due to bleeding from hemorrhoids following painful defecation [8, 30], the occurrence of mental disorders such as depression and anxiety [8], delay in the return of the normal function of the digestive system after childbirth [15], disturbance in the relationship between mother and newborn [31], in severe cases, the occurrence of intestinal obstruction and emergency surgery is [32]. In addition, there is a possibility of damage to the pelvic floor muscles and the pudendal nerve following continuous straining and continuous efforts to defecate [33].

Considering the complications mentioned for the mother and the baby, constipation can harm the quality of life and physical and social health of women during pregnancy [29–34], and considering that policymaking and preventive measures require access to accurate information. Also, there is no comprehensive study that can evaluate such a problem without any ambiguity at the world level, considering the importance of this digestive complication in the lives of pregnant women and their fetuses, this study is designed to investigate the prevalence of constipation during pregnancy.

Methods

The present systematic review and meta-analysis were conducted by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA2020) and Cochran review approach. The stages in the systematic review process include: selecting a research question, determining inclusion and exclusion criteria, identifying articles, selecting studies, evaluating study quality, extracting data, and analyzing and interpreting findings. The present study is a meta-analysis that used published data to examine the prevalence of constipation during pregnancy. In order to conduct a comprehensive search, all relevant databases were used to access the desired articles. Articles from 1966 to 2024 were gathered by searching six databases: Embase, PubMed, Scopus, Science Direct, WoS, and Google Scholar. The initial search was conducted on July 21, 2024, and the final search was completed on August 10, 2024. A total of 1,350 articles were collected through database searches, and an additional 35 articles were found through manual searches (search the references section of extracted articles) and

imported into EndNote. Gray literature or unpublished articles and sources that could not be cited were excluded from the study. Screening of the articles was carried out following the PRISMA guidelines (search process in the supplementary).

Inclusion criteria

In the **Inclusion criteria** section, articles that would have prevented us from achieving prevalence of constipation during pregnancy were considered, such as:

1. Studies regarding the prevalence of constipation during pregnancy (because the prevalence is obtained in a cross-sectional study and can be used for policy making.)
2. Studies whose full text was available.
3. Studies whose text is written in English.
4. Cohort studies.
5. Cross-sectional studies.

Exclusion criteria

Also, studies that were irrelevant and did not provide us with information on prevalence of constipation during pregnancy, or studies that were not prevalence in nature, were excluded from the study, such as:

1. Studies related to the prevalence of disease in the general population.
2. Interventional studies.
3. Review studies, meta-analysis, and theses.
4. Studies that are about the incidence rate of constipation during pregnancy and post-delivery.
5. Duplicate studies.

Study selection method

Researchers followed the PRISMA guidelines to extract articles imported into EndNote software. After removing duplicate articles, the primary evaluation based on inclusion and exclusion criteria was conducted. The selected articles underwent a secondary review, and those with unsuitable content were excluded. Two researchers completed data review and extraction. In cases of discrepancies between the two researchers, a third researcher made the final decision to include or exclude the article. Ultimately, 13 articles were chosen for the study.

Quality assessment

The quality of the articles was assessed and validated using the STROBE checklist, which consists of six sections and 22 items. This checklist is used to report observational epidemiological studies and enhance the quality

of reporting. Articles that scored less than 16 based on the criteria in the checklist were excluded from the study due to poor quality.

Data extraction

The collected data were transferred to an Excel table to organize them. This table included columns titled “name of the first author of the article, year of publication, place of study, type of study, age group of the studied population, size of the studied sample, number of affected people in the studied sample, disease prevalence, and data collection tools.”

Statistical analysis

To analyze and combine the results of different studies, in each study, the prevalence of constipation during pregnancy was considered as the probability of binomial distribution, and its variance was calculated through binomial distribution. The heterogeneity of studies was assessed using the I^2 test. The random effects model was used in the case of the I^2 index above 50%. Publication bias was performed using the Funnel Plot and Egger tests. Data were analyzed using Comprehensive Meta-Analysis (Version 2) software and the significance level of the test was $P < 0.05$. Given that the study was conducted in different countries with different sample sizes, races, and ages, as well as in other years, the heterogeneity of the studies is justified. Also, the publication bias analysis addresses the issue that studies may have been conducted in this field but not published, and this situation may overstate the results.

Results

Based on PRISMA guidelines and after searching the reviewed databases, in the first stage, 1350 articles were found in international databases and 35 articles were found in additional records identified through other resources, of which 525 studies repeated in different databases were removed. 738 articles were deleted based on the inclusion and exclusion criteria by reviewing the title and abstract of the study. In the next stage (competency assessment), out of the remaining 122 studies from the screening stage, 22 articles were removed by reviewing the full text of the article because it was not relevant to the research. The quality evaluation of 100 articles included in this study was performed using the STROBE checklist, 87 studies did not have the required information for meta-analysis and presented low quality. Thus, 13 articles related to the descriptive part of the study entered the process of systematic review and meta-analysis (Fig. 1; Table 1).

