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REVIEW ARTICLE

Chewing gum improves postoperative recovery of gastrointestinal function after cesarean delivery: a systematic review and meta-analysis of randomized trials

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ABSTRACT

Objective: To examine whether chewing gum hastens the return of gastrointestinal function after a cesarean delivery.

Methods: All randomized controlled trials comparing the use of chewing gum in the immediate postoperative recovery period (i.e. intervention group) with a control group were included in the meta-analysis. The primary outcome was the time to first flatus in hours. Meta-analysis was performed using the random effects model of DerSimonian and Laird, to produce summary treatment effects in terms of mean difference (MD) or relative risk (RR) with 95% confidence interval (CI).

Results: Seventeen trials, including 3041 women, were analyzed. Trials were of moderate to low quality with different inclusion criteria. In most of the included trials chewing gum was given right after delivery, three times a day for 30 min each and until the first flatus. Women who were randomized to the chewing gum group had a significantly lower mean time to first flatus (MD – 6.49 h, 95%CI −8.65 to −4.33), to first bowel sounds (MD – 8.48 h, 95%CI −9.04 to −7.92), less duration of stay (MD – 0.39 days, 95%CI –0.78 to −0.18), lower time to first feces (MD – 9.57 h, 95% CI −10.28 to 8.87) and to the first feeling of hunger (MD – 2.89 h, 95%CI −4.93 to −0.85), less number of episodes of nausea or vomiting (RR 0.33, 95%CI 0.12 to 0.87), less incidence of ileus (RR 0.39, 95%CI 0.19 to 0.80) and significantly higher satisfaction.

Conclusions: Gum chewing starting right after cesarean delivery three times a day for about 30 min until the first flatus is associated with early recovery of bowel motility. As this is a simple, generally inexpensive intervention, providers should consider implementing cesarean postoperative care with gum chewing.

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KEYWORDS
Labor; delivery; vaginal delivery; operative delivery; cesarean section

Introduction

Cesarean delivery is the most common major surgical operation in the United States, with about one million done annually for an overall rate of about 30% in 2015 [1]. Postoperative ileus is an impaired condition of gastrointestinal motility defined as an abnormal interval from surgery until the passage of flatus or stool and the tolerance of an oral diet, that should occur within day 4 postoperatively [2]. It can be characterized by nausea, vomiting, loss of appetite, cramps, and abdominal pain and distention, and complicates up to 20% of cesarean delivery [2]. Moreover, it can also be associated with an enhanced length of stay in the hospital [2,3].

Several approaches have emerged in an attempt to hasten the return of gastrointestinal motility after cesarean delivery, including early hydration and ambulation. Chewing gum may offer an efficacious intervention for improving postoperative gastrointestinal function recovery after cesarean delivery [4–15], since it has been already proven to improve gastrointestinal function in non-obstetric abdominal surgery [3]. Considering the number of people who undergo cesarean delivery each year globally, this could have implications for health care costs and recovery [16]. It is therefore essential that benefits and costs are carefully evaluated.

Thus, the aim of this systematic review and meta-analysis of randomized controlled trials (RCTs) was to

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examine whether chewing gum after cesarean delivery hastens the return of gastrointestinal function.

Materials and methods

Search strategy

This review was performed according to a protocol designed *a priori* and recommended for systematic review [17]. Electronic databases (i.e. MEDLINE, Scopus, ClinicalTrials.gov, EMBASE, Sciencedirect, the Cochrane Library at the CENTRAL Register of Controlled Trials, Scielo) were searched from their inception until November 2016. Search terms used were the following text words: "gum," "cesarean", "caesarean", "delivery", "labor", "labour", "chewing," "sham feeding," "general anesthesia," "morbidity," "mortality," "meta-analysis," "metaanalysis," "review," "randomized," "post-operative," "clinical trial," "randomised," "effectiveness," "guidelines," "cost," "ileus," and "clinical trial." No restrictions for language or geographic location were applied. In addition, the reference lists of all identified articles were examined to identify studies not captured by electronic searches. The electronic search and the eligibility of the studies were independently assessed by two authors (AC, GS). Differences were discussed with a third reviewer (VB).

Study selection

We included all RCTs comparing the use of chewing gum in the immediate postoperative recovery period (i.e. intervention group) with a control group for comparison. Studies in which the gum contained an active therapeutic agent were not included. Studies in which the intervention consisted of gum in combination with another intervention were also excluded. Quasi RCTs (i.e. trials in which allocation was done on the basis of a pseudo-random sequence, e.g. odd/even hospital number or date of birth, alternation) were not included.

