THE JOURNAL OF
SEXUAL MEDICINE

ORIGINAL RESEARCH & REVIEWS

INTERVENTIONS

Sexual Intercourse for Induction of Spontaneous Onset of Labor: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

Luigi Carbone, MD,[1] Valentino De Vivo, MD,[1] Gabriele Saccone, MD,[1] Francesco D'Antonio, MD,[2,3] Antonio Mercorio, MD,[1] Antonio Raffone, MD,[1] Bruno Arduino, MD,[1] Pietro D'Alessandro, MD,[1] Laura Sarno, MD,[1] Alessandro Conforti, MD,[1] Giuseppe Maria Maruotti, MD,[1] Carlo Alviggi, MD,[1] and Fulvio Zullo, MD[1]

ABSTRACT

Introduction: Sexual intercourse during pregnancy is commonly believed to trigger the onset of contractions and, therefore, labor. However, in low-risk pregnancies, there is neither association with preterm birth, premature rupture of membranes, or low birth weight, nor with spontaneous onset of labor at term.

Aim: To evaluate the effectiveness of sexual intercourse for spontaneous onset of labor at term in singleton pregnancies.

Methods: The systematic search was conducted using electronic databases from inception of each database to June 2019. Review of articles also included the abstracts of all references retrieved from the search. Inclusion criteria were randomized controlled trials comparing sexual intercourse in singleton low-risk pregnancies at term with controls (either reduced number of coitus or no coitus) for spontaneous onset of labor. Estimates were pooled using random-effects meta-analysis.

Main Outcome Measures: The primary outcome was the incidence of spontaneous onset of labor. The summary measures were reported as summary relative risk with 95% CI using the random-effects model of DerSimonian and Laird.

Results: Data extracted from 3 trials, including 1,483 women with singleton pregnancy at term and cephalic presentation, were analyzed. Women who were randomized in the sexual intercourse group had similar incidence of spontaneous onset of labor compared with control subjects (0.82% vs 0.80%; relative risk 1.02, 95% CI 0.98−1.07).

Clinical Implication: Sexual intercourse should not be restricted in low-risk term pregnancies. Further studies are needed to properly evaluate the impact of orgasm, penetration, condom use, frequency of intercourse and other factors on induction of labor at term.

Strength & limitations: Our study has several strengths. The three included trials had low risk of allocation bias; intention-to-treat analysis was used; this is the first meta-analysis on this issue so far. Limitations mainly depend on the design of the included studies. Firstly, compliance to the protocol relied on self-reporting by patients; in addition, not all the features of sexual intercourse could be adequately assessed (orgasm, nipple stimulation, sexual positions, etc.).

Conclusion: In women with singleton, cephalic, low-risk pregnancies, sexual intercourse at term does not significantly increase the incidence of spontaneous onset of labor. **Carbone L, De Vivo V, Saccone G, et al. Sexual Intercourse for Induction of Spontaneous Onset of Labor: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. J Sex Med 2019;16:1787−1795.**

Key Words: Sexual Intercourse; Coitus; Induction Of Labor; Term Pregnancy; Meta-Analysis

Received April 7, 2019. Accepted August 5, 2019.

[1]Department of Neuroscience, Reproductive Sciences and Dentistry, School of Medicine, University of Naples Federico II, Naples, Italy;

[2]Department of Obstetrics and Gynecology, University Hospital of Northern Norway, Tromsø, Norway;

[3]Department of Clinical Medicine, Faculty of Health Sciences, Women's Health and Perinatology Research Group, UiT-The Arctic University of Norway, Tromsø, Norway

https://doi.org/10.1016/j.jsxm.2019.08.002

INTRODUCTION

Interest in the relationship between sexual intercourse and labor has been raised since the 1970s,[1–7] originally driven by the concept that sexual intercourse in pregnancy was associated with an increased risk of preterm birth, directly increasing uterine contractility or indirectly increasing the risk of intra-amniotic infections.[6,8] Furthermore, the safety of coitus in pregnancy was questioned with regard to possible direct harm to the baby by penile penetration.[9] However, none of these hypotheses have been confirmed. Next, sexual intercourse has been considered a natural method for induction of labor.[10] There are many physiological explanations for this assumption. First, semen is rich in prostaglandins E and $F2_{\alpha}$ (in lower dosages), which are those used for induction of labor.[11,12] In addition, there is evidence that, a few hours after coitus, the concentration of prostaglandins in the cervical mucus of pregnant women is much higher than normal.[13] Nipple stimulation has also been reported to promote cervical ripening, because of the subsequent release of endogen oxytocin,[14,15] with an increase in the number of women spontaneously starting in labor.[16,17] Coitus may have also mechanical effects, because there can be an increase in uterine contractions after it.[18,19] Even female orgasm has been associated with uterine contractility.[19,20] Several retrospective and prospective studies seem to confirm this association.[21–24] Nonetheless, contrasting findings emerged from randomized controlled trials (RCTs).[25–27] Moreover, there is only 1 Cochrane review on sexual intercourse for cervical ripening and induction of labor that included only a small trial with 28 women, without drawing any conclusions.[28]

Aims

The aim of this systematic review and meta-analysis of RCTs was to evaluate the effectiveness of sexual intercourse for spontaneous onset of labor at term in low-risk singleton pregnancies.