Based on Table 1, there are 8 cohort studies and five cross-sectional studies. Seven of these studies were

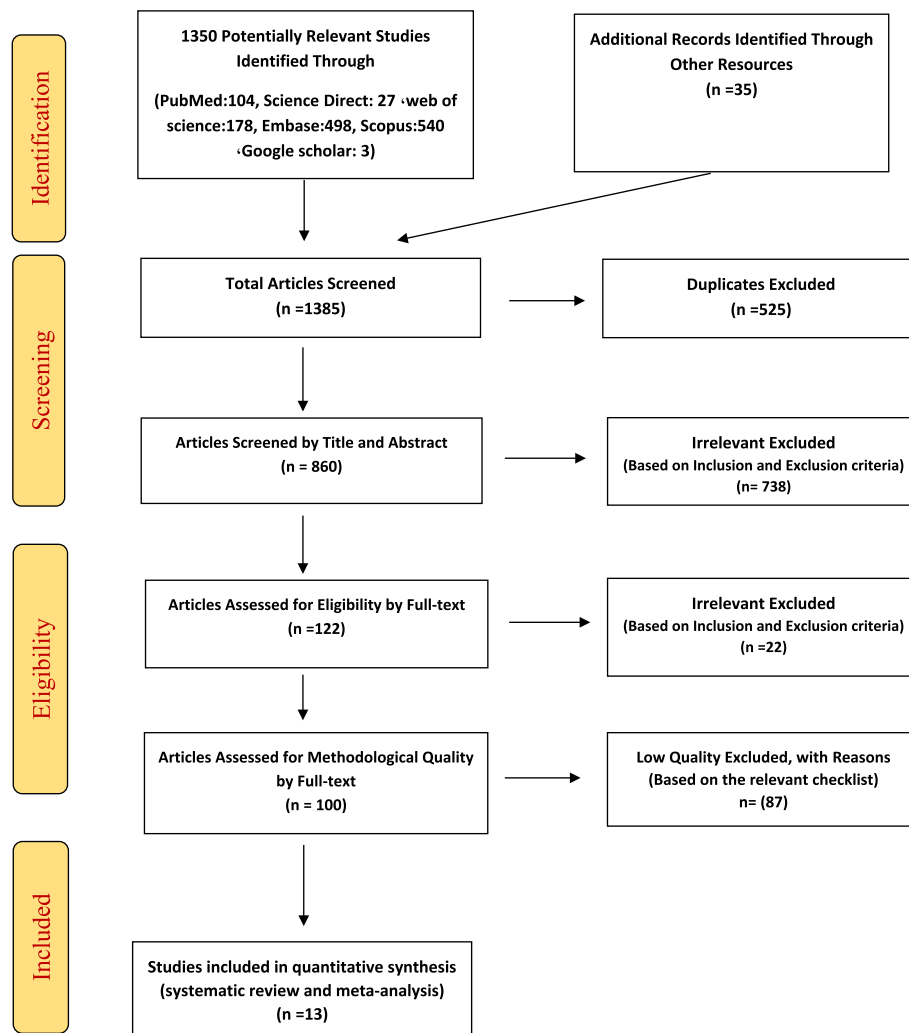


Fig. 1 The flowchart on the stages of including the studies in the systematic review (PRISMA 2009)

conducted in Europe (Belgium, Italy, Finland, Spain, Netherlands, and the UK), five in Asia (China, Japan, Pakistan, and Indonesia), and one in America. The number of study populations varied across the different trimesters of pregnancy. Some studies examined the prevalence of constipation in all three trimesters, while others focused on the first or second trimesters (Table 1).

These studies examined 7082 pregnant women. The largest study was conducted by Shi et al. [15] in China, where 2000 pregnant women in their third trimester (37 to 41 weeks) were included to determine the epidemiology of functional constipation (FC) during pregnancy. The most minor study was conducted by Derbyshire et al. [12] in the UK, where 94 pregnant women were examined (Table 1).

Constipation diagnosis criteria

In the studies, various criteria have been used to evaluate constipation during pregnancy, and a summary of these criteria is given in Table 2 as follows:

Assessing the prevalence of constipation during pregnancy

In the present study, the evaluation of constipation in two studies [12, 36] was based on the Rome II criteria, in seven studies [13, 15, 30, 38, 40–42] based on the Rome III criteria and in one study [35] based on the Rome IV criteria is done. In the study of Kurenon et al. [35], the prevalence of constipation was evaluated based on the three Rome IV criteria, the BFI index, and the constipation self-report questionnaire. Also, in this study, because the BFI index is the result of two methods, the Rome

Table 1 Summary of characteristics of studies of global prevalence of constipation in pregnancy