Risk of bias

The risk of bias in each included study was assessed by using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions*. Seven domains related to risk of bias were assessed in each included trial since there is evidence that these issues are associated with biased estimates of treatment effect: (1) random sequence generation; (2) allocation concealment; (3) blinding of participants and personnel; (4) blinding of outcome assessment; (5) incomplete outcome data; (6) selective reporting; and (7) other bias. Review authors' judgments were categorized as "low risk", "high risk," or "unclear risk" of bias [17].

Two authors (AC, GS) independently assessed inclusion criteria, risk of bias, and data extraction. Disagreements were resolved by discussion with a third reviewer (VB).

Outcomes

All analyses were done using an intention-to-treat approach, evaluating women according to the treatment group to which they were randomly allocated in the original trials. Primary and secondary outcomes were defined before data extraction.

The primary outcome was time to first flatus in hours after cesarean delivery. The secondary outcomes were time to first bowel sounds in hours, length of hospital stay in days, time to first feces in hours, maternal satisfaction, assessed by self-reported patient satisfaction survey, first feeling of hunger in hours, number of episodes of nausea or vomiting after cesarean, need for additional analgesics or antiemetics, and incidence of paralytic ileus, defined as symptoms or signs of gastrointestinal disturbance such as nausea, vomiting, abdominal cramping, or abdominal distension within the first 72 h after the cesarean delivery or as defined by the original trial.

We planned to assess the primary outcome (i.e. time to first flatus in hours) in subgroup analysis according to the type of cesarean delivery.

Statistical analysis

The data analysis was completed independently by two authors (AC, GS) using Review Manager v. 5.3 (The Nordic Cochrane Centre, Cochrane Collaboration, 2014, Copenhagen, Denmark). The completed analyses were then compared, and any difference was resolved by discussion with a third reviewer (VB).

Data from each eligible study were extracted without modification of original data onto custom-made data collection forms. For continuous outcomes means ± standard deviation were extracted and imported into Review Manager v. 5.3.

Meta-analysis was performed using the random effects model of DerSimonian and Laird, to produce summary treatment effects in terms of mean difference (MD) or relative risk (RR) with 95% confidence interval (CI). Heterogeneity was measured using I-squared (Higgins I^2).

Potential publication biases were assessed statistically by using Begg's and Egger's tests. The meta-

analysis was reported following the Preferred Reporting Item for Systematic Reviews and Meta-analyses (PRISMA) statement [18]. Before data extraction, the review was registered with the PROSPERO International Prospective Register of Systematic Reviews (CRD 42017056270).

Results

Study selection and study characteristics

The flow of study identification is shown in Figure 1. 18 trials were assessed for eligibility [4–15,19–24]. One was excluded since no data were available [24]. Therefore, 17 trials, including 3041 women, were analyzed [4–15,19–23]. No quasi-randomized trials were included. Publication bias, assessed using Begg's and Egger's tests, was not significant ($p = .75$ and .84, respectively). The quality of the included trials in general was low and most of the trials had high or unclear risk of bias in most of the seven Cochrane domains related to the risk of bias (Figure 2).

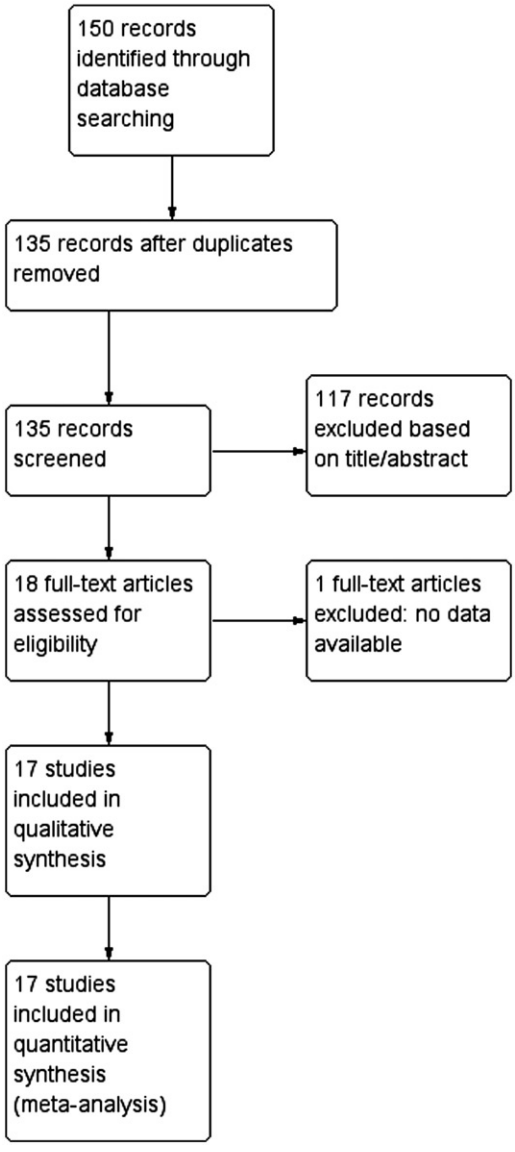

Figure 1. Flow diagram of studies identified in the systematic review. Prisma template (Preferred Reporting Item for Systematic Reviews and Meta-analyses).

