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Effects of consuming date fruits (Phoenix dactylifera Linn) on gestation, labor, and delivery: An updated systematic review and meta-analysis of clinical trials

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ABSTRACT

Background: Recent studies have shown that consumption of date fruits during pregnancy and also postpartum period might affect some pregnancy outcomes. We performed an updated systematic review and meta-analysis about the effects of consuming date fruits on gestation, labor, and delivery.

Methods: Two researchers independently searched the online databases of PubMed, Scopus, Web of Science, Embase, Google Scholar, and EBSCO up to January 2019 for clinical trials examining the effects of date fruits consumption on any types of gestation, labor, and delivery outcomes. A fixed-effects model or random-effects models were applied to pool data, where appropriate. Quality assessment was done by Jadad scale.

Results: In total, 11 and 8 studies were included in the systematic review and meta-analysis. Meta-analysis revealed that date fruit consumption significantly reduced gestation duration (pooled effect size: −0.30, 95% CI: −0.45, −0.15; P < 0.001), increased cervical dilation on admission (pooled effect size: 0.94, 95% CI: 0.88, 1.00; P < 0.001), and shorten duration of first stage of labor (pooled effect size: −50.09, 95% CI: −72.25, −27.93; P < 0.001). Also, it was revealed that date fruit consumption significantly reduced duration of second stage of labor in fixed-effects model (pooled effect size: −9.85, 95% CI: −14.00, −5.70; P < 0.001); however, this effect was not significant in random-effects analysis (pooled effect size: −11.27, 95% CI: −28.23, −5.68; P = 0.193).

Conclusions: Date fruits intake seems to reduce gestation duration and duration of the first stage of labor, and also increase cervical dilation on admission.

Abbreviations: CD, cervical dilation; CMC, carboxymethylcellulose; C/S section, caesarean section; FFQ, food frequency questionnaire; Hb, hemoglobin; NVD, normal vaginal delivery; PBLAC, pictorial blood loss assessment chart; PRISMA, preferred reporting items for systematic reviews and meta-analyses; RCT, randomized controlled trial; SD, standard deviation

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1. Introduction

Phoenix dactylifera Linn, commonly known as date fruits, is considered as a sacred fruit with various therapeutic properties in different cultures, especially in Islamic traditions.[1–4] Date fruits contain high percentage of carbohydrate, B-vitamins, calcium, magnesium, potassium, and phytochemicals (i.e., carotenoids, polyphenols, tannins, and sterols); all have been shown to beneficially affect women health, particularly pregnant women.[5–9] Based on the recent literature, date fruits have been consumed traditionally either during pregnancy or postpartum period as one of the most common fruits in different regions of Asia and Africa.[10–16] However, the effects of consuming date fruits on pregnancy outcomes has not yet been fully understood.

Currently several clinical trials have been conducted to assess the effects of date fruits on different pregnancy outcomes including labor pain,[17] cervical dilation (CD) on admission,[18–23] duration of gestation,[18,19,23,24] duration of different stages of labor,[18–20,22,25] bleeding rate after delivery,[26–28] need for labor induction,[19–21,23] augmentation,[18,19,22] and vacuum,[22] onset of spontaneous labor,[19–23] cervical effacement, consistency, and position on admission,[21,23] fetal station on admission,[21] vomiting rate during delivery,[29] mode of the delivery,[23] Apgar score, and fetal birth weight.[18,25] In a recent clinical trial, intake of date fruits (70 g/day, in Rutab stage) from 37 weeks of pregnancy until the onset of labor pain led to a significant reduction in the need for labor augmentation, and an increase in CD on admission and also the onset of spontaneous labor.[20] However, a clinical trial revealed that daily intakes of date fruits (80 g/day, in Tamer stage) in the same time had no effect on CD on admission, duration of latent phase of labor, duration of the 1st, 2nd, 3rd stages of labor, gestation duration, and maternal hemoglobin (Hb) status.[18] Other trials showed beneficial effects of date fruits consumption on bleeding rate after delivery only in some measured times,[26–28]whereas some indicated no significant effect on bleeding rate during delivery.[18] Therefore, data on the effects of date fruits consumption on pregnancy outcomes seems to be conflicting. Also, there is no consensus on the consumption amount of date fruits that needs to be taken to make appropriate gestation, labor, and delivery outcomes. In addition, the optimum length of time that date fruits should be consumed during pregnancy and in the postpartum period has not been completely specified. As far as we know, no meta-analysis has been evaluated the effects of date fruits on pregnant women. However, previously we conducted a mini-systematic review without meta-analysis in Persian to summarize the effects of date fruits consumption on safe labor.[30] In the current review, we extended the date of publication and also changed the search strategy and inclusion and exclusion criteria to conduct an updated systematic review and a meta-analysis on the effects of date fruits consumption on gestation, labor and delivery.

2. Methods

2.1. Protocol

This study performed based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol.[31]

2.2. Data sources and search strategy

A systematic search was conducted by two investigators independently in the online databases of PubMed, Scopus, Web of Science, Embase, Google Scholar, and EBSCO for all potential relevant publications up to January 2019, without restriction on the language and time of publication. In the earlier review, we searched databases until May 2017, 30 and created an email alert service to identify new studies that might be published after our search. Also to find more relevant publications, we altered the keywords and terms in search strategy as follows: (Phoeniceae OR "Phoenix dactylifera" OR Palm OR Date OR "Date Palm*" OR "Palm Date*" OR "Date Fruit*" OR Rutab OR Rotab OR Tamer) AND (Labour OR "Labor, Obstetric" OR "Delivery, Obstetric" OR Pregnancy OR "Obstetric Labor Complications" OR "Labor Onset" OR "Cervical Ripening" OR "Labor Presentation" OR "Pregnancy, Prolonged" OR "Labor, Induced" OR "Labor Pain" OR "Uterine Hemorrhage" OR "Postpartum Hemorrhage" OR "Postpartum Period"). To access further relevant publications, we checked the reference lists of the relevant articles meticulously.

2.3. Inclusion criteria

Publications with the following criteria were eligible for inclusion: 1) studies with any kinds of clinical trial design; 2) studies that assessed the effects of date fruits consumption on any types of gestation, labor, and delivery outcomes; 3) those that applied date fruits in edible stages (Khalal, Rutab, and Tamer) in any form (date-based products, mixed extracts or pure); 4) studies that were performed on women with low-risk pregnancies (defined as lack of the following conditions in the current pregnancy: multiple pregnancy, placenta praevia, history of antepartum haemorrhage, ruptured membranes, preeclampsia, hypertension, diabetes and other medical conditions, fetal growth restriction, fetal anomalies or any contraindications to normal vaginal delivery (NVD)); and 5) studies that reported either mean and standard deviation (SD) or number and percent for the effects of date fruits on presented outcomes. However, we have done the meta-analysis on outcomes with reported mean and SD, and those with number and percent were included only in the systematic review.

2.4. Excluded studies

We excluded conference papers, thesis, letters, comments, short communication, reviews, meta-analyses, and animal studies. In the initial search, 1901 articles were identified. After removing duplicates, 1615 publications were found. By screening the titles and abstracts, 1569 papers were excluded (mostly due to the study design). Among remained 40 studies, 29 were excluded due to following reasons: 1) having other research design except for clinical trial (n = 13); 2) evaluating the effects of other fruits either in combination to date fruits or alone (n = 14); 3) considering free intake of either date fruits or other foods as carbohydrate (n = 1)[29]; and 4) lack of information about inclusion criteria to determine low-risk pregnancy in the recruited women (n = 1).[32] Finally, 11 studies were included in this review[18–28](Fig. 1).