Author	Year	Country	Type of study	Age range	Sample size	Prevalence of Constipation	Instrument	Evaluation method
Bradley, et al. [13]	2007	USA	prospective & longitudinal cohort	mean (28/4 ± 5)	Trimester 1 (103) Trimester 2(77) Trimester 3(70)	Trimester 1 (23.3%) Trimester 2(26.3%) Trimester 3(15.7%)	self-administered questionnaires and a prospective 7-day stool diary	Rome III
Kuronen, et al. [35]	2021	Finland	Cross-sectional	14–52	Trimester 2 (263) Trimester 3(209) All Pregnant(472)	Trimester 2 (43.7%) Trimester 3(35.8%) All Pregnant(40.08%)	questionnaire	Rome IV
Kuronen, et al. [35]	2021	Finland	Cross-sectional	14–52	Trimester 2 (263) Trimester 3(209) All Pregnant(472)	Trimester 2 (39%) Trimester 3(33%) All Pregnant(36.44%)	questionnaire	BFI
Kuronen, et al. [35]	2021	Finland	Cross-sectional	14–52	Trimester 2 (263) Trimester 3(209) All Pregnant(472)	Trimester 2 (61%) Trimester 3(55%) All Pregnant(64.83%)	questionnaire	Self-Report
Derbyshire, et al. [12]	2006	UK	prospective cohort	19–40(mean = 33.4)	Trimester 1 (66) Trimester 2(54) Trimester 3(56)	Trimester 1(35%) Trimester 2(39%) Trimester 3(21%)	diet record book and electronic calibrated scales, Bowel habit diary, Physical activity questionnaire	Rome II
Ponce, et al. [36]	2008	spain	prospective cohort	18–39(mean = 31)	Trimester 1 (206) Trimester 2(179) Trimester 3(142)	Trimester 1(45.4%) Trimester 2(37.1%) Trimester 3(39.4%)	Questionnaire	Self-Report
Ponce, et al. [36]	2008	spain	prospective cohort	18–39(mean = 31)	Trimester 1 (206) Trimester 2(179) Trimester 3(142)	Trimester 1(29.6%) Trimester 2(19.0%) Trimester 3(21.8%)	Questionnaire	Rome II
Frigerio, et al. [37]	2023	italy	cohort	Age ≥ 18 (mean = 33 ± 4.9)	third trimester(927)	66.60%	Questionnaire	PFQPP
Hestiantoro, et al. [38]	2018	Indonesia	Cross-sectional	20–35	174	Trimester 1 (5.88%) Trimester 2(21.4%) Trimester 3(11.3%) All pregnant(13.2%)	Questionnaire	Rome III
Ishibashi, et al. [39]	2023	Japan	prospective cohort	31.1 ± 5.9	211	51.18%	Questionnaire	CAS
Shi, et al. [15]	2015	china	Cross-sectional	18–45	1698	13.01%	hospital databases	Rome III
Reijonen, et al. [40]	2022	finland	prospective cohort	18–41	Trimester 1 (170) Trimester 2(134) Trimester 3(109)	Trimester 1 (26.5%) Trimester 2(29.1%) Trimester 3(20.2%)	Questionnaire	Rome III

Table 1 (continued)

Author	Year	Country	Type of study	Age range	Sample size	Prevalence of Constipation	Instrument	Evaluation method
van brummen, et al. [11]	2006	Netherland	prospective cohort	Mean(30/3)	12w gesta-tion(487) 36w gestation(400)	12w gesta-tion(8.9%) 36w gestation(4.5%)	self-report ques-tionnaire, Def-ecatory Distress Inventory(DDI), Interview	Self-Report
Ferdinande, et al. [30]	2018	Belgium	prospective cohort	mean(31)	Trimester 2(94) Trimester 3(90)	Trimester 2(29.8%) Trimester 3(32.2%)	Questionnaire	Rome III
Shamim, et al. [41]	2019	Pakistan	Cross-sectional	17–46	332	62.30%	Questionnaire	Rome III
Zaman, et al. [42]	2023	Pakistan	Cross-sectional	18–25	37–41 w gesta-tion (340)	64.70%	Questionnaire	Rome III

criteria, and the constipation self-report questionnaire, it is used to evaluate It has been used for constipation in pregnant women. Three studies [11, 35, 36] assessed the prevalence of constipation based on self-reporting of constipation. In Ishibashi et al.'s study [39], the Japanese version of the CAS scale was used to evaluate constipation.

The first trimester of pregnancy

According to Table 2, in Bradley et al.'s study [13], which evaluated constipation using Rome III criteria, the prevalence of constipation in the first trimester was 23.3%. In Ponce et al.'s study [36], the prevalence of constipation was based on a different criterion, and very different results were obtained. The prevalence of constipation in the first trimester was estimated to be 29.6% using the Rome II criteria, similar to the 26.5% prevalence reported in Finland in Reijonen et al.'s study [40]. However, according to the self-reports of pregnant women in Ponce's study [36], the prevalence of constipation was estimated at 45.4%, which is the highest reported prevalence in the first trimester of pregnancy among the studies reviewed. The lowest reported prevalence of constipation during the first trimester is from Hestiantoro's study [38] based on Rome III criteria and Van Brummen's study [11] based on self-report of primiparous pregnant women. These studies show the prevalence of first-trimester constipation to be 5.88% and 8.9%, respectively. In the survey conducted by Ishibashi et al. [39] in Japan in 2023 on 211 pregnant women, it was reported that 16 (14.8%) participants experienced the onset of constipation symptoms in the first trimester. Some pregnant mothers who were constipated during the first trimester reported the onset of constipation symptoms before pregnancy, and 10.2% of pregnant mothers were unaware of the onset of their

symptoms. Therefore, in this study, it is not clearly mentioned that in total, in the first, second, and third trimesters of pregnancy, separately, what percentage of pregnant mothers were constipated? The study by Derbyshire et al., based on Rome II, reported the prevalence of constipation in the first trimester to be 35%.

The second trimester of pregnancy

Most of the articles reviewed in this study have meticulously focused on the prevalence of constipation during the second trimester of pregnancy. For instance, the comprehensive survey conducted by Kuronen et al. [35] in Finland, which evaluated constipation during the second and third trimesters of pregnancy, used a range of criteria including Rome IV, Bowel Function Index (BFI), and self-reports from pregnant women. This thorough approach instills confidence in the findings. In the second trimester, the prevalence of constipation was 44%, 39%, and 61%, according to a study by Kuronen. However, Ponce et al. reported a prevalence of 37.1% based on self-reports from pregnant women, which differs significantly from Kuronen's findings based on the same criteria [36]. The prevalence of constipation was reported as 19% in a study by Ponce, based on Rome II criteria, which is the lowest among the studies examined. In two other studies, the prevalence of constipation in the second trimester was 39% [12, 35]. Based on the Japanese version of CAS, Ishibashi et al.'s study [39] found that 19.4% of pregnant women reported the onset of constipation symptoms in the second trimester, which matches the prevalence of constipation in this study. However, it must also be clearly stated in the second quarter. In Bradley's [13] study, Ferdinande [30] and Hestiantoro [38] reported a constipation prevalence of 26.3%, 29.8%, and 21.4%, respectively, according to the Rome criteria (Table 1).