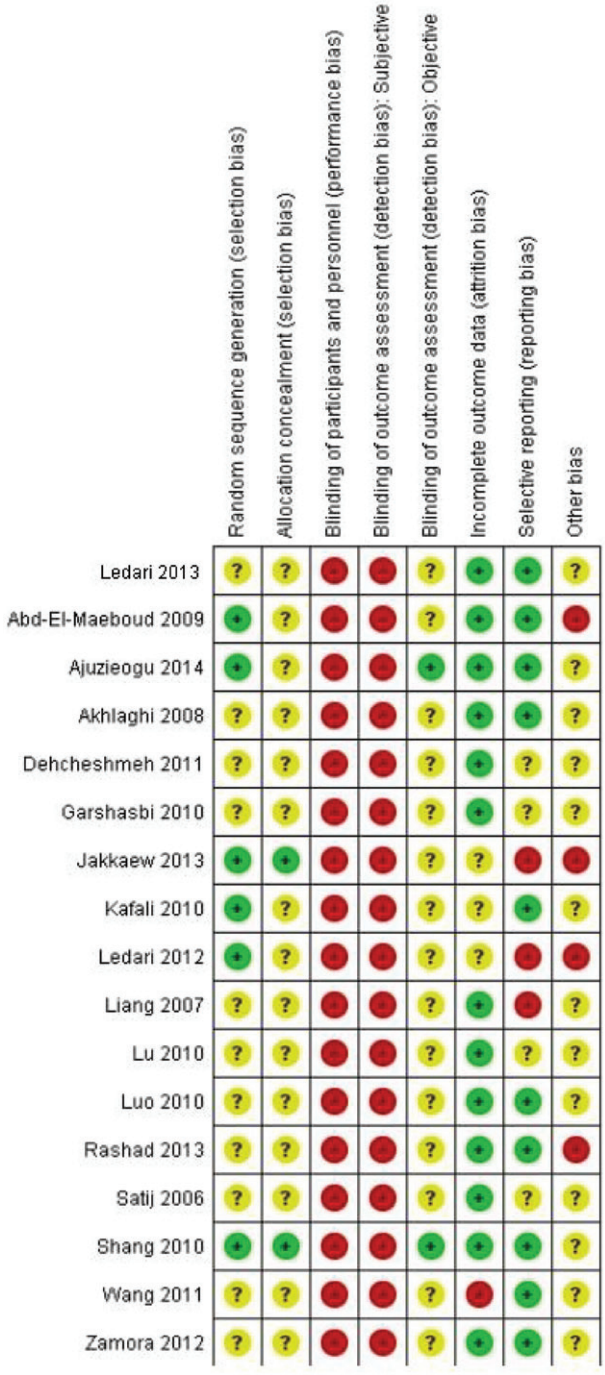

Figure 2. Assessment of risk of bias. Summary of risk of bias for each trial; Plus sign: low risk of bias; minus sign: high risk of bias; question mark: unclear risk of bias.

Table 1. Characteristics of the included studies.

	Study location	Simple size	Chewing gum Start	Chewing gum Times per day	Chewing gum Duration	Chewing gum End	Postoperative diet	Out of bed policy	Need for intestinal enema	Prior cesarean delivery	Prior abdominal surgery	Type of anesthesia	Primary outcome[a]
Satij [19]	USA	32 (15 versus 17)	From delivery	Three	30 min	First flatus or defecation	Not reported	Not reported	Not reported	Not reported	Not reported	Spinal anesthesia, or general anesthesia	Evaluate the effect of the gum chewing on the return of bowel function in cesarean delivery patients
Liang [23]	China	120 (60 versus 60)	From delivery	Three	15 min	First flatus	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Time to first flatus, to first bowel movement, complications, tolerability of gum
Akhlaghi [15]	Iran	400 (200 versus 200)	From delivery	Three	45 min	First flatus	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	To investigate the effect of gum chewing as false nutrition on the bowel movement and prevention of post cesarean ileus
Abd-El-Maeboud [14]	Egypt	200 (93 versus 107)	From 2 h postoperatively	Every 2 h during daytime	15 min	First flatus	Oral intake of clear fluids and soft foods began after passage of first flatus	Not reported	Not reported	Not reported	3/93 versus 11/107	General anesthesia	To test the hypothesis that gum chewing would enhance rapid return of bowel motility after elective cesarean section
Luo [21]	China	300 (150 versus 150)	From 2 h postoperatively	Four	10–15 min	3 days after CS	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Time to first bowel flatus, first bowel movement, first bowel sound and complications
Lu [22]	China	97 (47 versus 50)	From 2 h postoperatively	Every 2 h (at least 6 h chewing)	30–40 min	First flatus	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Time to first flatus, time to first bowel movement
Kafali [11]	Turkey	150 (74 versus 76)	From 2 h postoperatively	Three	1° 15 min; then 1 h	First flatus	Oral fluids 6h after surgery, irrespective of return of bowel sound. Oral food after 24h on detection of bowel sounds on auscultation	Early ambulation encouraged	If no flatus in the first 48h postoperatively	28/74 versus 22/76	22/74 versus 20/76	Spinal anesthesia, or general anesthesia	To assess the effects of gum chewing on post-operative bowel function after cesarean section
Shang [13]	China	386 (195 versus 191)	From delivery	Three	30 min	Defecation of discharge	Oral intake of clear fluids and soft foods after first flatus	Early ambulation encouraged	Not reported	34/195 versus 30/191	Not reported	Spinal anesthesia	Time to first operative passage of flatus
Garshasbi [12]	Iran	500 (238 versus 262)	From delivery	Three	At least 30 min	Until start of regular diet	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	To determine whether gum chewing in the immediate postoperative period facilitated recovery from ileus following cesarean section