2.5. Data extraction

Two investigators reviewed the search outputs and then extracted data independently using a designed data extraction form. Any disagreements were resolved by discussion and consensus. Any reported mean and SD or number and percent for presented outcomes in the intervention and the control groups were extracted. If some studies did not provide required data such as SD or percent, if possible, we calculated these estimates using standard methods. If necessary, email contact was made with the authors of the published studies to obtain the required information. All the included studies have been recorded outcomes only after the intervention, and the mean and SD of outcomes changes were not presented because the baseline value of outcomes was impossible to measure (except for bleeding rate in post-partum period). Therefore, the means and SDs reported after the intervention were extracted and included in the meta-analysis. Among the included studies, five were done on the same population. However, some outcomes were different between these studies. To avoid double-counting data, similar outcomes were extracted only from the recent studies.[20–23,25] One trial had three arms including the intervention (honey-date syrup), placebo (sodium saccharin tablet plus water) and the control (standard obstetric care). In this trial, we only extracted data from the

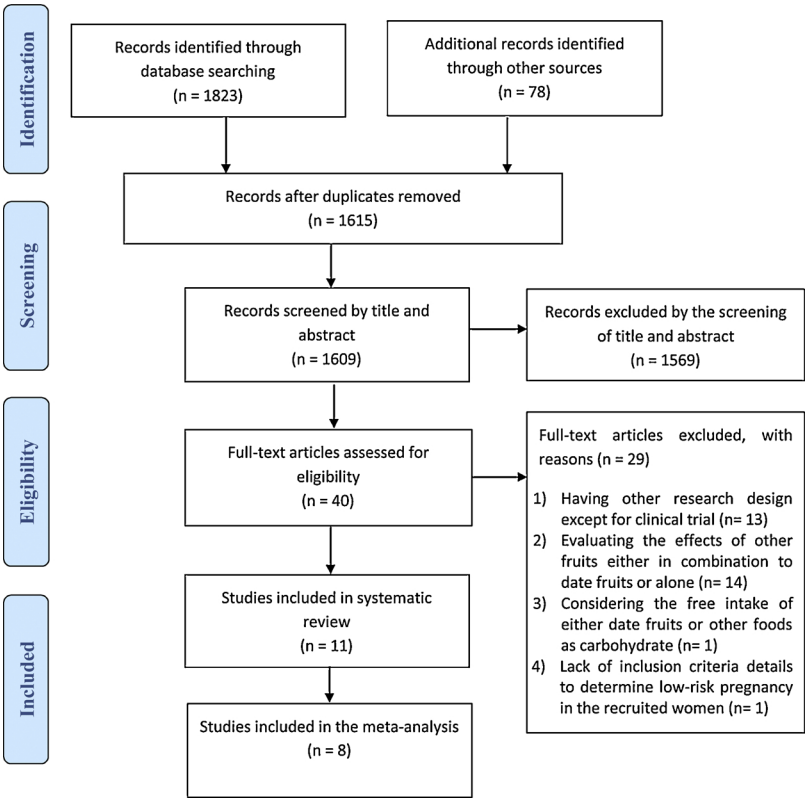

Fig. 1. Flow diagram of the study selection.

intervention and the placebo groups to include in the current systematic review and meta-analysis.[22] Also, we extracted the following data from each included study: first author name, publication year, recruited women' characteristics (maternal age, parity, gestational age at recruitment), sample size, intervention details in groups, presented outcomes, and results (Table 1).

2.6. Assessment of the study quality

Two researchers independently assessed methodological quality of the included studies using the Jadad scale designed for clinical trials. This scale contains three parts; one for randomization, one for blinding, and one for withdrawals and dropouts. According to this scale, a maximum of five points can be awarded to each clinical trial. The studies that obtained a point of three or more were considered as high-quality.[33]

2.7. Statistical analysis

The means and SDs of outcomes after the intervention were used for the meta-analysis if at least three identical outcomes were presented in the included studies. Combined mean estimates with corresponding standard mean differences were derived using the fixed-effects model. If there was between-study heterogeneity, we also applied random-effects models to take between-study variation into account. Cochran's Q test and I^2 were used to assess between-study heterogeneity. We considered between-study heterogeneity as I^2 values of 50% or more.[34] In addition, we applied subgroup analysis based on fixed-effects models to find probable sources of heterogeneity for some variables including date fruits maturity stage (Rutab and Tamer), amount of date fruits consumption (under 70 g/day and 70 or more gr/day), time of date fruits intake based on gestational age (37 weeks or less and more than 37 weeks), and estimated length of consumption (less than one day and one day or more[20 days or less and more than 20 days]). Moreover, we applied sensitivity analyses to determine the dependency of the overall estimate on the effect size from a single study. If the overall estimate depended on the effect size of a study, data were re-analyzed after excluding that study. Visual inspection of funnel plots and also Egger test was used to assess potential publication bias. Statistical analyses were done using Stata, version 11.2 (Stata Corp, College Station, TX). All P-values were considered significant at the level of < 0.05.

3. Results

3.1. Findings of the systematic review

In the systematic review, 11 studies were included.[18–28] All studies represented maternal variables as the main outcomes, and only two studies reported neonatal variables as the secondary outcomes.[18,25]

The sample size of the included trials was different varying from 35 to 105 in both the control and the intervention groups. Totally, 921 women aged 18–35 years with a gestational age of 36–42 weeks were enrolled in the included studies. The timeframe of publication was between 2007 and 2017. In all studies, women had the cephalic fetal presentation; however, two studies did not mention to this criteria.[18,19]

All studies assessed the efficacy of date fruits in pure form, and only one study used honey-date syrup.[22] Length of date fruits consumption was more than one days (ranged from 10 to 28 days) in eight studies,[18–21,23–26] and less than one day (varied from 10 to 120 min) in three studies.[22,27,28] Of studies that women consumed date fruits more than one day, daily intake was 50–100 gr. In addition, intake of date fruits in studies that consumption length was less than one day varied from 50 to 132 gr. More details about the characteristics and results of the included studies are indicated in Table 1.

3.2. Findings from the meta-analysis

Out of the 11 studies included in the systematic review, eight were

Table 1
Summary of trials on the effects of date fruits (Phoenix dactylifera Linn) consumption on gestation, labor, and delivery outcomes.

Authors (year)	Design	Maternal age (years)	Gestational age (week)	Parity	Sample size	Intervention		Presented outcomes	Results
						Control	Intervention		
Razali et al. (2017)[18]	RCT	20-44	36	Nulliparous	Control: 77 Intervention: 77 Total: 154	Standard obstetric care (was asked to abstain from date fruits intake)	Standard obstetric care plus daily intake of date fruits (7 pieces, equate to 80 gr/day, in Tamer stage and in pure form) from 36 weeks of pregnancy until the onset of the active phase of labor	[a]Gestation duration, CD on admission, duration of the latent phase of labor, duration of the 1st, 2nd, and 3rd stages of labor, maternal Hb status before and after delivery	NS
								[a]Intervention to delivery interval	Sig longer[c]
								[b]Need for labor induction, NVD rate, C/S section need, assisted vaginal delivery need, bleeding rate during delivery, the onset of spontaneous labor, neonatal Apgar score at 5 min, neonatal arterial cord blood pH, admission rate to neonatal care unit, fetal birth weight	NS
								[b]Need for labor augmentation	Sig less[c]
Kordi et al. (2017)[20]	RCT	18-35	37-38	Nulliparous	Control: 91 Intervention: 91 Total: 182	Standard obstetric care (was asked to abstain from date fruits intake)	Only daily intake of date fruits (6-7 pieces, equate to 70-76 gr/day, in Rutab stage and in pure form) from 36 weeks of pregnancy until the onset of labor pain	[a]CD on admission	Sig higher[c]
								[a]Duration of the 1st, 2nd, and 3rd stages of labor, duration of the 1st stage of labor in need of spontaneous labor	Sig shorter[c]
								[a]Duration of the 2nd and 3rd stages of labor in need of spontaneous labor, duration of the 1st, the 2nd, and the 3rd stages of labor in need of labor induction	NS
								[b]Onset of spontaneous labor	Sig more[c]
								[b]Need for labor induction	Sig less[c]
Yadegari et al. (2016)[26]	RCT	18-35	37-42	Nulliparous	Control: 45 Intervention: 45 Total: 90	Standard obstetric care (was asked to use date fruits less than 50 gr/day in the same time of intervention group)	Only daily intake of date fruits (100 gr/day in Rutab stage and in pure form) from 2 h after placenta delivery until 10 days after delivery	[a]The bleeding rate on the 1st day after delivery, the bleeding duration for 10 days after delivery	NS
								[a]The bleeding rate on the 2nd day until the 10th day after delivery	Sig less[c]
Yousefy Jadidi et al. (2015)[23]	RCT	18-35	38	Nulliparous	Control: 54 Intervention: 52 Total: 106	Standard obstetric care (was asked to abstain from date fruits intake)	Only daily intake of date fruits (7 pieces per day in Rutab stage and in pure form) from 38 weeks of pregnancy until the onset of labor pain	[a]Gestation duration	Sig shorter[c]
								[a]CD on admission, Bishop score on admission	Sig higher[c]
								[b]Onset of spontaneous labor, cervical effacement on admission	Sig more[c]
								[b]Need for labor induction	Sig less[c]
								[b]Vacuum and forceps need	NS
Kariman et al. (2015)[25]	RCT	18-35	38	Nulliparous	Control: 55 Intervention: 51 Total: 106	Standard obstetric care (was asked to abstain from date fruits intake)	Only daily intake of date fruits (7 pieces per day in Rutab stage and in pure form) from 38 weeks of pregnancy until the onset of labor pain	[a]Duration of the 1st stage of labor	Sig shorter[c]
								[a]Neonatal Apgar score at 1 min, neonatal Apgar score at 5 min	NS
								[b]C/S section need, NVD rate	NS