Table 2 Specifications of criteria used in direction studies Assessment of constipation

Criterion Name	Description	Attributes
Rome criteria	This criterion is determined by the Rome Foundation in the United States of America. It is used to classify, diagnose, and treat gastrointestinal (GI) disorders and is revised every few years [43].	<p>In the latest review, according to the Rome IV criteria, functional constipation is defined as follows:</p> <ul style="list-style-type: none"> - Presence of 2 or more of two of the following: <ul style="list-style-type: none"> - The need to strain during defecation in at least 25% of cases - Hard and knot-like stools in at least 25% of cases - Feeling of an obstacle or blockage during defecation in the anorectal area in at least 25% of cases - The need to use a finger to facilitate the exit of feces in at least 25% of cases - The feeling of not completely emptying the rectum in at least 25% of cases - The frequency of defecation should be less than three times a week. <p>2- Loose and watery stools are rarely seen if laxatives are not used.</p> <p>3- Irritable bowel syndrome (IBS) criteria are absent in the person. It should be noted that these symptoms must have existed during the last three months and started at least six months before diagnosis [3, 35, 44].</p>
BFI	BFI (Bowel Function Index) is a new index to evaluate constipation in people who use drugs and suffer from constipation caused by drug use [45].	<p>This index consists of three criteria:</p> <ul style="list-style-type: none"> - Symptoms of easy elimination - Lack of complete bowel emptying - Judgment and personal opinion of the person about constipation during the last seven days [35] <p>The final score of this index is calculated based on the average of the three mentioned criteria. Its scoring range is from 0 to 100, and a score of 100 indicates severe constipation [45].</p>
Self-Report questionnaire	Constipation self-report questionnaire	<p>This questionnaire surveys people's personal judgments and opinions about their constipation. It is scored from 0 to 10, where a score of 10 indicates very severe constipation [35].</p> <p>This scale examines six subjective symptoms of constipation. If the final score is equal to or greater than 5, it indicates constipation that needs treatment [39].</p>
CAS	CAS is a new scale for evaluating the presence and severity of constipation [46]. Broussard et al.'s study [47] has confirmed its validity and reliability in assessing constipation during pregnancy.	

The third trimester of pregnancy

Most of the studies listed in Table 1 have focused on determining the frequency of constipation during the third trimester of pregnancy. The highest prevalence during this trimester was documented in the cross-sectional study conducted by Frigerio et al. [37] in Italy in 2023, which involved 927 women in their 37th week of pregnancy. The study aimed to identify intestinal disorders during the third trimester of pregnancy using the Italian pelvic floor examination questionnaire (PFQPP) in pregnant and postpartum women. It reported a constipation prevalence of 66.6% during the third trimester, consistent with the 64.70% prevalence reported by Zaman and colleagues [42] in Pakistan for the 37th to 41st weeks of pregnancy. The lowest reported prevalence of constipation is from the study by Van Brummen et al. [11], which found a prevalence of about 4.5% based on self-reports from first-time pregnant women. This rate is much lower than in other studies. Three other studies by Derbyshire [12], Ponce [36], and Reijonen [40] used the Rome II criteria and reported consistent prevalence rates of 21%, 21.8%, and 20.2% for third-trimester constipation. Another study by Shi et al. [15] in China, which used the Rome III criteria, reported a prevalence of 13.01% for functional constipation in the third trimester of pregnancy, according to Table 1.

According to Kuronen et al.'s study [35], the prevalence of constipation in the third trimester was reported as 36% based on the Rome IV criteria, 55% based on the self-report of pregnant mothers, and 33% based on the BFI index, which is 32.2% reported in the study by Ferdinande et al. [30] is consistent. In the study of Ishibashi et al. [39], only one person (0.9%) reported the onset of constipation symptoms in the third trimester, which indicates that the prevalence of constipation in the third trimester of pregnancy is less than in the first and second trimester. In other studies, the prevalence of 11%, 39.4%, and 13% have been reported [13, 36, 38].

Table 1 presents the findings of five studies that have significantly contributed to our understanding of constipation prevalence during pregnancy. Two studies focused on the second and third trimesters, one on the first and third trimesters, and two on the third trimester. In addition, three studies reported the overall prevalence of constipation during pregnancy. The analysis of these studies has yielded the following significant results:

The entire pregnancy

In a review of 1² studies involving 5595 people, the I² heterogeneity test indicated high heterogeneity (I²: 98.7). As a result, the random effects method was used for the analysis. Based on the meta-analysis, the overall

prevalence of constipation during pregnancy was 32.4 (CI:95%: 20.9–46.5) (Fig. 2). Additionally, the Egger test revealed no publication bias in the studies (p: 0.750) (Fig. 3).

The first trimester of pregnancy

In a review of 7 studies involving 1412 people, the I² heterogeneity test indicated high heterogeneity (I²: 95.1). As a result, the random effects method was used to analyze the results. The meta-analysis revealed that the global prevalence of constipation in the first trimester of pregnancy was reported as 21.1 (95% CI: 12–34.3) (Fig. 4). Additionally, the Egger test showed no publication bias in the studies (p: 0.420) (Fig. 5).