(*continued*)

Table 1. Continued

	Study location	Simple size	Chewing gum Start	Chewing gum Times per day	Chewing gum Duration	Chewing gum End	Postoperative diet	Out of bed policy	Need for intestinal enema	Prior cesarean delivery	Prior abdominal surgery	Type of anesthesia	Primary outcome[a]
Dehcheshmeh [4]	Iran	120 (60 versus 60)	From delivery	Four	–	First flatus or defecation	Not reported	Not reported	Not reported	0/60 versus 0/60	Not reported	Spinal anesthesia	To assess the effects of chewing of sugar free gum after elective cesarean delivery of return of bowel function in primiparous women
Wang [20]	China	233 (116 versus 117)	From 2 h postoperatively	Every 2 h during day time	15 min	First flatus	Not reported	Not reported	Not reported	Not reported	Not reported	Spinal anesthesia	Time to first flatus
Ledari [9]	Iran	100 (50 versus 50)	From 6 h postoperatively	Three	At least 1 h	Discharge	Not reported	Not reported	Not reported	50/50 versus 50/50	Not reported	Spinal anesthesia	To evaluate the effect of chewing gum on the recovery of bowel function after cesarean section
Zamora [10]	Philippines	53 (18 versus 35)	From 12 h postoperatively	–	15 min	First flatus	Not reported	Not reported	Not reported	Not reported	Not reported	Spinal anesthesia	To compare the effects of post-operative gum chewing with traditional feeding on the early return of bowel motility after cesarean delivery
Rashad [6]	Egypt	60 (30 versus 30)	From delivery	Three	30 mi	Discharge	Not reported	Not reported	Not reported	Not reported	Not reported	Spinal anesthesia, or general anesthesia	To identify the effect of sugarless chewing gum on intestinal movement after cesarean section
Ledari [7]	Iran	60 (30 versus 30)	From 6 h postoperatively	Three	1 h	Discharge	Not reported	Not reported	Not reported	0/30 versus 0/30	0/30 versus 0/30	Spinal anesthesia	To investigate the effect of gum chewing on the return of intestinal function in women with cesarean section
Jakkaew [8]	Thailand	50 (25 versus 25)	From delivery	Four	30 min	First flatus	Oral intake of clear fluids and soft foods after first flatus	Not reported	Not reported	4/25 versus 8/25	0/25 versus 1/25	Spinal anesthesia, or general anesthesia	To evaluate the effect of gum chewing on recovery of bowel function after cesarean section
Ajuzieogu [5]	Nigeria	180 (90 versus 90)	From the first day postoperatively	Three	30 min	5 days	Not reported	Not reported	Not reported	0/90 versus 0/90	0/90 versus 0/90	Spinal anesthesia	To identify the effect of chewing gum on duration of post operative ileus following cesarean section

Data are presented as total number (number in the intervention versus number in the control group).
[a]When the primary outcome was not specifically stated, all listed outcomes were included in this table.

Table 2. Inclusion and exclusion criteria.

