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Article *in* Bosnian journal of basic medical sciences / Udruzenje basicnih mediciniskih znanosti = Association of Basic Medical Sciences · November 2019

DOI: 10.17305/bjbms.2019.4499

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REVIEW ARTICLE

Human brucellosis in pregnancy – an overview

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Submitted: 26 October 2019/**Accepted:** 26 November 2019
DOI: https://dx.doi.org/10.17305/bjbms.2019.4499

ABSTRACT

Human brucellosis during pregnancy is characterized by significantly less pronounced adverse obstetric outcomes than in animals, but with remarkably more adverse obstetric outcomes when compared to healthy pregnant women. Seroprevalence of brucellosis in pregnancy and cumulative incidence of brucellosis cases per 1000 delivered obstetrical discharges in endemic regions were reported to be 1.5–12.2% and 0.42–3.3, respectively. Depending on the region, frequency of pregnant women in the cohorts of patients with brucellosis was from 1.5% to 16.9%. The most common and the most dramatic unfavorable outcomes during brucellosis in pregnancy are the obstetric ones, manifested as abortions (2.5–54.5%), intrauterine fetal death (0–20.6%) or preterm deliveries (1.2–28.6%), depending on the stage of pregnancy. Other unfavorable outcomes due to brucellosis are addressed to infant (congenital/neonatal brucellosis, low birth weight, development delay or even death), the clinical course of disease in mother and delivery team exposure. When diagnosed in pregnant women, brucellosis should be treated as soon as possible. Early administration of adequate therapy significantly reduces the frequency of adverse outcomes. Rifampicin in combination with trimethoprim-sulfamethoxazole for 6 weeks is the most commonly used and recommended regimen, although monotherapies with each of these two drugs are also widely used while waiting for the results from prospective randomized therapeutic trials. As no effective human vaccine exists, screening of pregnant women and education of all women of childbearing age about brucellosis should be compulsory preventive measures in endemic regions.

KEYWORDS: Seroprevalence; brucellosis; pregnancy; complications; treatment

INTRODUCTION

Human brucellosis is one of the most common zoonoses in the World and important public health problem in many parts of Africa, South and Central America, Asia and the Mediterranean region (1, 2). Clinically it is presented as febrile disease with affection of various body systems (3) or as a fever of unknown origin (4). The disease is contracted via direct contact with infected animals, ingestion of unpasteurized dairy products or by aerosol inhalation (3, 5, 6).

Human brucellosis is ubiquitous, found in all age groups and both genders likewise (3, 5, 7) and consequently pregnant women can acquire it as well. In the absence of well-designed prospective studies, current knowledge about brucellosis in pregnant women is based on observational studies and case reports (8). Therefore, many important questions regarding the incidence of brucellosis in pregnancy, the effect on obstetric outcome and infant health; and vice versa, the influence of pregnancy on the severity and outcome of brucellosis remain unanswered.

The aim of this study is to assess different aspects of brucellosis in pregnancy based on the data found in current literature.

History

The first human abortion due to *Brucella* infection was reported in 1905 by Thierry in France, followed by Devoir in 1906 who described a case of abortion in pregnant farmer [cited in (9, 10)]. In 1908, Eyre recognized the occurrence of brucellosis during pregnancy (11). In 1917, De Forest et al. proposed a correlation between abortion and active brucellosis in humans, despite the fact that they were unable to prove it microbiologically (12). Preterm delivery due to brucellosis was reported for the first time by De Carle in 1931 (13, 14). In 1938, Vecchio published the first case series of 59 pregnant women with brucellosis among them 78.6% had a spontaneous abortion (15) whereas the first case of congenital brucellosis was reported by Hagebusch and Frei in 1941 (16).

Prevalence of human brucellosis in pregnancy and vice versa

The incidence and prevalence of brucellosis among pregnant women is unknown in many endemic regions even today (17). According to various reports, seroprevalence of brucellosis during pregnancy varied between 1.5% (13 seropositive among 890 pregnant women) (18), 3.5% (18 out of 513) in rural areas of Saudi Arabia (19), 5.8% (25 out of 429) in Pakistan (20) and 12.2% (55 out of 450) in another study from Saudi Arabia (21). Cumulative incidence of brucellosis cases in pregnancy per 1000 delivered obstetrical discharges was estimated to be from 0.42 (22) to 3.3 (23).