The second trimester of pregnancy

In a review of 10 studies involving 1690 people, the I² heterogeneity test indicated high heterogeneity (I²: 92.1). As a result, the random effects method was used to analyze the results. Based on the meta-analysis, the global prevalence of constipation in the second trimester of pregnancy was reported as 34 (95%CI: 26.1–42.8) (Fig. 6). The Egger test showed no publication bias in the studies (p: 0.059) (Fig. 7).

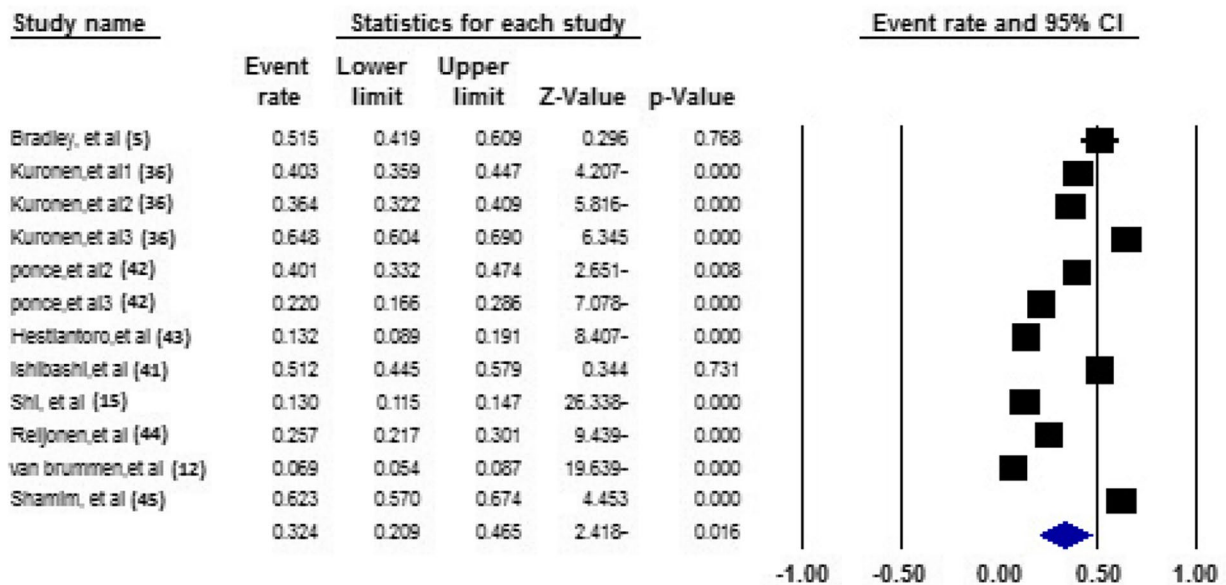
The third trimester of pregnancy

In a review of 12 studies involving 3021 participants, the I² heterogeneity test indicated high heterogeneity (I²: 97.7). As a result, the random effects method was used to analyze the results. The meta-analysis revealed that the global prevalence of constipation in the third trimester of pregnancy was reported as 30.3 (95% CI: 18.9–44.8) (Fig. 8). Additionally, the Egger test detected publication bias in the studies (p: 0.0004) (Fig. 9).

Discussion

The following is a meta-analysis study on the global prevalence of constipation during pregnancy. The study estimates the overall prevalence of constipation during pregnancy to be 32.4%. Constipation has been assessed in various studies using different criteria, resulting in varying reports of its prevalence in pregnant women. Generally, constipation is more prevalent in women than men [48]. The occurrence of this condition varies among individuals due to cultural and dietary diversity [49]. Constipation is a common disorder during pregnancy. It may occur due to worsening pre-existing conditions or as a new experience caused by hormonal and mechanical changes during pregnancy [35, 50, 51]. Mild cases usually do not require medical attention, but severe and resistant cases should be referred to a specialist [26]. Lifestyle modifications, increased physical activity, and a

Meta Analysis



Meta Analysis

Fig. 2 Forest plot of the global prevalence of constipation throughout pregnancy based on random effects method