	Inclusion criteria	Exclusion criteria
Satij [19]	Women at term undergoing planned CD	Preterm, emergency CD
Liang [23]	Women undergoing CD	Not reported
Akhlaghi [15]	Women at term undergoing planned CD	Preterm, emergency CD
Abd-El-Maeboud [14]	Women at term undergoing planned CD under general anesthesia	Preterm, emergency CD, spinal anesthesia, cesarean hysterectomy, prior abdominal surgery
Luo [21]	Women undergoing CD	Not reported
Lu [22]	Women undergoing CD	Not reported
Kafali [11]	Women undergoing planned or emergency CD	Chronic medical disorders, high risk pregnancy, antepartum hemorrhage, blood transfusion, postoperative admission to intensive care unit
Shang [13]	Women at term undergoing planned or emergency CD	Preterm, preexisting gastrointestinal disorders, blood transfusion
Garshasbi [12]	Women planned or emergency CD	Not reported
Dehcheshmeh [4]	Primiparous women at term undergoing planned CD	Preterm, emergency CD, multiparous
Wang [20]	Women undergoing CD	Not reported
Ledari [9]	Women at term undergoing planned or emergency CD with prior CD	Preterm, primiparous, prior abdominal surgery
Zamora [10]	Women at term undergoing planned or emergency CD	Preterm
Rashad [6]	Women at term undergoing planned or emergency CD	Preterm
Ledari [7]	Primiparous women at term undergoing planned or emergency CD	Preterm, multiparous, prior abdominal surgery
Jakkaew [8]	Women at term undergoing planned or emergency CD	Preterm, cesarean hysterectomy, recent chemotherapy, postoperative admission to intensive care unit
Ajuzieogu [5]	Primiparous women at term undergoing planned CD	Preterm, emergency CD, multiparous, prior abdominal surgery, diabetic, hypothyroid, women who were on opioids

Data are presented as total number (number in the intervention versus number in the control group).
CD: cesarean delivery.

Table 1 shows the characteristics of the included clinical trials. All the studies used postoperatively sugar-free gum chewing as intervention. In most of the included trials, chewing gum was given right after or within 2 h of delivery (7/17, 41%, immediately after, and 5/17, 29%, 2 h after), three times a day (10/17, 59%) for 15–30 min each (7/17, 41%, 30 min, and 5/17, 29%, for 15 min) and until the first flatus (10/17, 59%). Women in both groups received routine post-operative diet. Most of the included women were undergoing planned CD at term (Table 2).

Eight studies described in details how the outcomes were assessed [5–9,11,13,15]. In Shang et al. and Rashad et al., every patient was checked for bowel sounds and/or flatus five times a day, and women were asked to tell to study investigators when they passed a bowel movement [6,13]. Ajuzieogu et al., Ledari 2012 et al., Ledari 2013 et al., and Jakkaew et al. reported that a research assistant who was not aware of the gum prescription and groups, visited the patients regularly, every 1 h and recorded the time of the first bowel sounds, passage of flatus, and defecation [5,7–9]. In the other two trials, women were checked five times every day [11,15].

Synthesis of results

Table 3 shows the primary and secondary outcomes in the overall and in subgroup analyses. In the overall analysis, the statistical heterogeneity ranged from 0% to 92%, with I^2=29% for the primary outcome.

Women who were randomized to the chewing gum group had a significantly lower mean of the first flatus time (MD – 6.49 h, 95%CI −8.65 to −4.33; Figure 3), first bowel sounds (Figure 4), less duration of stay, lower time to first fees and to first feeling hunger, less incidence of ileus, less episodes of nausea or vomiting, and significantly higher satisfaction (Table 3). Subgroup analyses concur with the overall analysis (Table 3).

Discussion

Main findings

This meta-analysis from 17 RCTs [4–15,19–23], provides evidence that gum chewing after CD is an intervention that enhances early recovery of bowel function. In most of the included trials, chewing gum was given right after delivery three times a day for 30 min each and until the first flatus. Our meta-analysis represented level 1 data and included only RCTs. Test of heterogeneity and sensitivity analyses all point to the efficacy of gum chewing as studied so far. However, the quality of the included trials is low.

Comparison with existing literature

Our data support earlier findings by two prior Cochrane Reviews. Short et al. in a meta-analysis of 81

Table 3. Primary and secondary outcomes in overall and subgroup analyses.