In cohorts of patients with brucellosis, pregnant women comprised from 19 out of 1245 (1.5%) (24) and up to 92 out of 545 cases (16.9%) (25). In addition, Buzgan et al. reported 17 pregnant women among 1028 patients with brucellosis (1.7%) (26), Kurdoglu et al. reported 21 pregnant women out of 342 patients with brucellosis (6.1%) (22), Madkour's study reported 30 pregnancies among 500 patients with brucellosis (6%) (27), while in the study of Glick et al. 11 out of 114 patients (9.6%) were pregnant (28). The largest recently published multicenter study found 242 (2.1%) pregnant women among 11,602 adult brucellosis patients (23).

Having in mind that some of mentioned studies in this paragraph were not based on universal microbiological diagnostic criteria, there is still a possibility of some minor differences in brucellosis seroprevalence (**Table 1.**).

The influence of human brucellosis on obstetric outcomes

Contrary to the well-known fact that *Brucella* infection in animals is associated with high incidence of abortion, the data about relationship between the disease and pregnancy outcome in humans are controversial (29-31).

According to the previous experiences, mainly of older date, brucellosis does not play a role in the appearance of adverse obstetric outcomes during human pregnancy (32). Spink also did not

manage to find definitive evidence in his observation that *Brucellae* produce abortions any more frequently than other bacterial species do (33). In the same line, several newer studies from endemic regions demonstrated that *Brucella* seroprevalence among pregnant women with and those without history of spontaneous abortion was similar, i.e. that women with spontaneous abortion were not more commonly seropositive than those with normal pregnancy outcome (18, 31, 34). It is important to emphasize that as a control group in these three studies, the prevalence of abortions among general population was investigated instead of abortion prevalence among seronegative women.

Contrary to these findings, some contemporary data suggest that brucellosis has a significant role in adverse obstetric outcomes in humans and they imply that *Brucella species* may indeed produce human abortions more frequently than other bacterial pathogens (25). With the rate of adverse obstetric outcomes from 14 to 46%, brucellosis exceeds the rate that can be seen in the general population of pregnant women (13, 21, 23). In the context of such assertions are positive culture isolates of *Brucella spp.* obtained from human placenta, aborted fetuses or preterm stillbirths, and other products of conception (13, 27, 35-37). The first large series on the causative relationship between abortion in humans and brucellosis was published by Criscuolo and di Carlo, and reported 52 abortions among 200 pregnant women with active brucellosis (26%) (38). The authors confirmed their findings by positive blood culture of *B. melitensis* from maternal blood in one, maternal urine in two and uterine tissue culture in one (27, 38). Having in mind numerous socio-demographic co-factors that had been applied, an association between human brucellosis incidence and adverse pregnancy outcomes was also documented in a study from Israel where the rates of preterm delivery, intrauterine fetal death (IUFD) and poor fetal growth were significantly higher in Israeli-Arab localities with a high incidence of brucellosis compared to localities where the disease was not reported (39).

As previously mentioned, brucellosis is an established factor of spontaneous abortion or sterility in animals (40). In humans, brucellosis causes fewer spontaneous abortions than in animals as a result of absence of erythrol in women's placenta (27, 41, 42). Erythrol is a sugar alcohol and it is considered an important growth factor for *Brucella spp.* that can be found in large amounts in animal placentas. Furthermore, the additional reasons for potential role of brucellosis in the incidence of adverse obstetric outcomes in humans might be attributed to maternal bacteremia, disseminated intravascular coagulation (DIC), placentitis and acute febrile reaction. Thus, released endotoxins could also play an important cause of adverse obstetric outcomes, since endotoxins increase the frequency and intensity of uterine contractions by means of an oxytocin-like effect on uterine smooth muscules (10, 43, 44). Finally, allergic mechanisms in chronic brucellosis may also cause spasms in myometrium by histamine discharge (10, 17). In addition, it has been recently observed that pathogenic *Brucellae* can proliferate in human trophoblasts and are able to interfere with the invasive capacity of extravillous trophoblasts. This is crucial for implantation during the early stages of pregnancy and could possibly play central role during early abortion in women with brucellosis (45). It is also noteworthy to mention that in pregnant animal models IFN-γ induced by the immune response plays an important role in causing abortion during brucellosis (46).