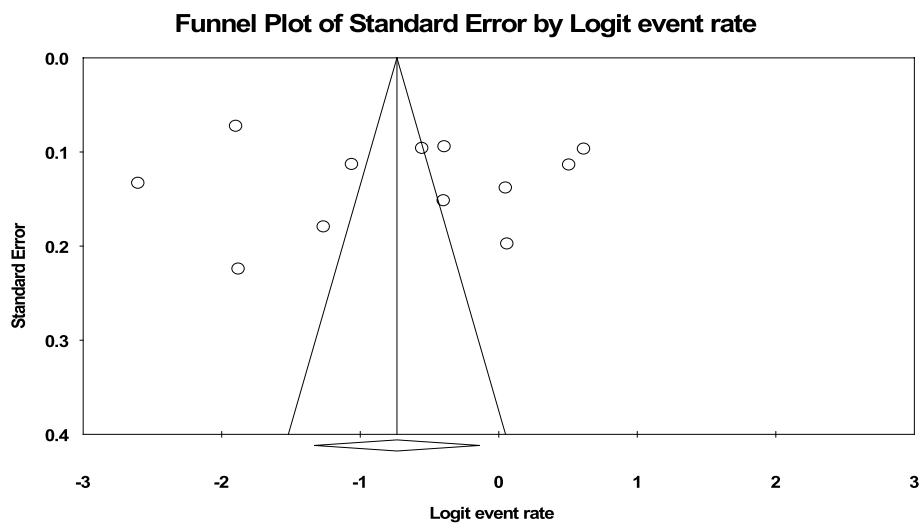


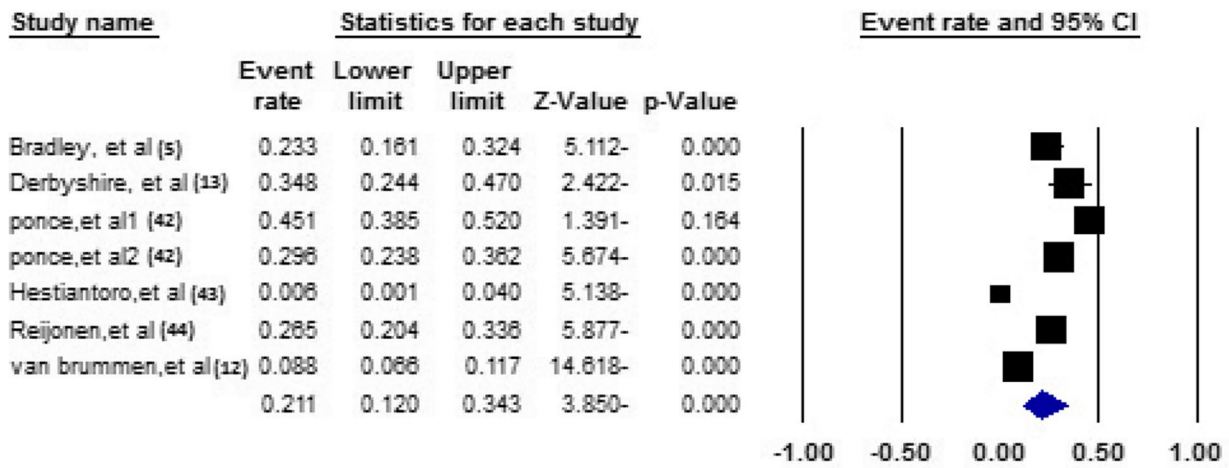
Fig. 3 Funnel plot of the distribution bias in the reviewed studies

high-fiber diet are the primary treatments for constipation [51].

The prevalence of constipation during pregnancy varies in different studies. Bradley’s study [13] found an overall prevalence of 51%, while Reijonen’s [40] reported

a prevalence of about 25.4%. Shi’s study [15] indicated that functional constipation affected 13.01% of pregnant women. Additionally, it was found that constipated pregnant women were more likely to have a cesarean delivery than a natural delivery [15]. According to a Chinese

Meta Analysis



Meta Analysis

Fig. 4 Forest plot of global prevalence of constipation in the first trimester of pregnancy based on the random effect’s method

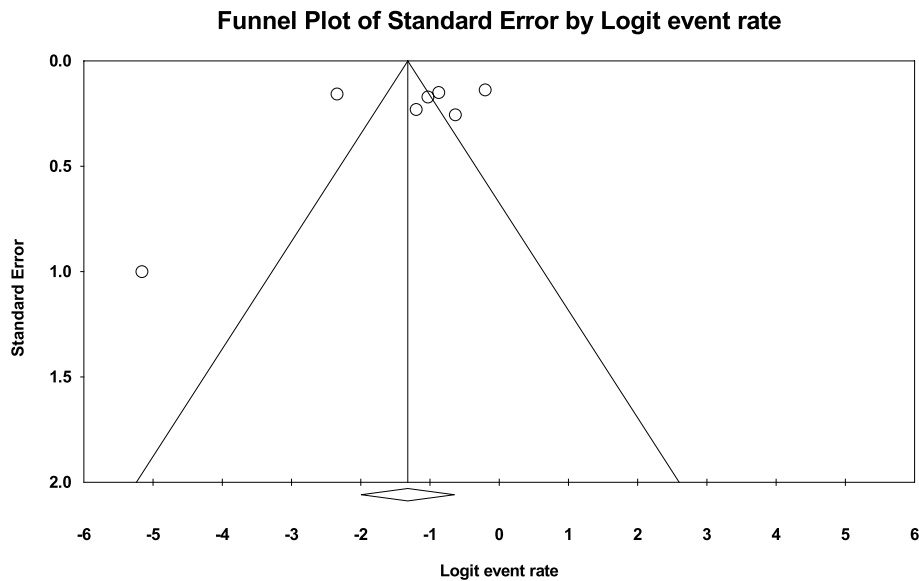
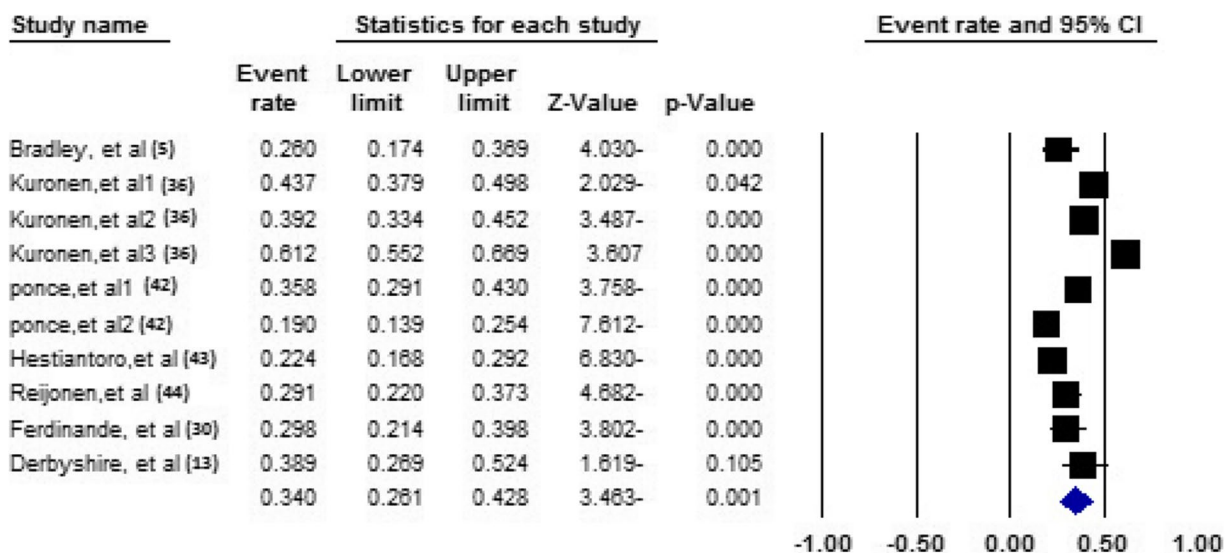