Overall analysis	Number of included studies	Chewing gum group	Control group	Number of included women	RR or MD (95%CI)	I^2
First flatus (h)	14 [4–7,9–11,13–15,20–23]	23.1 h	29.5 h	2459	**−6.49 (−8.65 to −4.33)**	95%
First bowel sounds (h)	10 [4–7], [9,11,13,14,20,21]	13.5 h	18.3 h	1789	**−4.63 h (−6.20 to −3.05)**	92%
Duration of stay (days)	7 [4,5,10,11,13–15]	2.85 days	3.24 days	1489	**−0.39 (−0.78 to −0.18)**	50%
First feces (h)	5 [5,7,9,13,15]	33.9 h	43.2 h	2076	**−9.57 h (−10.28 to −8.87)**	0%
Satisfaction (points)	2 [5–8]	8.25 points	6.8 points	230	**1.99 points (1.70 to 2.29)**	0%
First feeling of hunger (h)	3 [7–9]	12.7 h	15.2 hours	210	**−2.89 h (−4.93 to −0.85)**	60%
Nausea or vomiting	4 [8,10,11,14]	5/210 (2.4%)	16/243 (6.6%)	453	**0.33 (0.12 to 0.87)**	0%
Need for additional analgesics or antiemetics	3 [11,13,14]	15/362 (4.1%)	25/364 (6.9%)	726	0.50 (0.12 to 2.13)	69%
Ileus[a]	4 [10,12–14]	28/544 (4.6%)	68/595 (11.4%)	1139	**0.39 (0.19 to 0.80)**	39%
First cesarean delivery						
First flatus (h)	4 [4,5,20,21]	28.6 h	36.4 h	833	**−7.71 (−11.89 to −3.52)**	97%
Repeated cesarean delivery						
First flatus (h)	1 [14]	93.2 h	107.2 h	200	**−6.50 (−8.14 to −4.86)**	Not applicable
Planned cesarean delivery						
First flatus (h)	7 [4,5,8,9,14,15,20]	24.9 h	29.7 h	1293	**−4.83 (−8.06 to 2.58)**	90%
Emergent cesarean delivery						
First flatus (h)	3 [4,10,13]	19.8 h	25.5 h	499	**−5.89 (−7.13 to −4.65)**	3%

Data are presented as number (percentage) or as mean difference ± standard deviation. Boldface data, statistically significant.
RR: relative risk; MD: mean difference; CI: confidence interval.
[a]Definitions of ileus were given in only two of the four RCTs which reported this outcome: "the delayed return of physiological coordinated bowel motility"[11]; "a group of manifestations persisting longer than 24 h or requiring naso-gastric tube placement" [14].

studies, including 9072 participants who underwent abdominal surgery, found some evidence for the benefit of postoperative chewing gum in improving recovery of gastrointestinal function after obstetric and non-obstetric abdominal surgery [25]. Pereira Gomes Morais et al. showed a beneficial effect of chewing gum in women undergoing cesarean delivery [26]. However, both of these meta-analyses did not include all currently available RCTs on cesarean delivery. In 2014, Craciunas et al. also showed efficacy of chewing gum in reducing the incidence of postoperative ileus in 1462 patients (seven RCTs) who underwent cesarean delivery [27]. Conversely, Huang et al. in a meta-analysis of five RCTs found no benefit of postoperative gum chewing in women who underwent cesarean delivery [28]. Another review by Wen et al. was recently published, including 10 trials ($n = 1659$ women). The authors concluded that gum chewing hastens the intestinal function recovery after cesarean delivery offering a safe and inexpensive option for postoperative care [29].

Strengths and limitations

Our study has several strengths. Intent-to-treat analysis was used. In addition, publication bias was not apparent by statistical analysis. Limitations of our study are mostly inherent to the limitations of the included studies. The quality of evidence as well as the quality of the included trials was low. There were no reports of adverse effects related to gum chewing in the 17 included trials. However, since none of them specifically stated that this was a pre-specified outcome in their protocols or methods, we cannot be sure that gum chewing in the postoperative period of cesarean delivery is devoid of adverse effects. None of the trials assessed or reported adherence to gum chewing. None of the included trial was double blind. We used a random effect model in all analyses given the high statistical and clinical heterogeneity within the trials.

Conclusions

In summary, this meta-analysis showed that gum chewing reduced the time to first passage of flatus and reduced the rate of ileus when given right after cesarean delivery, three times a day for 30 min each and until the first flatus. As simple, generally inexpensive intervention, providers should consider implementing cesarean delivery postoperative care with gum chewing.

Future large, better designed, randomized trials will help to increase the quality of the evidence for this intervention. Future trials should also establish the