(*continued on next page*)

Table 1 (*continued*)

Authors (year)	Design	Maternal age (years)	Gestational age (week)	Parity	Sample size	Intervention		Presented outcomes	Results
						Control	Intervention		
Kordi et al. (2014)[21]	RCT	18-35	37-38	Primiparous	Control: 105 Intervention: 105 Total: 210	Standard obstetric care (was asked to abstain from date fruits intake)	Only daily intake of date fruits (6-7 pieces, equate to 70-76 gr/day, in Rutab stage and in pure form) from 37 weeks of pregnancy until the onset of labor pain	[a]CD on admission, cervical effacement on admission, Bishop score on admission	Sig higher[c]
								[b]Cervical consistency (soft) on admission, cervical position (mid and anterior) on admission, fetal station (−2, −1, 0, +1) on admission, successful rate of labor induction	Sig higher[c]
								[b]Need for labor induction	Sig less[c]
								[b]NVD rate, C/S section need, vacuum and forceps need	NS
								[b]Bishop score > 5 at different pregnancy weeks	Sig more[c]
Kordi et al. (2013)[24]								[a]Gestation duration	Sig shorter[c]
								[b]Onset of spontaneous labor	Sig more[c]
								[b]Presence of intact amniotic membranes on admission	Sig higher[c]
Mojahed et al. (2012) [27]	RCT	20-35	38-42	Multiparous (< 5)	Control: 51 Intervention: 44 Total: 95	Infusion of 20 units of oxytocin in 1000 ml of dextrose 5% in water with the normal slain solution immediately after placenta delivery	Infusion of 20 units of oxytocin in 1000 ml of dextrose 5% in water with the normal slain solution, in addition to date fruits intake (100 gr in Rutab stage and in pure form) immediately after placenta delivery	[a]The total bleeding rate for 2 h after delivery	Sig less[c]
Al-Kuran et al. (2011) [19]	Non-RCT	25.8	36	Nulliparous and primiparous	Control: 45 Intervention: 69 Total: 114	Standard obstetric care (was asked to abstain from date fruits intake)	Standard obstetric cares plus daily intake of date fruits (6 pieces, equate to 60-67 gr/day in Tamer stage and in pure form) from 36 weeks of pregnancy until the onset of labor pain	[a]CD on admission	Sig higher[c]
								[a]Duration of latent phase of labor	Sig shorter[c]
								[a]Duration of the 1st, 2nd, and 3rd stages of labor, gestation duration	NS
								[b]NVD rate, C/S need	NS
								[b]Presence of intact amniotic membranes on admission	Sig higher[c]
								[b]Onset of spontaneous labor	Sig more[c]
								[b]Need for labor induction/ augmentation	Sig less[c]
Kordi et al. (2010) [22]	double-blind RCT	18-35	37-42	Nulliparous	Control 1: 30 Control 2: 30 Intervention: 30 Total: 90	Control 1: standard obstetric care plus small quantities of water as desired, Control 2: consumption of 140 ml of the first placebo[f] in CD of 4 cm, and consumption of 60 mL of the second placebo[g] each 30 min until delivery	Standard obstetric cares plus intake of date fruits (in Tamer stage and in honey-date syrup form) in two separate times (the first dosage of syrup[h] in CD of 4 cm, and consumption of 60 mL of the second dosage of syrup[i] each 30 min until delivery)	[b]CD on admission	Sig higher[d]
								[b]Duration of the 2nd and 3rd stages of labor, duration of labor from CD of 4 cm until delivery	Sig shorter[d]
								[b]Normal labor progression rate in the 1st stage of labor, NVD rate, urinary ketones 1 hour after delivery	NS
								[b]Normal labor progression rate in the 2nd stage of labor, normal labor progression rate from CD of 4 cm until delivery	Sig higher[d]
								[b]Vacuum need	Sig less[e]

(*continued on next page*)

Table 1 (*continued*)

Authors (year)	Design	Maternal age (years)	Gestational age (week)	Parity	Sample size	Intervention: Control	Intervention: Intervention	Presented outcomes	Results
Khadem et al. (2007)[28]	RCT	20-35	38-42	Multiparous (< 5)	Control: 31 Intervention: 31 Total: 62	10 units of intramuscular oxytocin immediately after placenta delivery	Only intake of 50 gr of date fruits (in Tamer stage and in pure form) immediately after placenta delivery	[a]Bleeding rate at the end of the 1st hour after delivery, total bleeding rate during 3 h after delivery [a]The bleeding rate at the end of the 2nd and 3rd h after delivery	Sig less[a] NS

Abbreviation: CD: Cervical dilation, C/S section: Caesarean section, NVD: Normal vaginal delivery, NS: Not significant, Sig: Significant, RCT: Randomized controlled trial.
[a] Data was presented as the mean and standard deviation.
[b] Data was presented as number and present.
[c] In the intervention group compared to control group.
[d] In the intervention group compared to control and placebo groups.
[e] In intervention group compared to the placebo group.
[f] Eight numbers of sodium saccharin tablet with Carboxymethylcellulose (CMC) (0.25%) for each 100 ml water.
[g] Two numbers of sodium saccharin tablet with CMC (0.5%) for each 100 ml water.
[h] Ninety-two gr of honey-date in combination with 140 ml of hot water.
[i] Forty gr of honey-date in combination with 600 ml of hot water.

included in the meta-analysis.[18–25] Three studies were excluded because reported maternal bleeding status after delivery at various times.[26–28]

3.3. Gestation duration

We pooled four effect sizes from four studies,[18,19,23,24] and found that date fruits consumption significantly reduced gestation duration (pooled effect size: −0.30, 95% CI: −0.45, −0.15; $P < 0.001$) (Fig. 2). No between-study heterogeneity was found ($I^2 = 0.0\%$; $P_{heterogeneity} = 0.473$). So, the random-effects analysis was not conducted ($I^2 < 50\%$). However, subgroup analysis was done based on predefined variables (Table 2). Findings of this analysis showed that consumption of date fruits significantly decreased gestation duration in studies that women: consumed Rutab (pooled effect size: −0.36, 95% CI: −0.53, −0.19; $P < 0.001$), started consumption at 37 weeks of pregnancy or less (pooled effect size: −0.30, 95% CI: −0.45, −0.15; $P < 0.001$), consumed date fruits 70 g/day or more (pooled effect size: −0.10, 95% CI: −0.77, −0.57; $P < 0.001$), and consumed date fruits more than 20 days (pooled effect size: −0.30, 95% CI: −0.45, −0.15; $P < 0.001$).