Fig. 5 Funnel plot of the publication bias in the reviewed studies

study, a history of constipation before pregnancy is a significant risk factor for constipation during pregnancy and after delivery [39]. In one study [12], the highest prevalence of constipation was reported in the second trimester, consistent with our study’s results. However, another study [36] found the highest prevalence in the first

trimester, while in Ferigerio’s study [37], a high percentage of women experienced constipation in the third trimester (66.6% of pregnant women). In pregnant women who suffer from functional constipation (FC) during pregnancy, the prevalence of postpartum complications is higher [44]. Additionally, in Shamim et al.’s study [41],

Meta Analysis



Meta Analysis

Fig. 6 Forest plot of the global prevalence of constipation in the second trimester of pregnancy based on the random effect’s method

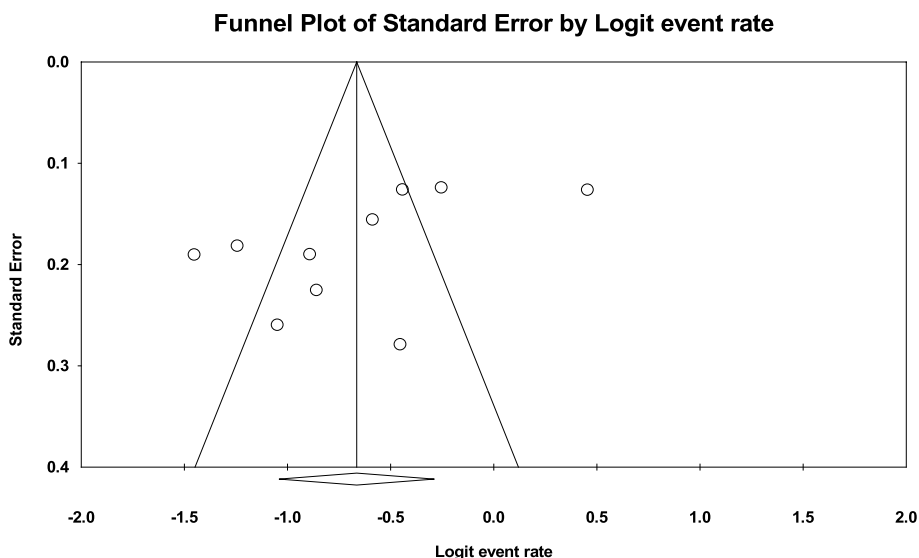


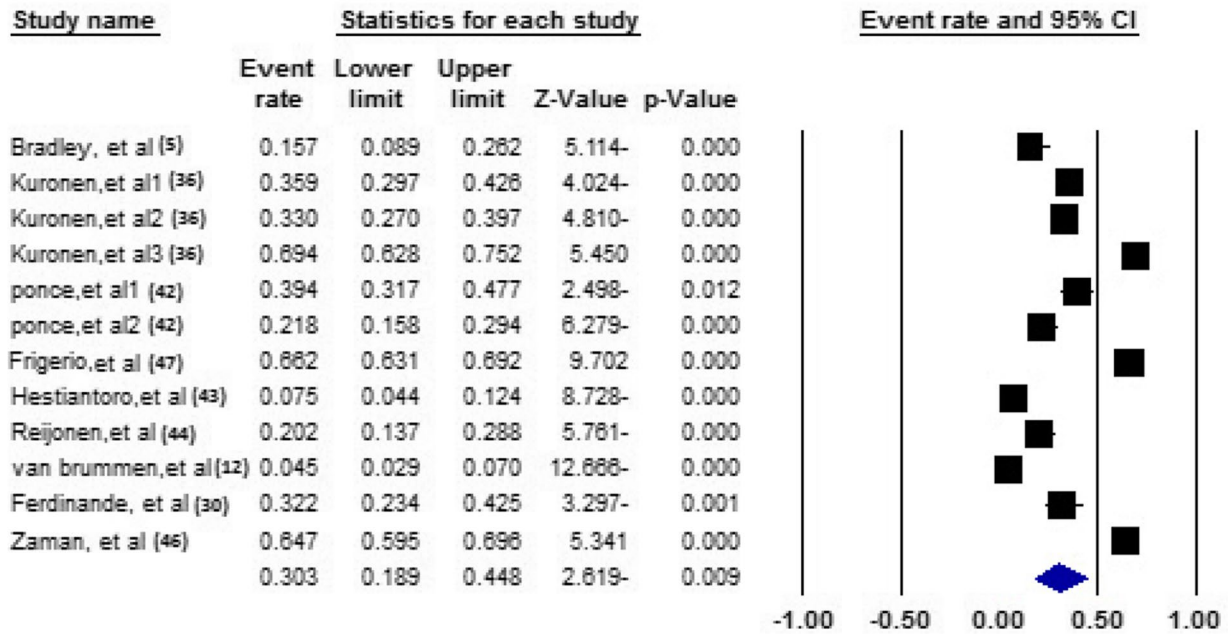
Fig. 7 Funnel plot of the publication bias in the reviewed studies

the prevalence of constipation during pregnancy was reported as 62.3%.