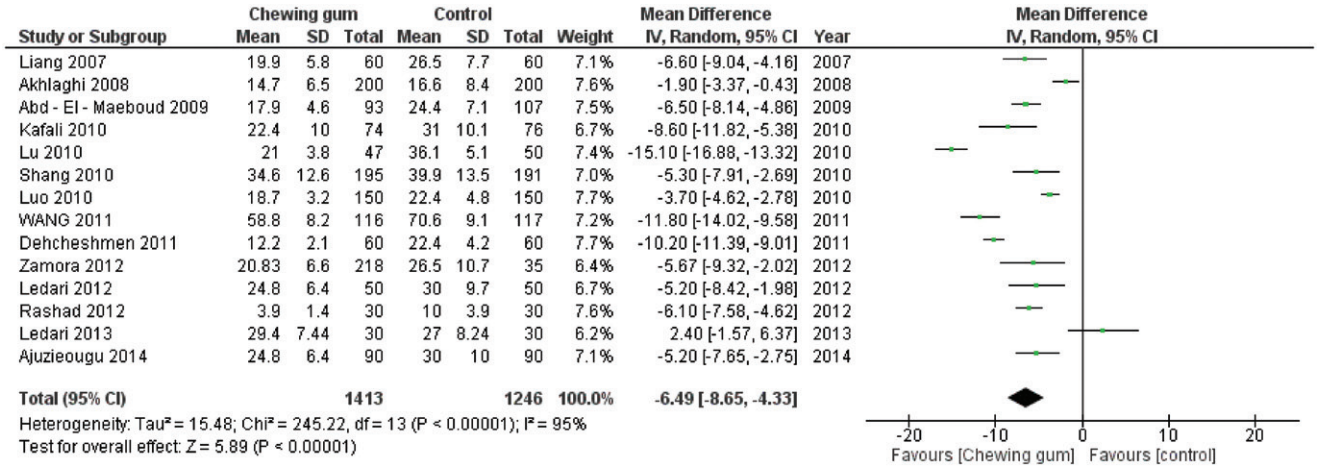

Figure 3. Forest plot for the mean of time to the first flatus in hours.

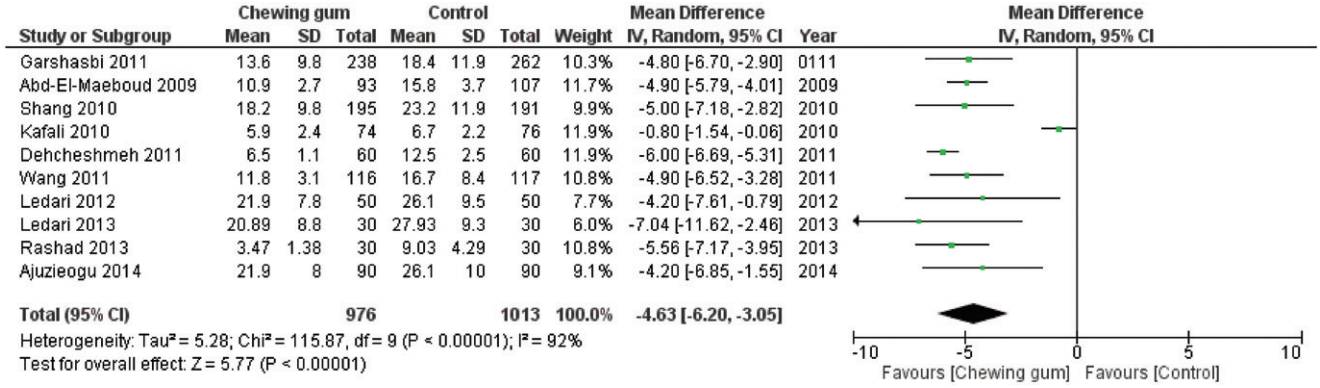

Figure 4. Forest plot for the mean of time to the first bowel sounds in hours.

optimal regimen of gum chewing (e.g. initiation, number, and duration of sessions per day) to enhance bowel function recovery after cesarean delivery, and assess how other beneficial interventions, such as early feeding [30,31], may give additional benefits during postpartum care for women who undergo gum chewing.

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Disclosure statement

The authors declare that they have nothing to disclose.

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References

[1] Martin JA, Hamilton BE, Osterman MJK. Births in the United States, 2015. NCHS data brief, no 258. Hyattsville (MD): National Center for Health Statistics. 2016
[2] Vather R, Trivedi S, Bissett I. Defining postoperative ileus: results of a systematic review and global survey. J Gastrointest Surg. 2013;17:962–972.
[3] Doorly MG, Senagore AJ. Pathogenesis and clinical and economic consequences of postoperative ileus. Surg Clin North Am. 2012;92:259–272.
[4] Safdari –Dehcheshmeh F, Salehian T, Gangi F, et al. The effect of chewing sugar free gum after elective cesarean-delivery on return of bowel function in primiparous women. Qom Univ Med Sci J. 2011;4:16–20.
[5] Ajuzieogu OV, Amucheazi A, Ezike HA, et al. The efficacy of chewing gum on postoperative ileus following cesarean section in Enugu, South East Nigeria: a randomized controlled clinical trial. Niger J Clin Pract. 2014 Nov-Dec;17:739–742.
[6] Rashad W, Suliman A, Yousef AL. Effect of sugarless gum chewing on intestinal movement after cesarean section. Life Sci J. 2013;10:3257–3261.
[7] Ledari FM, Barat S, Delavar MA, et al. Chewing sugar-free gum reduces ileus after cesarean section in