3.4. Cervical dilation

Out of six studies reported the mean and SD for CD,[18–23] we included five studies in the meta-analysis. Two studies [20,21] were conducted on the same population, and we included only one study with a higher sample size in the analysis.[21] Overall analysis for the efficacy of date fruits consumption on CD is presented in Fig. 3a. Combining five effect sizes from five studies revealed that date fruits consumption significantly increased CD (pooled effect size: 0.94, 95% CI: 0.88, 1.00; $P < 0.001$). However, a between-study heterogeneity was found ($I^2 = 99.4\%$; $P_{heterogeneity} \leq 0.001$). When we did random-effects analysis, the same finding was revealed (pooled effect size: 1.03, 95% CI: 0.15, 1.91; $P = 0.022$) (Fig. 3b). To find sources of heterogeneity, we performed subgroup analysis (Table 2). However, between-study heterogeneity was not disappeared ($I^2 > 50\%$). Based on these analyses, we found that consumption of date fruits significantly increased CD in studies that women: consumed either Rutab (pooled effect size: 1.92, 95% CI: 1.83, 2.02; $P < 0.001$) or Tamer (pooled effect size: 0.40, 95% CI: 0.33, 0.47; $P < 0.001$), started consumption either at 37 weeks of pregnancy or less (pooled effect size: 0.42, 95% CI: 0.34, 0.49; $P \leq 0.001$) or more than 37 weeks (pooled effect size: 1.59, 95% CI: 1.50, 1.67; $P < 0.001$), consumed date fruits either under 70 g/day (pooled effect size: 1.50, 95% CI: 0.78, 2.22; $P < 0.001$) or 70 g/day or more (pooled effect size: 0.94, 95% CI: 0.88, 0.99; $P < 0.001$), consumed date fruits either less than one day (pooled effect size: 0.30, 95% CI: 0.12, 0.48; $P = 0.001$) or one day and more (pooled effect size: 1.01, 95% CI: 0.95, 1.07; $P < 0.001$), and consumed date fruits either more than 20 days (pooled effect size: 0.42, 95% CI: 0.34, 0.49; $P < 0.001$) or 20 days or less (pooled effect size: 1.93, 95% CI: 1.84, 2.02; $P < 0.001$).

3.5. Duration of the 1st stage of labor

Of five studies that presented mean and SD for duration of the 1st stage of labor,[18–20,22,25] we included all in the meta-analysis. Combining five effect sizes from five studies led to significantly shorter duration of the 1st stage of labor (pooled effect size: −50.09, 95% CI: −72.25, −27.93; $P < 0.001$) (Fig. 4a). However, between-study heterogeneity was significant ($I^2 = 69.4\%$; $P_{heterogeneity} = 0.011$). When we did random-effects meta-analysis, this efficacy was significant (pooled effect size: −65.24, 95% CI: −114.53, −15.95; $P = 0.009$) (Fig. 4b). We conducted subgroup analysis to find sources of heterogeneity (Table 2). However, no variable explained between-study heterogeneity ($I^2 > 50\%$). Based on these analyses, we found that

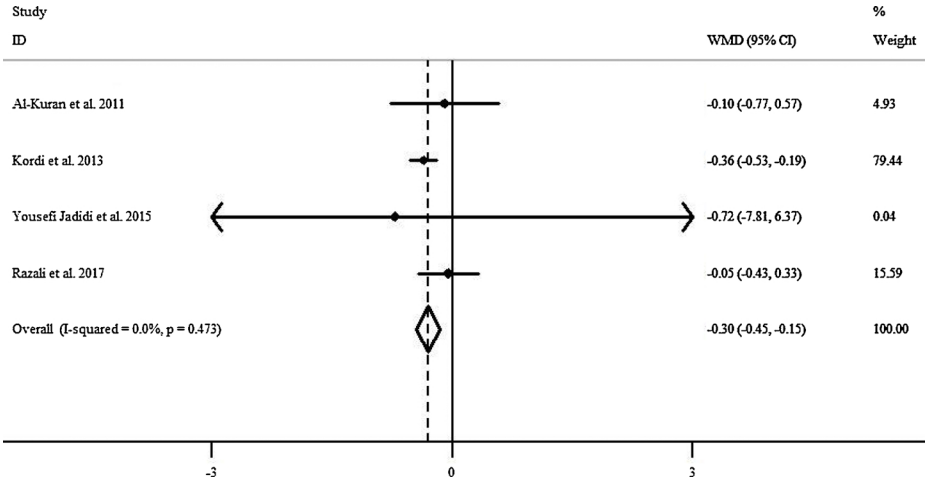

Fig. 2. Forest plot for the efficacy of date fruits consumption on gestation duration based on the fixed-effects analysis.

consumption of date fruits significantly decreased duration of the 1st stage of labor in studies that women: used either Rutab (pooled effect size: −59.10, 95% CI: −87.42, −30.78; P < 0.001) or Tamer (pooled effect size: −35.85, 95% CI: −71.45, −0.26; P = 0.048), started consumption either at 37 weeks of pregnancy or less (pooled effect size: −58.79, 95% CI: −92.73, −24.87; P = 0.001) or more than 37 weeks (pooled effect size: −43.63, 95% CI: −72.89, −14.38; P = 0.003), consumed date fruits 70 g/day or more (pooled effect size: −51.69, 95% CI: −76.59, −26.79; P < 0.001), consumed date fruits one day or more (pooled effect size: −50.22, 95% CI: −72.55, −27.89; P < 0.001), and consumed date fruit either more than 20 days (pooled effect size: −58.79, 95% CI: −92.73, −24.84; P = 0.001) or 20 days or less (pooled effect size: −43.63, 95% CI: −73.33, −14.03; P = 0.004).

3.6. Duration of the 2nd stage of labor

Of four studies reported the mean and SD for the duration of the 2nd stage of labor,[18–20,22] all were included in the meta-analysis. We combined four effect sizes from four studies and found that date fruits consumption significantly reduced the duration of the 2nd stage of labor (pooled effect size: −9.85, 95% CI: −14.00, −5.70; P < 0.001) (Fig. 5a). However, between-study heterogeneity was significant (I^2 = 81.2%; $P_{heterogeneity}$ < 0.001). When we did random-effects meta-analysis, this efficacy was not significant (pooled effect size: −11.27, 95% CI: −28.23, −5.68; P = 0.193) (Fig. 5b). We conducted subgroup analysis to find sources of heterogeneity (Table 2). Based on these analyses, time of date fruits intake and estimated consumption length could explain between-study heterogeneity. In addition, findings of subgroup analysis revealed that date fruits consumption significantly reduced duration of the 2nd stage of labor in studies that women: consumed either Rutab (pooled effect size: −8.50, 95% CI: −13.00, −4.00; P < 0.001) or Tamer (pooled effect size: −17.49, 95% CI: −28.22, −6.77; P = 0.001), started consumption either at 37 weeks of pregnancy or less (pooled effect size: −7.66, 95% CI: −11.97, −3.36; P < 0.001) or more than 37 weeks (pooled effect size: −37.84, 95% CI: −53.27, −22.41; P < 0.001), consumed date fruits 70 g/day or more (pooled effect size: −10.43, 95% CI: −14.72, −6.14; P < 0.001), consumed date fruits either less than one day (pooled effect size: −37.84, 95% CI: −53.27, −22.41; P < 0.001) or one day and more (pooled effect size: −7.66, 95% CI: −11.97, −3.36; P < 0.001), and consumed date fruits more than 20 days (pooled effect size: −7.66, 95% CI: −11.97, −3.36; P < 0.001).