In 2015, Rungsi普拉 et al. [27] conducted a review study on the effectiveness of various therapeutic

interventions on constipation during pregnancy, in which, based on multiple studies, the prevalence of constipation during pregnancy was reported as 11 to 44%. Its results showed that despite side effects such as abdominal

Meta Analysis



Meta Analysis

Fig. 8 Forest plot of the global prevalence of constipation in the third trimester of pregnancy based on the random effect's method

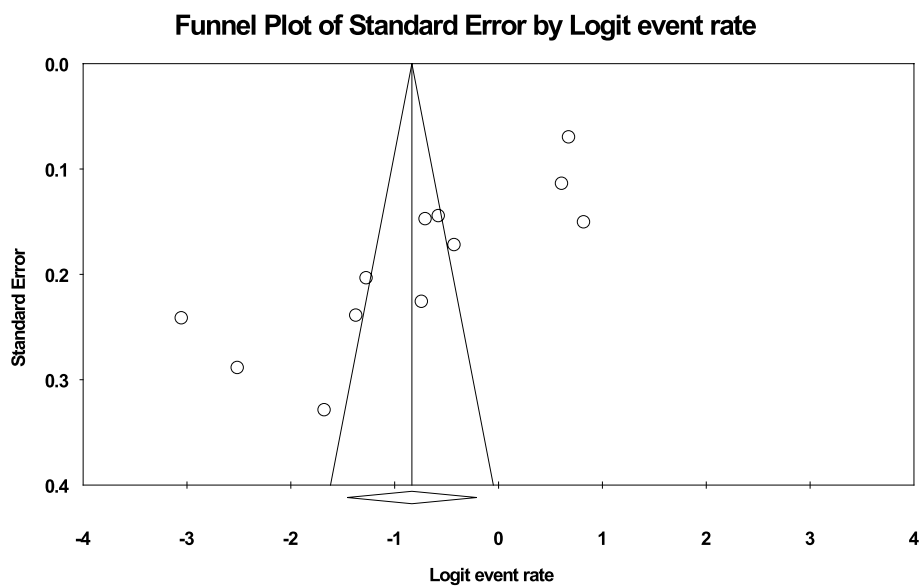


Fig. 9 Funnel plot of the distribution bias in the reviewed studies

cramps, stimulant laxatives are more effective in treating constipation. The prevalence of constipation is higher in the first days after delivery [35], and the decrease in physical activity can be one of the main contributors [15].

In a study by Marshal et al. [10], 3562 primiparous women and 4200 multiparous women were examined in the days following delivery. The study found that 37.5% of women without a history of constipation experienced constipation for the first-time during pregnancy. The occurrence of constipation was higher in multiparous women compared to primiparous women. The study suggested that the compressive effect of the uterus on the pelvic nerves due to multiple pregnancies could disrupt the normal function of pelvic muscles, leading to constipation [33].

The results of this study can be used by caregivers and health experts as well as midwives, and in this way, these caregivers can note the necessary recommendations to prevent constipation in pregnant women, these measures can include informing them to prevent constipation. Advise them to use a diet with high fiber and drink plenty of fluids from early pregnancy onwards, as well as regular exercise. Educational interventions regarding nutrition during pregnancy and moderate physical activity during this period are essential to reduce the prevalence of constipation. Especially in developing countries, increasing educational efforts in this area for families in health centers can reduce medical costs for people suffering from such problems and make families aware of this disease and its consequences.

Study limitations and strengths

The limitations of this study are as follows: The number of studies examining the prevalence of constipation during pregnancy is limited. The results of this study are specific to pregnant women and may not apply to other groups. Different criteria were used to assess constipation in the studies, leading to varying reported results. Pregnant women with constipation may be more likely to participate in such studies, potentially biasing the results. Some studies have limited participants, which can result in diagnostic errors. Many studies lack a non-pregnant control group to compare the prevalence rates between pregnant and non-pregnant individuals. Studies that have low quality can overestimate the prevalence or underestimate the prevalence because they did not meet the specific criteria of a study, and due to this problem, low-quality studies were excluded from the study. The most important strength of this study is the comprehensive review of all the investigated databases as well as a complete table for the specifications of the criteria used in the studies to evaluate constipation.

Conclusion

For several reasons, constipation is a common digestive disorder that becomes more common during pregnancy. It is most prevalent in the second trimester and least prevalent in the first trimester. When medication is required to treat constipation, some laxatives may have adverse effects on both the pregnant mother and the fetus. More studies on the causes of constipation and ways to prevent it are necessary to reduce the prevalence of constipation during pregnancy. Educational interventions focusing on nutrition during pregnancy and promoting moderate physical activity during this period are also essential.

Abbreviations

CAS	Constipation Assessment Scale
BFI	Bowel function index
IBS	Irritable bowel syndrome
GI	Gastrointestinal

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

NS and SM and MM contributed to the design, MM statistical analysis, and participated in most of the study steps. MM and MH and AF prepared the manuscript. MM and SHSH and HZ and SHSH assisted in designing the study, and helped in the, interpretation of the study. All authors have read and approved the content of the manuscript.

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Data availability

Datasets are available through the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

Ethics approval was received from the ethics committee of deputy of research and technology, Kermanshah University of Medical Sciences (IR.KUMS. REC.1403.412).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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