Incidence of human brucellosis as a cause of adverse pregnancy outcomes

Many studies have found significantly increased risk for abortion and IUFD in women with brucellosis compared to healthy ones (**Table 2**). Contrary to the study of Elshamy and Ahmed (21) which had not found significant difference in terms of preterm delivery, in the study of Gulshun et al. it was obvious that brucellosis in pregnancy increases the incidence of preterm delivery compared to healthy pregnant women - 17.9% (7 out of 39) and 2.5% (1 out of 40), respectively (29).

In the reports originating from Kuwait, Iran, Rwanda and Nigeria, brucellosis was confirmed in 2 out of 29 (6.9%) (47), 6 out of 51 (11.8%) (35), 11 out of 60 (18.3%) (48) and 23 out of 121 (19%) (49) women that exhibited spontaneous abortion, respectively. Brucellosis was also found in 5 out of 51 (9.8%) women that manifested IUFD and in 18 out of 227 (7.9%) women with preterm delivery (47).

Types of outcomes in pregnant women with brucellosis

As shown in Table 3, the outcomes during brucellosis in pregnancy can be observed from different aspects. Mainly, the outcomes depend on the prompt and appropriate treatment of the disease in pregnant women.

Obstetric outcomes are manifested as favorable (full-term delivery) and unfavorable (abortion, IUFD, preterm delivery). Unfavorable obstetric outcomes were found in 34 out of 242 (14%) pregnant women suffering from brucellosis (23). In the same study, splenomegaly, vomiting, vaginal bleeding, anemia, elevated serum aspartate aminotransferase, oligohydramnios, history of taking medication other than brucellosis treatment during pregnancy and *Brucella* bacteremia were the significant potential risk factors for unfavorable outcome (23).

Full-term delivery was ranging from 47.4% (9 out of 19) (24) to 100%, found in small series of 4 patients (50) and full-term delivery was also reported in 15 out of 29 (51.7%) (27), 19 out of 29 (65.5%) (22), 21 out of 39 (53.8%) (29), 50 out of 86 (58.1%) (9) and in 219 out of 242 (90.5%) (23) pregnant women with brucellosis. In conclusion, full-term delivery is primarily associated with early recognition of brucellosis during pregnancy and adequate treatment of the disease.

In brucellosis during pregnancy, spontaneous abortion (fetal death that occurred at $\leq$ 24 weeks of gestation) is more frequent than intrauterine fetal death (fetal death that occurred at > 24 weeks of gestation) and preterm delivery (the birth of a baby before 37 weeks of gestation) (22). The abortion rate was reported to be from 1 out of 39 (2.5%) (29) and up to 6 out of 11 (54.5%) (51),

mainly in a range between 17.6% and 41.0% of pregnant women with brucellosis (22, 27, 52). In the study by Inan et al. abortion rate was only 6.2% (15 out of 242), which is lower than usually reported frequencies – this could be attributed to early establishment of the diagnosis and appropriate treatment (23). Abortions were noted mostly in the first trimester (9, 24, 27), although other studies did not find difference in the incidence of abortion according to the trimester (25).

The rate of IUFD ranges between zero (29) and 20.6% (13). It was detected in 2.1% (5 out of 242) (23), 3.4% (1 out of 29) (27), 8.1% (7 out of 86) (9), 9.1% (1 out of 11) (53) and 12.7% (7 out of 55) (21) pregnant women with brucellosis.

Preterm delivery due to brucellosis is well recognized with rates between 1.2% (3 out of 242) (23) 9.1% (1 out of 11) (51), 14.0% (12 out of 86) (9), 17.9% (7 out of 39) (29) and up to 28.6% (2 out of 7) (30). Also, preterm delivery was associated with congenital brucellosis as well as growth and developmental delay, and as such it is considered as major determinant of immediate and long-term morbidity of the infant (54, 55).