3.7. Duration of the 3rd stage of labor

The efficacy of date fruits consumption on the duration of the 3rd stage of labor is shown in Fig. 6. We pooled three effect sizes from three studies[18–20] and found that date fruits consumption did not significantly reduce 3rd stage of labor (pooled effect size: −0.98, 95% CI: −2.10, 0.15; P = 0.089). No between-study heterogeneity was found (I^2 = 0.0%; $P_{heterogeneity}$ = 0.377). Therefore, the random-effects analysis was not conducted (I^2 < 50%). Findings of subgroup analysis showed that date fruits consumption significantly reduced labor duration in the 3rd stage in studies that women: used Rutab (pooled effect size: −1.70, 95% CI: −3.23, −0.17; P = 0.029), and consumed date fruits 70 g/day or more (pooled effect size: −1.38, 95% CI: −2.71, −0.06; P = 0.041).

3.8. Assessment of the study quality

Based on the Jadad scale, six studies had high quality,[18,22–24,27,28] (Table 3). Due to the limited number of the included studies and identical variables, we considered all studies in meta-analysis regardless of the quality.

3.9. Publication bias and sensitivity analysis

Using visual inspection of funnel plots, we found no evidence of publication bias (Fig. 7). Also according to the results of Egger test, no evidence of publication bias was revealed for gestation duration (P = 0.942), CD (P = 0.942), the 1st stage of labor (P = 0.427), the 2nd stage of labor (P = 0.866), and the 3rd stage of labor (P = 0.392). According to findings from sensitivity analysis, pooled effect sizes obtained for the efficacy of date fruits consumption on all outcomes were not depend on a particular study or group of studies.

4. Discussion

Maternal diet, particularly in the 3rd trimester of gestation, is considered as an important factor for gestation outcomes and current and future health of both mother and her child.[35–37]Earlier studies have been suggested a variety of dietary patterns for pregnant women to prevent and reduce maternal and neonatal complications.[38–40] Recently, there has been a growing interest in oral intake of natural substances like fruits during pregnancy and also in the postpartum period to improve pregnancy outcomes.[41–43] It is essential to consider the potential efficacy of fruits in prevention and reducing of pregnancy complications, especially those fruits that have been emphasized by tradition and religious but their therapeutic properties have not been elaborated by interventional investigations appropriately.

In the current review, we summarized findings of earlier studies on the efficacy of date fruits consumption on gestation, labor, and delivery

Table 2
Subgroup analysis based on fixed effects models for the efficacy of date fruits (Phoenix dactylifera Linn) consumption on gestation, labor, and delivery outcomes.

		effect sizes (n)	I^2	Q test	WMD (95%CI)	$P_{between}$
Gestational duration						
Overall		4	0.0	0.473	−0.30 (-0.45, -0.47)	
Date maturity	Rutab	2	0.0	0.921	−0.36 (-0.53, -0.19)	0.115
	Tamer	2	0.0	0.899	−0.06 (-0.39, 0.27)	
Amount of date consumption (gr/day)	Under 70	1	0	0	−0.10 (-0.77, 0.57)	0.553
	70 or more	3	7.4	0.399	−0.31 (0.46, -0.16)	
Time of date fruit intake (pregnancy weeks)	37 or less	3	20.0	0.287	−0.30 (-0.45, -0.15)	0.907
	More than 37	1	0	0	−0.72 (-7.81, 6.37)	
Estimated consumption length (day)	One or more	4	0.0	0.473	−0.30 (-0.45, -0.15)	
Estimated consumption length (more than one day)	20 or less	1	0	0	−0.72 (-7.81, 6.37)	0.907
	More than 20	3	20.0	0.287	−0.30 (-0.45, -0.15)	
Cervical dilation						
Overall		5	99.4	< 0.001	0.94 (0.88, 1.00)	
Date maturity	Rutab	2	67.9	0.077	1.92 (1.83, 2.02)	< 0.001
	Tamer	3	80.0	0.007	0.40 (0.33, 0.47)	
Amount of date consumption (gr/day)	Under 70	1	0	0	1.50 (0.78, 2.22)	0.129
	70 or more	4	99.5	< 0.001	0.94 (0.88, 0.99)	
Time of date fruit intake (pregnancy weeks)	37 or less	3	81.3	0.005	0.42 (0.34, 0.49)	< 0.001
	More than 37	2	99.6	< 0.001	1.59 (1.50, 1.67)	
Estimated consumption length (day)	Less than one	1	0	0	0.30 (0.12, 0.48)	< 0.001
	One or more	4	99.5	< 0.001	1.01 (0.95, 1.07)	
Estimated consumption length (more than one day)	20 or less	1	0	0	1.93 (1.84, 2.02)	< 0.001
	More than 20	3	81.3	0.005	0.42 (0.34, 0.49)	
The first stage of labor duration						
Overall		5	69.4	0.011	−50.09 (-72.25, -27.93)	
Date maturity	Rutab	2	91.5	0.001	−59.10 (-87.42, -30.78)	0.317
	Tamer	3	0.0	0.876	−35.85 (-71.45, -0.26)	
Amount of date consumption (gr/day)	Under 70	1	0	0	−44.00 (-92.61, 4.61)	0.783
	70 or more	4	76.9	0.005	−51.69 (-76.59, -26.79)	
Time of date fruit intake (pregnancy weeks)	37 or less	3	84.2	0.002	−58.79 (-92.73, -24.87)	0.507
	More than 37	2	0.0	0.985	−43.63 (-72.89, -14.38)	
Estimated consumption length (day)	Less than one	1	0	0	−41.90 (-221.11, 137.31)	0.928
	One or more	4	77.0	0.005	−50.22 (-72.55, -27.89)	
Estimated consumption length (more than one day)	20 or less	1	0	0	−43.63 (-73.33, -14.03)	0.803
	More than 20	3	84.2	0.002	−58.79 (-92.73, -24.84)	
The second stage of labor duration						
Overall		4	81.2	0.001	−9.85 (-14.00, -5.70)	
Date maturity	Rutab	1	0	0	−8.50 (-13.00, -4.00)	0.130
	Tamer	3	85.3	0.001	−17.49 (-28.22, -6.77)	
Amount of date consumption (gr/day)	Under 70	1	0	0	−1.40 (-17.73, 14.93)	0.295
	70 or more	3	86.5	0.001	−10.43 (-14.72, -6.14)	
Time of date fruit intake (pregnancy weeks)	37 or less	3	13.4	0.315	−7.66 (-11.97, -3.36)	< 0.001
	More than 37	1	0	0	−37.84 (-53.27, -22.41)	
Estimated consumption length (day)	Less than one	1	0	0	−37.84 (-53.27, -22.41)	< 0.001
	One or more	3	13.4	0.315	−7.66 (-11.97, -3.36)	
Estimated consumption length (more than one day)	More than 20	3	13.4	0.315	−7.66 (-11.97, -3.36)	< 0.001
The third stage of labor duration						
Overall		3	0.0	0.377	−0.98 (-2.10, 0.15)	
Date maturity	Rutab	1	0	0	−1.70 (-3.23, -0.17)	0.170
	Tamer	2	0.0	0.793	−0.12 (-1.79, 1.55)	
Amount of date consumption (gr/day)	Under 70	1	0	0	0.06 (-2.07, 2.19)	0.259
	70 or more	2	0.0	0.410	−1.38 (-2.71, -0.06)	
Time of date fruit intake (pregnancy weeks)	37 or less	3	0.0	0.377	−0.98 (-2.10, 0.15)	–
Estimated consumption length (day)	One or more	3	0.0	0.377	−0.98 (-2.10, 0.15)	–
Estimated consumption length (more than one day)	More than 20	3	0.0	0.377	−0.98 (-2.10, 0.15)	–

which has been emphasized in traditional Arabic and Islamic medicine. Based on historic Islamic medical literature and some anecdotal evidence, date fruits either alone or in combination to others foods have been suggested to be consumed as an appropriate nutritious food by pregnant women before and after the delivery [4,7,44–46]