nulliparous women: a randomized clinical trial. Iran Red Crescent Med J. 2013;15:330–333.
[8] Jakkaew B, Charoenkwan K. Effects of gum chewing on recovery of bowel function following cesarean section: a randomized controlled trial. Arch Gynecol Obstet. 2013;288:255–260.
[9] Ledari FM, Barat S, Delavar MA. Chewing gums has stimulatory effects on bowel function in patients undergoing cesarean section: a randomized controlled trial. Bosn J Basic Med Sci. 2012;12:265–268.
[10] Zamora BBB, Kalalo RE. Gum chewing versus traditional feeding on the early return of bowel motility after cesarean delivery: a prospective randomized controlled trial. Free Communication (Oral) Presentations/Int J Gynecol Obstetr. 2012;119S3:S261–S530.
[11] Kafali H, Duvan CI, Gözdemir E, et al. Influence of gum chewing on postoperative bowel activity after cesarean section. Gynecol Obstet Invest. 2010;69: 84–87.
[12] Garshasbi A, Behboud S. The effect of Gum chewing on postoperative ileus after cesarean section. Society for Obstetrics Anesthesia and Perinatology (SOAP) 42nd Annual Meeting 2011
[13] Shang H, Yang Y, Tong X, et al. Gum chewing slightly enhances early recovery from postoperative ileus after cesarean section: results of a prospective, randomized, controlled trial. Am J Perinatol. 2010;27:387–391.
[14] Abd-El-Maeboud KH, Ibrahim MI, Shalaby DA, et al. Gum chewing stimulates early return of bowel motility after caesarean section. BJOG. 2009;116:1334–1339.
[15] Akhlaghi F, Pourjavad M, Mansouri A, et al. Vahedian. Effect of gum chewing on prevention of post cesarean ileus. JFaculty Nurs Midwifery. 2008;14:84–92.
[16] Satij B, Cohen SA. Evaluation of gum chewing on the return of bowel function in cesarean-delivery patients. Obstet Gynecol. 2006;107:10S.
[17] Higgins JPT, Green S, eds. Cochrane handbook for systematic reviews of interventions, version 5.1.0 (update March 2011) (cited 2016 Oct 20). The Cochrane Collaboration, 2011, Issue 3. Available from: www.cochrane-handbook.org
[18] Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. J Clin Epidemiol. 2009;62:1006–1012.
[19] Satij B. Evaluation of Gum Chewing on the return of bowel function in cesarean delivery patients. Obstet Gynecol. 2006;107:10S.
[20] Wang X, Ren Y, Qin X, et al. Influence of sham feeding on motilin and evacuating time after accepting cesarean section [Chinese]. Chin Nurs Res. 2011;25: 682–683.
[21] Luo S, Wu C, Yang X, et al. Effect of chewing gum after cesarean section on restoration of gastrointestinal function [Chinese]. China J Mod Nurs. 2010;16:2948–2949.
[22] Lu L, Zhao A. "False eat" diet promote cesarean section with recovery of gastrointestinal function and clinical studies lactation [Chinese]. J Nurs Training. 2010;25:2158–2159.
[23] Liang J, Gao T, Han W, et al. The clinical observation of enhancing recovery of gastrointestinal function after cesarean section by gum chewing. J Tonji Univ Med Sci. 2007;28:81–83.
[24] Abasi Z, Alavi F, Salehian M, et al. An investigation on the effect of chewing gum on gastrointestinal function after cesarean operation. J Ur Nurs Mid Fac. 2014;12:214–220.
[25] Short V, Herbert G, Perry R, et al. Chewing gum for postoperative recovery of gastrointestinal function. Cochrane Database Syst Rev. 2015;(2):CD006506.
[26] Perriera Gomes Morais E, Riera R, Porfirio GJ, et al. Chewing gum for enhancing early recovery of bowel function after caesarean section. Cochrane Database Syst Rev. 2016;(10):CD011562.
[27] Craciunas L, Sajid MS, Ahmed AS. Chewing gum in preventing postoperative ileus in women undergoing caesarean section: a systematic review and meta-analysis of randomised controlled trials. BJOG. 2014;121: 793–799.
[28] Hua-Ping H, Mei H. Usefulness of chewing gum for recovering intestinal function after cesarean delivery: a systematic review and meta-analysis of randomized controlled trials. Taiwan J Obstet Gynecol. 2015;54: 116–112.
[29] Wen Z, Shen M, Wu C, et al. Chewing gum for intestinal function recovery after caesarean section: a systematic review and meta-analysis. BMC Pregnancy Childbirth. 2017;17:105. doi: 10.1186/s12884-017-1286-8.
[30] Guo J, Long S, Li H, et al. Early versus delayed oral feeding for patients after cesarean. Int J Gynaecol Obstet. 2015;128:100–105.
[31] Mangesi L, Hofmeyr GJ. Early compared with delayed oral fluids and food after caesarean section. Cochrane Database Syst Rev. 2002;(3):CD003516.