Outcomes for infants are the second most dramatic condition as a consequence of brucellosis during pregnancy. The newborn can be either uninfected which is more frequent condition or infected characterized by the deployment of congenital or neonatal brucellosis. Uninfected newborns are usually associated with full-term delivery. Congenital brucellosis can be contracted transplacentally whereas neonatal brucellosis can be acquired through the contact with body fluids secreted during delivery or by breastfeeding in postpartum period (43, 56-58). However, it is a rare condition, most of the cases are associated with preterm delivery (55, 59) and it occurs in approximately 2% of infants exposed to brucellosis *in utero* (60). From 1988 to 2007 only 15 cases of congenital brucellosis were reported in the literature (55). Nevertheless, in the study by Vilchez et al., 4 out of 86 (4.6%) patients had congenital brucellosis (9). Clinical manifestations

of congenital brucellosis are serious and morbidity as well as mortality rates are high (43, 61). This condition can be clinically presented with poor feeding, fever, jaundice, respiratory distress syndrome, meconium aspiration syndrome, sepsis and multiple organ failure (56, 62-64), so it is very difficult to clinically distinguish congenital brucellosis from other bacterial infections (43). However, favorable outcome in congenital brucellosis was described as well (56). Favorable outcome was evident in most of the uninfected and full-term delivered newborns, whereas in preterm cases and cases with congenital brucellosis an increased risk for neonatal death is obvious. After delivery, neonatal death occurred in 2 out of 36 infants (5.6%) from mothers who were treated for brucellosis (25) and in 7 out of 86 (8.1%) in another study (9). Low birth weight (<2500 grams) of infants from mothers who had brucellosis during pregnancy was reported in 7% (17 out of 242) (23), 14.5% (9 out of 62) (9) and up to 25.6% (10 out of 39) (29). General impression is that brucellosis in pregnant mothers was not associated with congenital malformations (17, 29, 57, 62).

Outcome for pregnant women. The age of pregnant women with brucellosis ranged from 15 to 50 years, with majority aged between 25 and 29 years (9, 23, 48). Positive epidemiological (family) history in pregnant women who had brucellosis was 61.3% (65), 63.0% (22) and 76.9% (29). Clinical course of human brucellosis during pregnancy was the same to the course observed in non-pregnant patients and ranged from asymptomatic to severe disease (44). Most of the pregnant women suffered from acute form and manifested as mild illness (9). Clinical symptoms in pregnant women with brucellosis were nonspecific, consisting of weakness, arthralgia, fever, fatigue, excessive night sweating, lack of appetite, myalgia, chills, depression, weight loss, headache and back pain. The most common signs were fever, hepatomegaly, splenomegaly and osteoarticular affection (23, 29). Other focal manifestations were recognized as well (22, 29, 54). However, one study from Israel noticed that complications in pregnant population were present in

45%, which was significantly higher than 10% in non-pregnant women (28). Similarly, in another study focal brucellosis was found in 46.7% (113 out of 242) among pregnant population (23). The most frequent laboratory finding was anemia and elevated ESR (29). Gram-negative sepsis and DIC (66), as well as maternal death as a complication of severe sepsis (9) were sporadically described in pregnant women. Relapses and chronicity can occur during pregnancy as well as in all other patients that suffer from brucellosis, although in the study performed by Inan et al., frequency of relapses was extremely rare (0.4%) (23).

Obstetric manifestations in women with brucellosis can be vaginal bleeding in 9.1% (22 out of 242) (23), postpartal endometritis in 28.6% (2 out of 7) (30), groin pelvic pain in 23.5% (8 out of 34) (23) as well as preterm rupture of membranes (43, 55, 56) and chorioamnionitis (60, 67). Repeated abortions were described among women with brucellosis too (24, 27) and one old report found infertility in 19% (10) which was not further confirmed (24, 27).

Outcome for the medical personnel includes exposure and possible infection of the delivery team due to contact with infective amniotic fluid and there are several cases described so far (57, 62, 64).

Correlation between *Brucella* antibody titer and human pregnancy outcome

There are contradictory results concerning the association between pregnancy outcome and level of antibody titer or blood culture positivity. According to some insights, there was conection between *Brucella* antibody titres ≥1:160 and spontaneous abortion. Women with titres 1:160 were twice at risk of having a spontaneous abortion as compared to those with lower titres. This has been confirmed by Sharif et al. and Elshamy and Ahmed, so according to these authors, if the titre was higher than 1:160, the incidence of abortion was 17.6% and 44% respectively, whereas if the titre was less than 1:160, the incidence was 7.7% and 19%, respectively (19, 21). These findings were not confirmed in the cases of IUFD and preterm delivery (21). On the other side,

other studies did not find a correlation between the *Brucella* antibody titers and spontaneous abortion (24, 25, 31). Serum agglutinin titers (SAT) ≥1:2560 were not significantly associated with the appearance of spontaneous abortion when compared with the lower titers (25). Also, the abortion rates in patients with SAT <1:640 and ≥1:640 were 45.5% and 62.5%, respectively which was not significantly different (24).