Based on systematic results, we revealed that women in the date fruits-consumer group compared with those in non- consumer group had significantly: shorter duration of the latent phase of labor[19]; less bleeding rate after delivery;[26–28] less need for labor induction,[19–21,23] augmentation,[18–22] and vacuum;[22] and higher onset of spontaneous labor.[19–21,23] Also it was supported that the following variables were significantly higher in the date fruits-consumer group: presence of intact amniotic membrane on admission,[19,24] Bishop Score on admission,[21,23]cervical effacement on admission,[21,23] cervical consistency on admission,[21] cervical position on admission,[21] fetal station on admission,[21] normal labor progression rate in the 2nd stage of labor and from CD of 4 cm until the delivery.[22]

Based on the meta-analysis, it was revealed that women in the date fruit-consumer group had a significantly shorter duration of the 1st stage of labor and also gestational duration (in all studies represented by gestational age at the delivery). In addition, it was found that CD at the time of admission was significantly higher in women that consumed date fruits. Related to the duration of the 2nd stage of labor, it was found that date fruits consumption significantly reduced duration only in the fixed model but not in the random-effects meta-analysis. Moreover, it was revealed that date fruits consumption did not significantly reduce the duration of the 3rd stage of labor.

Only three included trials evaluated adverse effects of date fruits consumption,[18,22,26] and none of the studies reported any harmful effects on mother and fetus. Currently, there is a dearth of knowledge

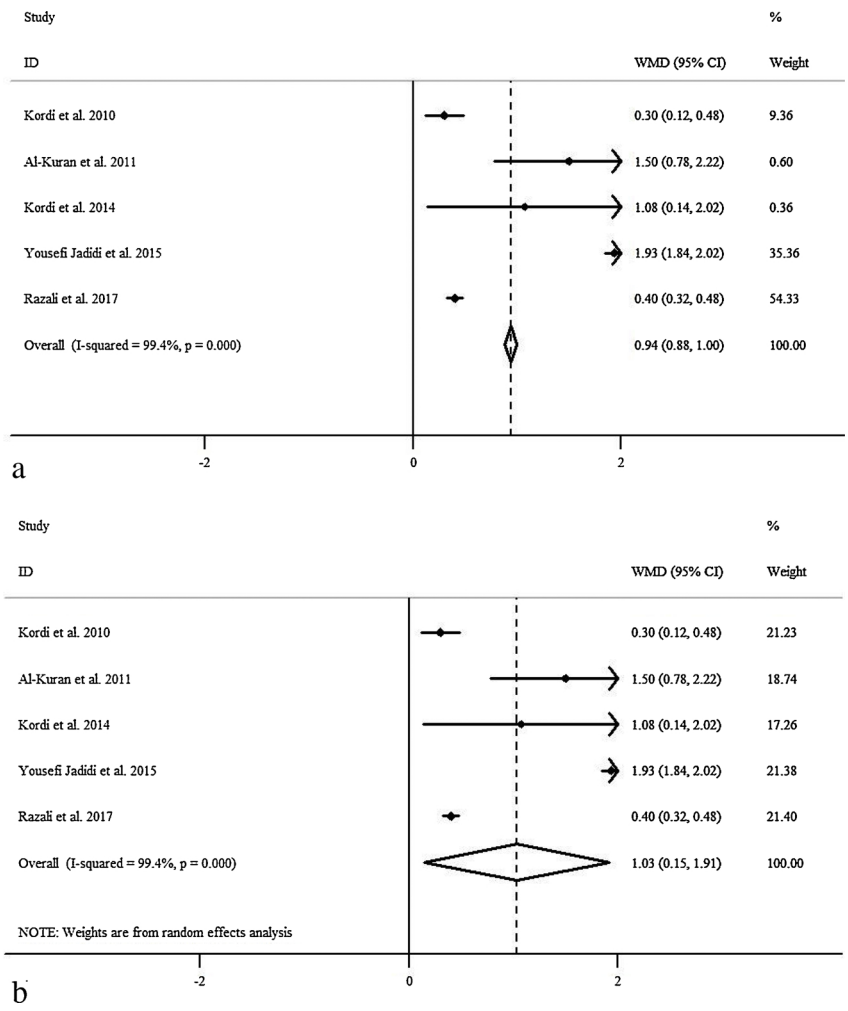

Fig. 3. a Forest plot for the efficacy of date fruits consumption on cervical dilation based on the fixed-effects analysis. b Forest plot for the efficacy of date fruits consumption on cervical dilation based on the random-effects analysis.

about the safety of date fruits during pregnancy. A systematic review related to the safety of herbal medicines used among pregnant women in Asian indicated that date fruits used frequently as a safe remedy during pregnancy.[15] However, in a descriptive research, the rate of neonatal jaundice during the post-partum period was higher in infants of mothers who ingested herbs (including red and black dates) compared to infants of mothers who did not ingest herbs.[47] Thus, it seems that high quality RCTs are required in relation to adverse effects of date fruits intake during pregnancy to consider date fruits as a safe supplement in complementary and alternative medicine.

In spite of various studies have been discussed the mechanism of action of date fruits in different medicinal conditions,[2,4,6,8,9,48,49] to our knowledge no special attention is given to the efficacy in obstetrics and gynecology. The efficacy of date fruits consumption in late pregnancy and during labor is attributed to nutritional and biochemical properties. It is assumed that date fruits consumption is helpful in supplying and saving energy of pregnant women due to the high proportion of carbohydrate, which mostly is fructose and glucose.[20,23,29,50] Oral intake of date fruits during labor has been suggested as the best nutritious food because of the high proportion of glucose.[28] In a recent trial, it was confirmed that consuming three date fruits (equate to 15 g carbohydrate with 60 calories) as carbohydrate foodstuffs with either 110 ml water or light tea during delivery not only prevented severe vomiting but also decreased the length of the 2nd stage of labor significantly.[29] It was also hypothesized that date fruits have a semi-oxytocin efficacy and cause more effective uterine contractions and CD during labor, therefore leading to a reduction in blood loss and less need for oxytocin and prostaglandins for induction and augmentation of labor.[19,27,28] This efficacy is attributed to some nutritional and chemical compositions of date fruits including iron, calcium, serotonin, linoleic acid, tannin, and Prochcidas enzyme.[28]

In addition to semi-oxytocin and also energizer efficacies of date fruits, it is speculated that date fruits intake in the late pregnancy can accelerate labor due to its antinociceptive and anti-inflammatory properties both in animal models [51–53] and human.[17,21] In a recent trial it was indicated that oral intake of date syrup (a mixture of 6 pieces of date fruits in 150 ml water) until 8 cm CD significantly reduced labor pain during active phase in nulliparous women.[17] In an experimental research in mice, oral intake of date fruits (250 and 500 mg/kg) indicated moderate analgesic properties which attributed to *trans*-ferulic acid. In addition, date extracts have an antinociceptive effect through the peripheral mechanism of pain inhibition (i.e., blocking of the inflammatory pathway of pain sensation through the inhibition of prostaglandin synthesis).[54] Also in a recent study on a rat model of hepatotoxicity, the anti-inflammatory potential of the fleshy pericarp of date fruits was attributed to upregulation of the expression of heme oxygenase-1 and attenuation of the nuclear factor-κB activation and cyclooxygenase-2 expression.[55]

Some limitations should be considered in this review. In most included studies limited information or heterogeneous data were presented for the above mention variables. However, email contact was made with the authors of the studies to request further information, in