METHODS

Search Strategy

This study was performed according to a protocol recommended for systematic review.[29] The search was conducted using Medline, Embase, Web of Sciences, Scopus, ClinicalTrial.gov, Ovid, and Cochrane Library as electronic databases. The citations were identified with the use of a combination of the following text words: "coitus," "intercourse," "sexual activity", "labor," "induction of labor," "spontaneous labor," "term pregnancy," "post-term pregnancy," "post-date pregnancy," "prolonged pregnancy," and "randomized" from inception of each database to June 2019. Review of articles also included the abstracts of all references retrieved from the search. No restrictions for language or geographic location were applied.

Inclusion Criteria and Trial Selection

Selection criteria included RCTs comparing sexual intercourse in women with low-risk singleton pregnancy and cephalic

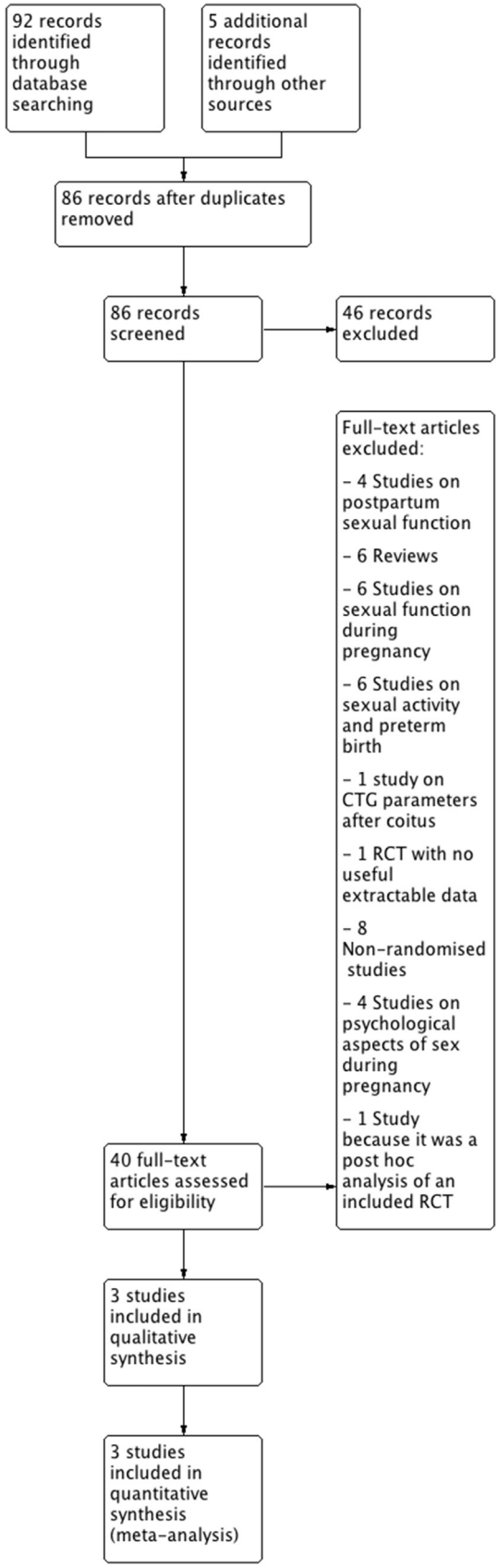

Figure 1. Flow diagram of studies identified in the systematic review. (Preferred Reporting Item for Systematic Reviews and Meta-analyses template).

presentation at term with controls (either reduced coitus or no coitus) for spontaneous onset of labor. Quasi-randomized trials (ie, trials in which allocation was done on the basis of a pseudorandom sequence, eg, odd/even hospital number or date of birth, alternation) were also excluded.

Data Extraction

The following information were extracted independently by 3 trained investigators: authors and publication year, year of study, publication type, study location, sample size, inclusion and exclusion criteria, method of intervention, methods of estimation, and primary outcomes.

Data from each eligible study were extracted without modification of original data onto custom-made data collection forms. All discrepancies were resolved by discussion.

Quality Assessment

The risk of bias in each included study was assessed by using the criteria outlined in the Cochrane Handbook for Systematic Reviews of Interventions.[29] 7 domains related to risk of bias were assessed in each included trial because there is evidence that these issues are associated with biased estimates of treatment effect: (i) random sequence generation; (ii) allocation concealment; (iii) blinding of participants and personnel; (iv) blinding of outcome assessment; (v) incomplete outcome data; (vi) selective reporting; and (vii) other bias. Review authors' judgments were categorized as "low risk," "high risk," or "unclear risk" of bias.[29] 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.

Data Synthesis and Analysis

The data analysis was completed independently by 2 authors (L.C., G.S.) using Review Manager v. 5.3 (The Nordic Cochrane Centre, Cochrane Collaboration, Copenhagen, Denmark).[30] The completed analyses were then compared, and any difference was resolved by discussion. The summary measures were reported as summary relative risk (RR) with 95% CI using the random effects model of DerSimonian and Laird. I-squared (Higgins I^2) >0% was used to identify heterogeneity. A 2 × 2 table was assessed for randomized risk (RR); for continuous outcomes means ± SD were extracted and imported into Review Manager v. 5.3.[30] The meta-analysis was reported following the Preferred Reporting Item for Systematic Reviews and Meta-analyses statement.[31]

Main Outcome Measures

The primary outcome was the incidence of spontaneous onset of labor. Secondary outcomes were maternal (pregnancy duration, induction of labor (IOL) rates, post-term IOL, spontaneous premature rupture of membranes (PROM), delivery mode, epidural analgesia, need of oxytocin for augmentation, indication for cesarean section, peri-delivery blood loss, rate of postpartum hemorrhage) and neonatal (cord blood pH, birthweight, admission to the neonatal intensive care unit) outcomes.

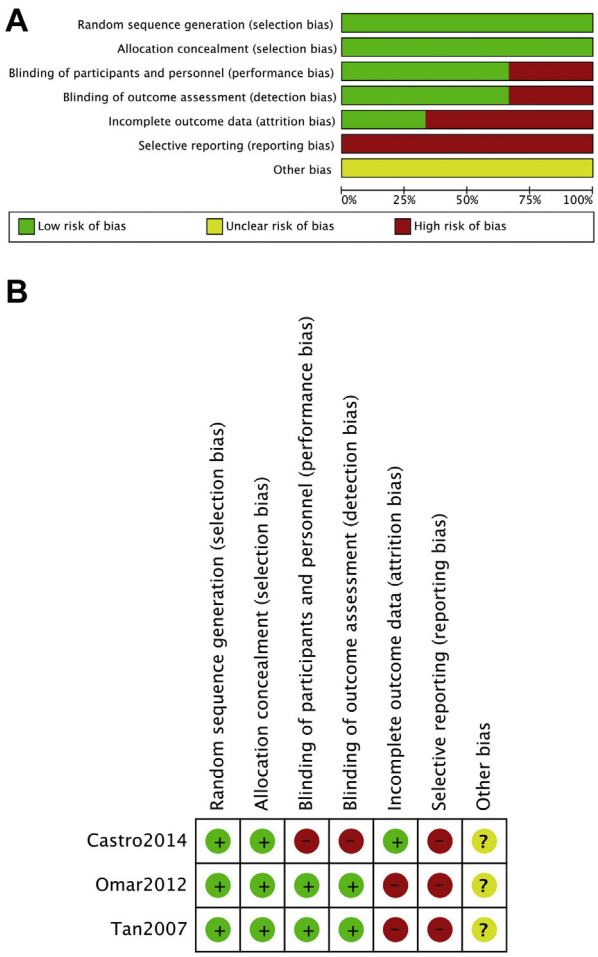

Figure 2. Assessment of risk of bias. (A) Risk of bias graph about each risk of bias item presented as percentages across all included studies. (B) Summary of risk of bias for each trial. Plus sign = low risk of bias; minus sign = high risk of bias; question mark = unclear risk of bias. Figure 2 is available in color online at www.jsm.jsexmed.org.

RESULTS

Study Characteristics

The flow of study identification is shown in Figure 1. 5 trials[25–27,32,33] were identified as relevant. 1 was excluded because it was only a post-hoc analysis of a previous RCT, considering the same study population[32]; another was excluded because there were no extractable data.[33] Therefore, 3 trials were included in the meta-analysis.[25–27]

The quality of the RCTs included in our meta-analysis was assessed by using the 7 criteria outlined in the Cochrane Handbook for Systematic Reviews of Interventions. All the included studies had "low risk" of bias in "random sequence generation" and in "allocation concealment" domains. The main biases came from the uncertain reliability of the reported sexual

Table 1. Characteristics of the included trials

	Tan 2007[25]	Omar 2012[26]	Castro 2014[27]
Study location	Malaysia	Malaysia	Portugal
Sample size*	210 (108 vs 102)	1150 (574 vs 576)	123 (63 vs 60)
Inclusion criteria	≥ 37 weeks, Singleton pregnancy, Cephalic presentation, Scheduled for non-urgent IOL at term	≥ 36 weeks, Singleton pregnancy, cephalic presentation	>18 years old, ≥ 37 weeks, Singleton pregnancy, Cephalic presentation
Exclusion criteria	Previous CS, Fetal abnormalities	Placental pathologies, PROM, previous stillbirth, obstetric complications, maternal pathologies, coitus in the last 6 weeks, no current partner, medical contraindication to coitus	Previous CS, PROM, Any medical or gestational pathological condition
Intervention	Advise to have coitus as frequently as possible to avoid IOL	Start vaginal intercourse after 36 weeks because is safe and can hasten labor	Vaginal intercourse at least twice a week
Control	Sex neither encouraged nor discouraged	Sex neither encouraged nor discouraged	Abstinence from coitus
Method for estimation	Diary sheets	Diary sheets	Not stated
Definition of labor	Cervical dilation ≥ 3 cm, with spontaneous contraction and/or PROM	Cervical dilation ≥ 3 cm, with one contraction every 4 minutes	Cervical dilation ≥3 cm, with spontaneous contraction and/or PROM
Primary outcomes	1) Coital activity 2) Onset of labor	1) Pregnancy duration (intervention to delivery interval and GA at delivery) 2) Rate of IOL	1) Rate of spontaneous onset of labor