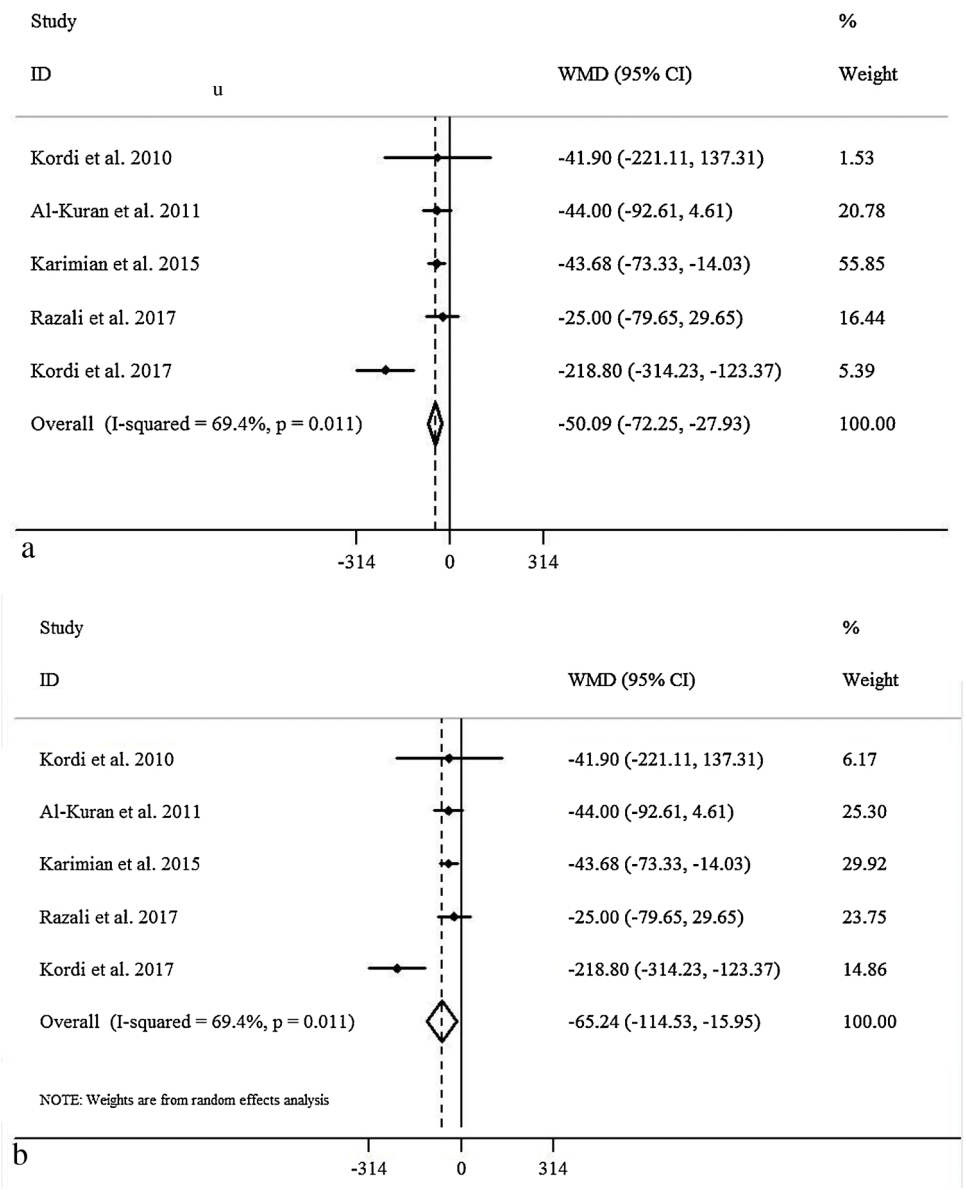

Fig. 4. a Forest plot for the efficacy of date fruits consumption on the duration of the 1st stage of labor based on the fixed-effects analysis. b Forest plot for the efficacy of date fruits consumption on the duration of the 1st stage of labor based on the random-effects analysis.

most cases we did not receive any feedback, therefore estimation was done based on discussion and consensus, and all variables were converted to the same condition. Although we did sub-group analysis, we could not determine source of heterogeneity for presented outcomes except for duration of the 2nd stage of labor. The limited number of studies might be a reason for between-study heterogeneity. In addition, this heterogeneity may be due to variation in other variables which we had no information about them. Therefore, significant effects in these outcomes should be used with caution.

5. Conclusions

Date fruits consumption by pregnant women could significantly reduce gestation duration and duration of the first stage of labor, and also increase CD on admission. Therefore, it is recommended to perform further studies on the properties of date fruits and the efficacy on gestation, labor, and delivery. According to the included studies and presented limitations, more high-quality trials are recommended on both maternal and neonatal outcomes to evaluate the efficacy of Rutab, consuming at 37 weeks of pregnancy or less with more than 20 days duration and at least 70 g/day amounts.

Authors' contribution

MN, OS, MA: study conception and design, study search, data extraction, data interpretation and analysis, and manuscript preparation and revision; ZG, AM, JR, VM, MK: study search, data extraction, data interpretation, and critical revision of the paper. All authors approved the final manuscript for submission.

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Ethical statement

This review approved by the Research Ethics Board of Qom University of Medical Sciences, Qom, Iran (code No. IR.MUQ.REC.1397.073).

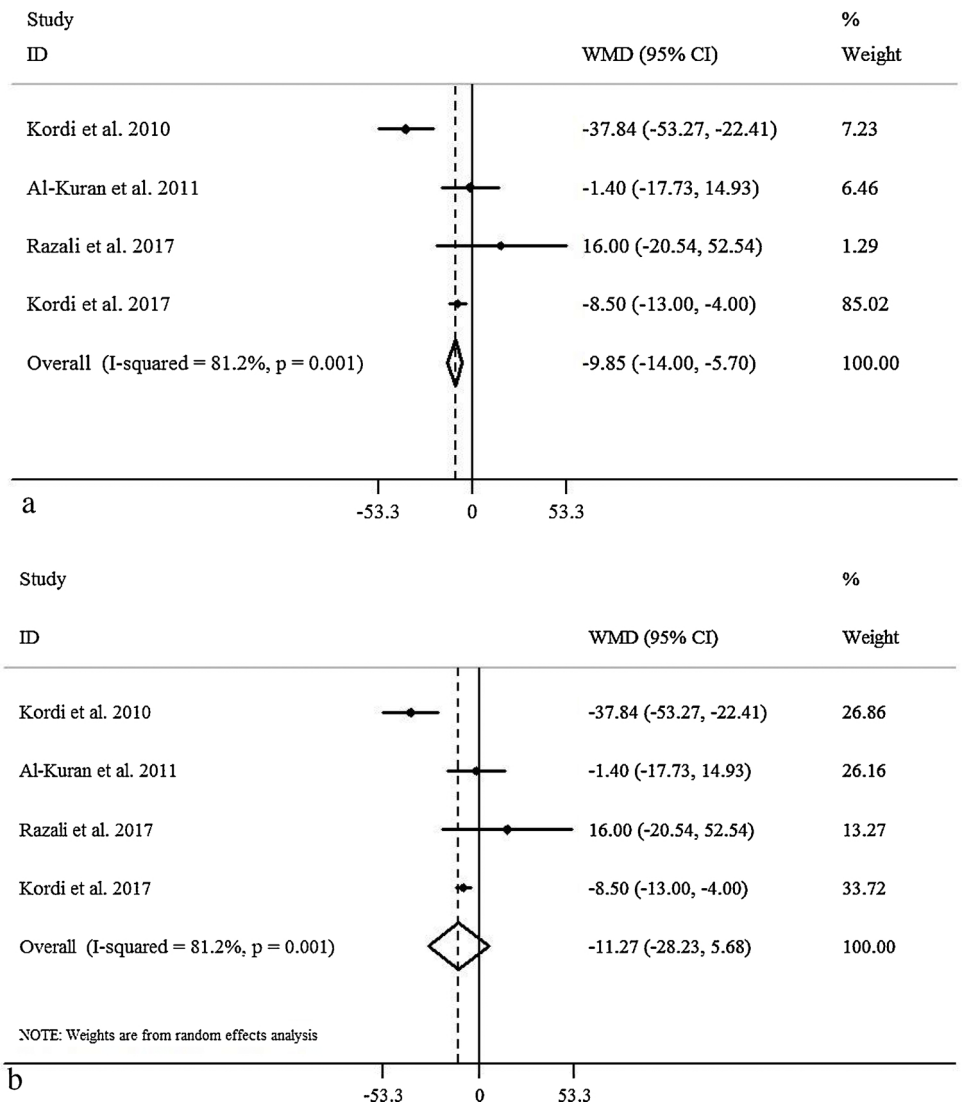

Fig. 5. a Forest plot for the efficacy of date fruits consumption on the duration of the 2nd stage of labor based on the fixed-effects analysis. b Forest plot for the efficacy of date fruits consumption on the duration of the 2nd stage of labor based on the random-effects analysis.