CS = cesarean section; GA = gestational age; IOL = induction of labor; PROM = premature rupture of membranes.
*Data are presented as total number (number in the intervention group vs number in the control group).

intercourse, which was, in fact, difficult to ascertain (Figure 2). Statistically heterogeneity within the trials was low ($I^2 = 0\%$) for the primary outcome.

Table 1 shows the characteristics of the included trials. 2 studies were conducted in Malaysia by the same authors, whereas the other trial was performed in Portugal. All of the studies included low-risk singleton pregnancies with cephalic presentation at term, excluding cases of previous cesarean section, or maternal or fetal disorders. Tan et al[25] and Omar et al[26] advised women to have sexual intercourse as frequently as possible to avoid medical induction of labor, whereas their control groups were neither encouraged nor discouraged regarding sexual intercourse; Castro et al,[27] instead, advised coitus at least twice a week until delivery, and abstinence for the control subjects. Tan et al[25] and Omar et al[26] used diary sheets to evaluate patients' compliance to the protocol. Labor was defined as cervical dilation ≥3 cm with spontaneous contractions or PROM. Primary outcome was labor onset for Tan et al[25] and Castro et al,[27] whereas Omar et al[26] considered pregnancy duration and rate of induction of labor. Women who did not had spontaneous onset of labor were managed with induction of labor.

Synthesis of Results

Table 2 and Table 3 show primary and secondary outcomes, respectively. Women who were advised to have sexual intercourse at term to expedite labor onset have not a significantly higher incidence of spontaneous onset of labor (82.7% vs 80.6%; RR 1.02, 95% CI 0.98−1.07) compared with those not advised (Figure 3). No significant differences were found in the incidence of the other maternal or fetal outcomes, except for the incidence of emergency cesarean sections performed because of non-reassuring cardiotocography (CTG) results (6.0% vs 9.4%; RR 0.64, 95% CI 0.44−0.93) (Figure 4), which was lower for women who were advised to have coitus at term.

DISCUSSION

Main Findings

This meta-analysis from 3 RCTs evaluated the effectiveness of sexual intercourse in pregnant women at term to hasten the onset of labor. We did not find significant differences in the spontaneous onset of labor for women advised to have coitus compared with control subjects. With regard to the secondary outcomes, our meta-analysis also showed a lower incidence of emergency cesarean sections due to abnormal CTG patterns in women advised to have coitus compared with control subjects.

Our study has several strengths. The 3 included trials had a low risk of allocation bias by Cochrane Collaboration tool assessment. Intention-to-treat analysis was used. To the best of our knowledge, no prior meta-analysis on this issue has been performed. Limitations of our study are mostly inherent to the limitations of the included studies.

Table 2. Maternal outcomes

Maternal outcomes	Tan 2007[25]	Omar 2012[26]	Castro 2014[27]	Total	I^2	RR (95% CI)
Spontaneous labor onset	60/108 (55.6) vs 53/102 (52)	503/574 (87.6) vs 497/576 (86.3)	53/63 (84.1) vs 45/60 (75)	616/745 (82.7) vs 595/738 (80.6)	0%	1.02 (0.98 to 1.07)
Any coitus	65/108 (60.2) vs 40/101 (39.6)	481/574 (85.3) vs 458/576 (79.9)	Not reported	546/682 (80) vs. 498/677 (73.5)	85%	1.23 (0.85 to 1.80)
Pregnancy duration (GA at delivery)	Not reported	39.4 ± 1.2 vs 39.5 ± 1.2	40.0 ± 0.12 vs 39.9 ± 0.11	-	86%	0.01 (-0.18 to 0.21)
IOL rates	45/107 (42) vs 48/102 (47)	126/574 (22) vs 120/576 (20.8)	Not reported	171/681 (25.1) vs. 168/678 (24.8)	0%	0.99 (0.83 to 1.19)
PROM	13/107 (12.1) vs 8/102 (7.8)	94/574 (16.4) vs 80/576 (13.4)	Not reported	107/681 (15.7) vs. 88/678 (13)	0%	1.21 (0.93 to 1.57)
IOL for post-term pregnancy	72/108 (66.6) vs 60/102 (58.9)	23/574 (4) vs 26/576 (4.5)	Not reported	95/682 (14) vs 86/678 (12.7)	0%	1.10 (0.90 to 1.34)
Epidural analgesia	35/108 (32.4) vs 26/101 (25.7)	141/574 (24.6) vs 130/576 (22.6)	Not reported	176/682 (25.8) vs 156/675 (23.1)	0%	1.12 (0.93 to 1.35)
Oxytocin augmentation	57/108 (53.3) vs 56/101 (54.9)	152/574 (26.5) vs 148/576 (25.7)	Not reported	209/682 (30.6) vs 204/677 (30.1)	0%	1.00 (0.86 to 1.17)
Delivery mode						
SVD	74/108 (68.5) vs 74/102 (72.5)	421/574 (73.3) vs 414/576 (71.9)	54/63 (85.7) vs 54/60 (90)	549/745 (73.7) vs 542/738 (73.4)	0%	1.00 (0.94 to 1.06)
IVD	7/108 (6.5) vs 7/102 (6.9)	52/574 (9.1) vs 46/576 (8)	Not reported	59/682 (86.5) vs 53/678 (78.2)	0%	1.11 (0.78 to 1.58)
CS	27/108 (25) vs 21/102 (20.6)	101/574 (17.6) vs 116/576 (20.1)	9 (14.3) vs 6 (10)	137/745 (18.4) vs 143/738 (19.3)	3%	0.95 (0.76 to 1.19)
CS indication	Total 48/210	Total 217/1150				
CTG	5/108 (4.6) vs 7/102 (6.8)	36/574 (6.3) vs 57/576 (9.9)	Not reported	41/682 (6) vs 64/678 (9.4)	0%	**0.64 (0.44 to 0.93)**
FTP	17/108 (15.7) vs 7/102 (6.8)	27/574 (4.7) vs 34/576 (5.9)	Not reported	44/682 (6.4) vs 41/678 (6.0)	78%	1.28 (0.46 to 3.58)
FIOL	1/108 (0.9) vs 4/102 (3.9)	13/574 (2.2) vs 9/576 (1.5)	Not reported	14/682 (2) vs 13/678 (1.9)	58%	0.78 (0.14 to 4.25)
Miscellaneous	4/108 (3.7) vs 3/102 (2.9)	25/574 (4.3) vs 16/576 (2.7)	Not reported	29/682 (4.2) vs 19/678 (2.8)	0%	1.52 (0.86 to 2.68)
Peridelivery blood loss (mL)	303 ± 164 vs 313 ± 214	316 ± 189 vs 323 ± 207	Not reported	-	0%	-7.49 (-28.44 to 13.46)
PPH	13/108 (12) vs 13/102 (12.7)	6/574 (1) vs 11/576 (1.9)	Not reported	19/682 (2.7) vs 24/678 (3.5)	0%	0.78 (0.44 to 1.40)

Data are presented as mean ± SD or numbers (percentage).
Bold-face data, statistically significant.
CS = cesarean section; CTG = cardiotocography; FIOL = failed IOL; FTP = failure to progress; GA = gestational age; IOL = induction of labor; IVD = instrumental vaginal delivery; PPH = postpartum hemorrhage; PROM = premature rupture of membranes; SVD = spontaneous vaginal delivery.

Table 3. Neonatal outcomes

Neonatal outcomes	Tan 2007[25]	Omar 2012[26]	Castro 2014[27]	Total	I^2	RR (95% CI)
Cord blood pH	7.3 ± 0.08 vs 7.3 ± 0.07	7.28 ± 0.08 vs 7.29 ± 0.09	Not reported	—	0%	−0.01 (−0.02 to 0.0)
Birthweight (kg)	3.3 ± 0.44 vs 3.2 ± 0.46	3.12 ± 0.41 vs 3.12 ± 0.41	3.38 ± 0.41 vs 3.27 ± 0.50	—	43%	0.05 (−0.03 to 0.12)
NICU admission	2/108 (1.8) vs 3/102 (2.9)	5/574 (0.9) vs 12/576 (2.1)	Not reported	7/682 (1) vs 15/678 (2.2)	0%	0.46 (0.19 to 1.14)

Data are presented as mean ± SD or numbers (percentage).
NICU = neonatal intensive care unit.

First, the methods to check the occurrence of sexual intercourse were based on women self-reporting it on diary sheets in 2 trials,[25,26] whereas they were lacking in the third.[27] In addition, differently from the other RCTs, the trial by Castro et al[27] was not blinded. Furthermore, most of the sample of this meta-analysis came from the study of Omar et al,[26] with unclear effects on overall results. Finally, orgasm, nipple stimulation, and condom use were not accurately evaluated as possible determinants or modifiers of the relationship between coitus and labor onset.

Actually, Tan et al[32] evaluated the impact of orgasm in a post-hoc analysis of their study. They found that mean intervals from recruitment to delivery were longer in women who reported orgasm. Moreover, spontaneous labor rates decreased proportionally to the increase of the number of sexual intercourses.

These findings could be explained by the fact that women who feel comfortable to engage in sexual intercourse in the third trimester are still far from labor onset.[9,27,34] A reduced libido and the presence of signs and symptoms of imminent labor, such as Braxton-Hicks contractions or vaginal discharge (eg, mucus plug) could induce women to avoid coitus. As a confirmation, Schaffir et al[34] showed lower Bishop scores and longer gestations for pregnant women who were sexually active at term.