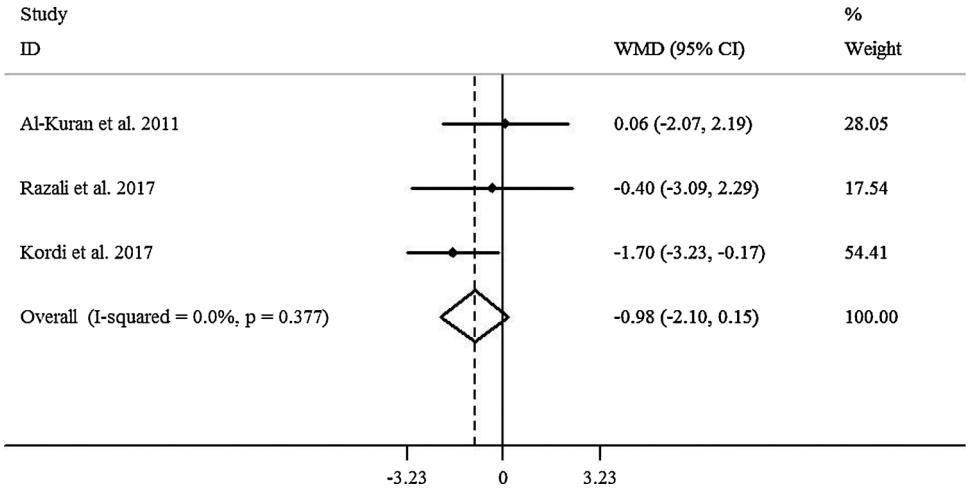

Fig. 6. Forest plot for the efficacy of date fruits consumption on the duration of the 3rd stage of labor based on the fixed-effects analysis.

Table 3
Quality assessment of clinical trials included in this review on the efficacy of date fruits (Phoenix dactylifera Linn) consumption on gestation, labor, and delivery[a].

Trails	Mention to randomization	An appropriate method of randomization	Mention to blinding	An appropriate method of blinding	Reporting of withdrawals and dropouts	Total score
Razali et al. (2017)[18]	*	*			*	3
Kordi et al. (2017)[20]	*				*	2
Yadegari et al. (2016)[26]	*				*	2
Yousefy Jadidi et al. (2015)[23]	*	*			*	3
Kariman et al. (2015)[25]	*	*			*	3
Kordi et al. (2014)[21]	*				*	2
Kordi et al. (2013)[24]	*				*	2
Mojahed et al. (2012)[27]	*		*		*	3
Al-Kuran et al. (2011)[19]			*		*	2
Kordi et al. (2010)[22]	*	*	*	*	*	5
Khadem et al. (2007)[28]	*	*			*	3

[a] According to the Jadad scale for reporting clinical trials[33].

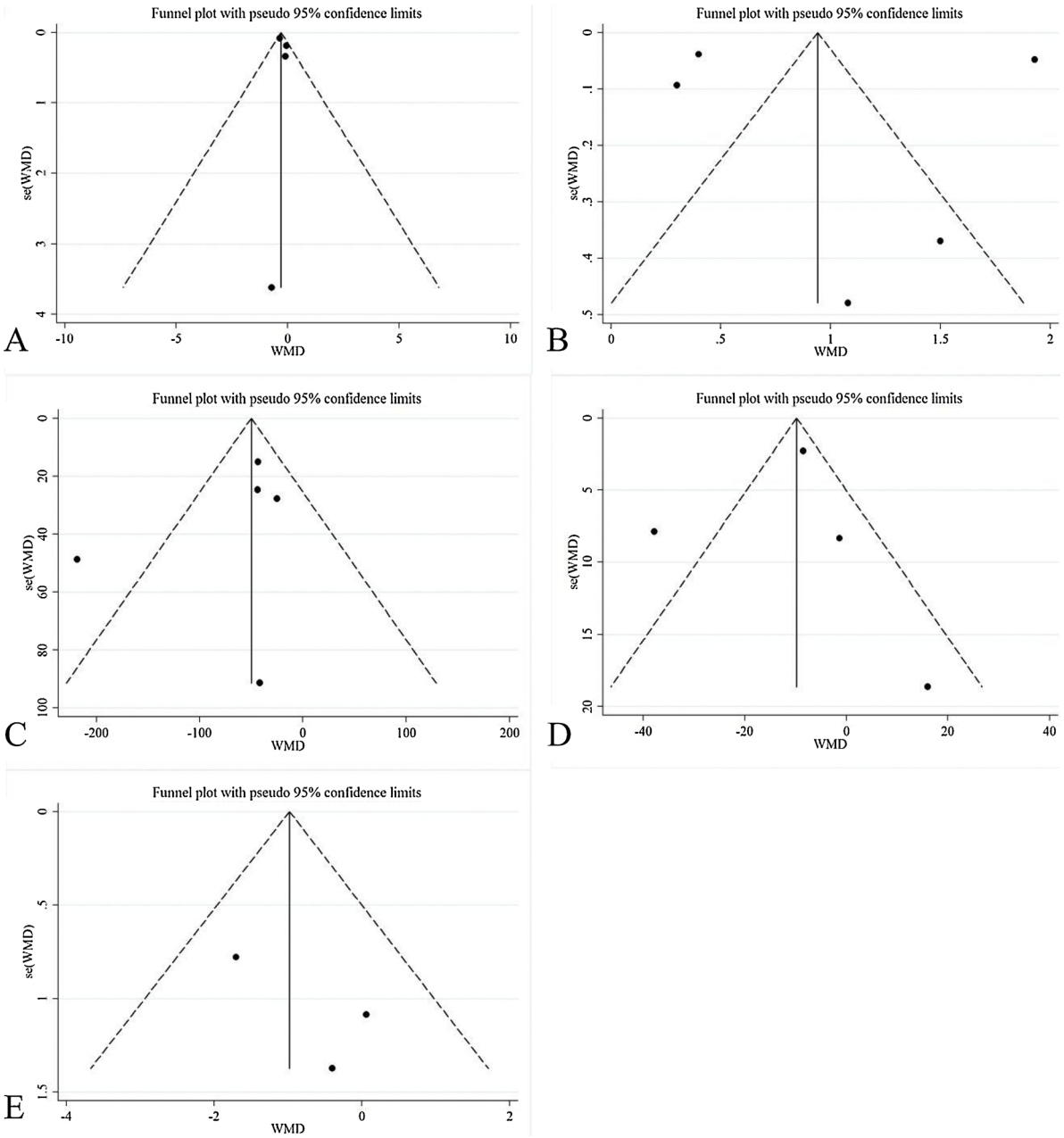

Fig. 7. Funnel plot for the efficacy of date fruits consumption on A) gestation duration; B) cervical dilation; C) the 1st stage of labor; D) the 2nd stage of labor; and E) the 3rd stage of labor.

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