Another limitation of our meta-analysis is that it was not possible to evaluate whether a continuous stimulation throughout pregnancy would be more effective than a brief stimulation close to term. However, in a questionnaire-based case-control study, Fox et al[35] found no differences in spontaneous onset of labor on the basis of physical or sexual activity across different periods during gestation. In a cross-sectional study, Kafaei Atrian et al[22] evaluated whether sexual intercourse in the last week of pregnancy was associated with labor outcomes. They found that gestational age at delivery was lower in the intercourse group and that it became even lower in case of contact with semen.[22]

Finally, another limitation of our study was that some interesting secondary outcomes, such as some labor features, were not evaluable. For example, the study by Omar et al[26] was the only one assessing the length of the active phase of labor. Interestingly, in a prospective trial, although sexual intercourse was not correlated to the onset of labor, women in the sexually active group were more commonly admitted in the active phase of labor, needed less oxytocin, had more vaginal delivery, and showed a shorter interval to delivery.[21]

With regard to the secondary outcomes of our meta-analysis, we found no significant results, with the exception of CTG-indicated emergency cesarean section in the sexual intercourse group. However, such a finding seems to be lacking any pathophysiological explanation.

Implications

Our meta-analysis of RCTs did not show a significant effect of sexual intercourse on the onset of labor at term nor any unfavorable results. These findings are in accordance with recently released guidelines on antenatal care by the National Collaborating Centre for Women's and Children's Health (UK)[36] and a recent review by Jones et al.[37] Therefore, in low-risk pregnancies, sexual intercourse should not be restricted. On the other hand, sexual intercourse is contraindicated in high-risk pregnancies,[37,38] such as PROM, low-lying bleeding placenta or threatened preterm labor, particularly when it is confirmed by a short cervix[39] or when a cerclage is placed.[40,41] However, also in low-risk pregnancies, further studies should investigate the impact of several factors related to sexual intercourse on the findings of our meta-analysis.

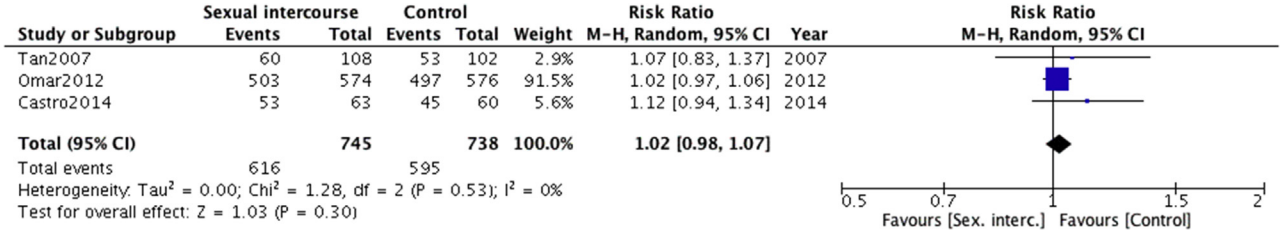

Figure 3. Forest plot for the incidence of spontaneous onset of labor. Figure 3 is available in color online at www.jsm.jsexmed.org.

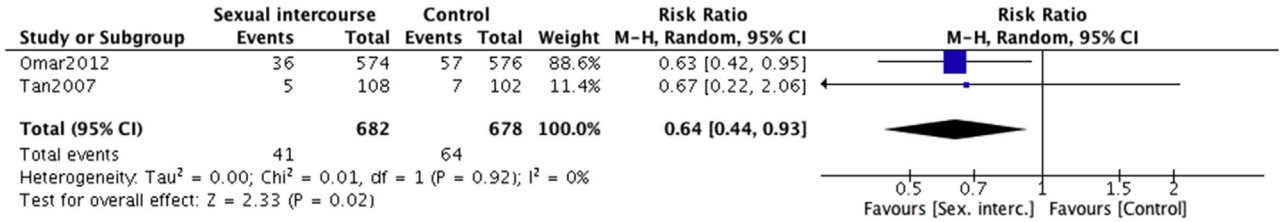

Figure 4. Forest plot for the risk of emergency cesarean section due to non-reassuring fetal heart rate pattern. Figure 4 is available in color online at www.jsm.jsexmed.org.

In fact, sexual positions and depth of penetration, duration and frequency of coitus, orgasm, condom use, duration of nipple stimulation, volume of ejaculate, concentration of prostaglandin within the ejaculate, or proximity of ejaculate to the cervical os are all different aspects of coitus that should be adequately assessed. Nevertheless, these are difficult to check, both for psychological reticence to speak about it, and also because it is complicated to objectively evaluate them apart from self-reporting. Given the suspected small impact of each of these variables on the link between labor onset and sexual intercourse, we assume that a very high number of cases would be required to achieve statistically significant results, and the certainty of abstinence from coitus in the control group should also be proven. Clearly, such a randomized controlled trial is very arduous to plan. A new strategy to objectively evaluate the impact of sexual intercourse on labor onset might be the measurement of cervical length, an objective parameter, the day after coitus or at regular intervals. In addition, it would be interesting to assess the impact of mechanical (penile penetration) and biochemical (prostaglandins contained into seminal fluids) stimulation on the onset of labor by differentiating them through condom use in an RCT. Moreover, the compliance to the use or not of condoms might be assessed by vaginal swab checking for male prostaglandins. Last, despite not being considered as sexual intercourse, a noteworthy feature of sexual contact is the practice of masturbation. This might be a good way to elicit some of the physical response to sexual intercourse, such as orgasm and oxytocin release, without needing a partner, and also avoiding fears about harms to the fetus from sexual intercourse. However, obviously, mechanical and biochemical aspects of penile stimulation would be lost. The intensity of contractions induced by orgasm after masturbation has already been studied, showing higher results compared with orgasm after penetration.[42] Therefore, it might be useful to assess such practice in an RCT to assess its true impact.

CONCLUSION

In summary, sexual intercourse in low-risk singleton pregnancies at term seems not to increase the incidence of spontaneous onset of labor. Further studies are needed to confirm these findings.

Corresponding Author: Dr Luigi Carbone, MD, University of Naples Federico II, Department of Neuroscience, Reproductive Sciences and Dentistry, School of Medicine, Federico II University, Via Sergio Pansini no. 5, 80131 Naples, Italy. Tel: 39 081 7462202; E-mail: drcarboneluigi@gmail.com

Conflicts of interest: The authors report no conflicts of interest.

Funding: None.

STATEMENT OF AUTHORSHIP

Category 1

(a) Conception and design
Laura Sarno; Alessandro Conforti; Giuseppe Maria Maruotti; Carlo Alviggi; Fulvio Zullo

(b) Acquisition of Data
Antonio Mercorio; Antonio Raffone; Bruno Arduino; Pietro D'Alessandro

(c) Analysis and Interpretation of Data
Luigi Carbone; Valentino De Vivo; Gabriele Saccone; Francesco D'Antonio

Category 2

(a) Drafting the article
Luigi Carbone; Valentino De Vivo; Antonio Mercorio; Antonio Raffone; Bruno Arduino; Pietro D'Alessandro

(b) Revising it for intellectual content
Gabriele Saccone; Francesco D'Antonio; Laura Sarno; Alessandro Conforti; Giuseppe Maria Maruotti; Carlo Alviggi; Fulvio Zullo

Category 3

(a) Final approval of the completed Article
Luigi Carbone; Valentino De Vivo; Gabriele Saccone; Francesco D'Antonio; Antonio Mercorio; Antonio Raffone; Bruno Arduino; Pietro D'Alessandro; Laura Sarno; Alessandro Conforti; Giuseppe Maria Maruotti; Carlo Alviggi; Fulvio Zullo

REFERENCES

1. Pugh WE, Fernandez FL. Coitus in late pregnancy: A follow-up study of the effects of coitus on late pregnancy, delivery, and the puerperium. **Obstet Gynecol 1953; 2:636-642.**
2. Goodlin RC, Keller DW, Raffin M. Orgasm during late pregnancy: Possible deleterious effects. **Obstet Gynecol 1971; 38:916-920.**

3. Solberg DA, Butler J, Wagner NN. Sexual behavior in pregnancy. **N Engl J Med 1973;298:1098-1103.**
4. Wagner NN, Butler JC, Sanders JP. Prematurity and orgasmic coitus during pregnancy: Data on a small sample. **Fertil Steril 1976;27:911-915.**
5. Grudzinskas JG, Watson C, Chard T. Does sexual intercourse cause fetal distress? **Lancet 1979;2:692-693.**
6. Naeye RL. Coitus and associated amniotic-fluid infections. **N Engl J Med 1979;301:1198-1200.**
7. Mills JL, Harlap S, Harley EE. Should coitus late in pregnancy be discouraged? **Lancet 1981;2:136-138.**
8. Berghella V, Klebanoff M, McPherson C, et al. Sexual intercourse association with asymptomatic bacterial vaginosis and *Trichomonas vaginalis* treatment in relationship to preterm birth. **Am J Obstet Gynecol 2002;187:1277-1282.**
9. Klebanoff MA, Nugent RP, Rhoads GG. Coitus during pregnancy: Is it safe? **Lancet 1984;2:914-917.**
10. Schaffir J. Survey of folk beliefs about induction of labor. **Birth 2002;29:47-51.**
11. Taylor PL, Kelly RW. 19-Hydroxylated E prostaglandins as the major prostaglandins of human semen. **Nature 1974; 250:665-667.**
12. Cenedella RJ. Prostaglandins and male reproductive physiology. **Adv Sex Horm Res 1975;1:325-358.**
13. Toth M, Rehnstrom J, Fuchs AR. Prostaglandins E and F in cervical mucus of pregnant women. **Am J Perinatol 1989; 6:142-144.**
14. Capeless EL, Mann LI. Use of breast stimulation for antepartum stress testing. **Obstet Gynecol 1984;64:641-645.**
15. Kavanagh J, Kelly AJ, Thomas J. Breast stimulation for cervical ripening and induction of labour. **Cochrane Database Syst Rev 2005;3:CD003392.**
16. Elliott JP, Flaherty JF. The use of breast stimulation to ripen the cervix in term pregnancies. **Am J Obstet Gynecol 1983; 145:553-556.**
17. Salmon YM, Kee WH, Tan SL, et al. Cervical ripening by breast stimulation. **Obstet Gynecol 1986;67:21-24.**
18. Moore TR, Iams JD, Creasy RK, et al. Diurnal and gestational patterns of uterine activity in normal human pregnancy. **Obstet Gynecol 1994;83:517-523.**
19. Chayen B, Tejani N, Verma UL, et al. Fetal heart rate changes and uterine activity during coitus. **Acta Obstet Gynecol Scand 1986;65:853-855.**
20. Goodlin RC, Schmidt W, Creevy DC. Uterine tension and fetal heart rate during maternal orgasm. **Obstet Gynecol 1972; 39:125-127.**
21. Foumane P, Mboudou ET, Sama JD, et al. Sexual activity during pregnancy and prognosis of labor in Cameroonian women: A cohort study. **J Matern Fetal Neonatal Med 2014; 27:1305-1308.**
22. Kafaei Atrian M, Sadat Z, Rasolzadeh Bidgoly M, et al. The association of sexual intercourse during pregnancy with labor onset. **Iran Red Crescent Med J 2015;17:e16465.**
23. Tan PC, Andi A, Azmi N, et al. Effect of coitus at term on length of gestation, induction of labor, and mode of delivery. **Obstet Gynecol 2006;108:134-140.**
24. Tenore JL. Methods for cervical ripening and induction of labor. **Am Fam Physician 2003;67:2123-2128.**
25. Tan PC, Yow CM, Omar SZ. Effect of coital activity on onset of labor in women scheduled for labor induction: A randomized controlled trial. **Obstet Gynecol 2007;110:820-826.**
26. Omar NS, Tan PC, Sabir N, et al. Coitus to expedite the onset of labor: A randomized trial. **BJOG 2013;120:338-345.**
27. Castro C, Afonso M, Carvalho R, et al. Effect of vaginal intercourse on spontaneous labor at term: A randomized controlled trial. **Arch Gynecol Obstet 2014;290:1121-1125.**
28. Kavanagh J, Kelly AJ, Thomas J. Sexual intercourse for cervical ripening and induction of labour. **Cochrane Database Syst Rev 2001;(2):CD003093.**
29. Higgins JPT Green S editors. Cochrane Handbook for Systematic Reviews of Interventions, Version 5.1.0. The Cochrane Collaboration. Available at: http://training.cochrane.org/handbook; Accessed July 27, 2019.
30. Review Manager (RevMan) [Computer program]. Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration. Available at: https://community.cochrane.org/help/tools-and-software/revman-5; Accessed July 27, 2019.
31. 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.**
32. Tan PC, Yow CM, Omar SZ. Coitus and orgasm at term: effect on spontaneous labor and pregnancy outcome. **Singapore Med J 2009;50:1062-1067.**
33. Bendvold E. Coitus and induction of labour [Samleie og induksjon av fodsel]. **Tidsskrift for Jordmodre 1990;96:6-8.**
34. Schaffir J. Sexual intercourse at term and onset of labor. **Obstet Gynecol 2006;107:1310-1314.**
35. Fox N, Gelber S, Chasen S. Physical and sexual activity during pregnancy are not associated with the onset of labor and mode of delivery in low risk term nulliparous women. **Internet J Gynecol Obstet 2006;8(1).**
36. National Collaborating Centre for Women's and Children's Health (UK). Antenatal care: Routine care for the healthy pregnant woman. NICE Clinical Guidelines no. 62. London, United Kingdom: RCOG Press; 2008.
37. Jones C, Chan C, Farine D. Sex in pregnancy. **CMAJ 2011; 183:815-818.**
38. MacPhedran SE. Sexual activity recommendations in high-risk pregnancies: What is the evidence? **Sex Med Rev 2018; 6:343-357.**
39. Navathe R, Saccone G, Villani M, et al. Decrease in the incidence of threatened preterm labor after implementation of

transvaginal ultrasound cervical length universal screening. **J Matern Fetal Neonatal Med 2019;32:1853-1858.**

40. Suhag A, Reina J, Sanapo L, et al. Prior ultrasound-indicated cerclage: comparison of cervical length screening or history-indicated cerclage in the next pregnancy. **Obstet Gynecol 2015;126:962-968.**
41. Ehsanipoor RM, Seligman NS, Saccone G, et al. Physical examination-indicated cerclage: A systematic review and meta-analysis. **Obstet Gynecol 2015;126:125-135.**
42. Masters WH, Johnson VE. Human sexual response. Boston: Little, Brown and Co; 1966.