Furthermore, there were contradictory data about the relationship between obstetrical outcomes and presence of maternal bacteremia. In one report abortions were registered in 8 out of 22 (36.4%) women with, and in 16 out of 30 (53.3%) women without *Brucella* bacteremia, which was not statistically significant (25). In the other hand, Gariguet et al. reported two spontaneous abortions in three bacteremic women, and no abortion among 13 pregnant culture negative women with brucellosis ($P < 0.05$) (68).

Principles of brucellosis treatment during human pregnancy

Until now no clinical trials on the treatment of brucellosis during pregnancy had been particularly conducted. Therapy in this group of patients is mostly based on expert recommendations, observational studies, case series (9) as well as clinical experience and tradition (69). Key points in the treatment of brucellosis in pregnancy are early recognition and prompt initiation of antimicrobial therapy as the measures that can decrease the risk of unfavorable obstetric, neonatal, maternal and delivery team outcomes (25, 29, 54, 57). In one case series of 19 pregnant women, among 13 patients who received antimicrobial treatment, only four aborted and nine had full-term deliveries whereas all 6 untreated women aborted (24). In other series of 11 pregnant women with brucellosis 3 were adequately treated and delivered full-term infants, whereas 8 untreated women manifested adverse outcomes (51).

Therapy of brucellosis in pregnancy is still challenging since pregnant women cannot take tetracyclines because of their potential to cause fetal tooth staining, although the risk from

doxycycline is much lower in comparison to other tetracyclines (61, 70). Quinolones are also not recommended during pregnancy because of their chondrotoxicity. The administration of streptomycin or gentamicin during pregnancy poses risk of ototoxicity or nephrotoxicity in the infant (61). Thus, the preferred antimicrobials in pregnant women are rifampicin and trimethoprim-sulphamethoxazole (TMP-SMX). The latter is associated with neonatal kernicterus and its use is not recommended after 36th gestational week (71). If TMP-SMX is used anyway, supplementation of folinic acid should be given (61). Rifampicin is the safest of all available antibiotics that can be used by pregnant women with brucellosis (1).

Therapeutic combinations in pregnant women with brucellosis

For treatment of brucellosis in pregnancy, rifampicin in combination with TMP-SMX for 6 to 8 weeks is the most commonly used and preferred regimen (13, 24, 57) despite the findings that the incidence of abortions among 22 patients treated with TMP-SMX monotherapy was not significantly different from that of 17 patients treated with combination of TMP-SMX and rifampicin (25). However, rifampicin is the mainstay of brucellosis treatment during pregnancy (2) and the World Health Organization advises rifampicin monotherapy as the first line (72). Monotherapy is still questionable in case of brucellosis treatment and further randomized studies should give the answer weather this option is suitable for treatment of pregnant women with brucellosis.

Some authors treat brucellosis in pregnancy with gentamicin for 1 week plus TMP-SMX for 6 weeks, with (9) or without (32) rifampicin. In the study of Inan et al. 11 different regimens composed of ceftriaxone, rifampicin, TMP-SMX, doxycycline and streptomycin/gentamicin were used and no association between any of three widely used combinations (rifampicin plus TMP-SMX, rifampicin plus ceftriaxone, rifampicin plus TMP-SMX plus ceftriaxone) and the occurrence of adverse pregnancy outcomes was found (23). Another study with a small number

of cases compared treatment outcome with four different regimens including TMP-SMX monotherapy, rifampicin monotherapy, TMP-SMX plus rifampicin and ceftriaxone plus rifampicin, and the overall conclusion was that the ceftriaxone-rifampicin combination therapy was the most effective one (29). Having in mind that a significant rate of antimicrobial resistance of *Brucella* has been recently observed *in vitro* for rifampicin and TMP-SMX (73), ceftriaxone could also be rational choice in combination treatment approach and promising regimen for treating pregnant women with brucellosis in endemic regions.

For neonatal brucellosis the treatment of choice should be the combination of TMP-SMX and rifampicin for 6 weeks, or TMP-SMX for 6 weeks and gentamicin for the first week (56). After the birth (delivery/abortion/IUFD), treatment of woman may be switched to doxycycline and rifampicin for 6 weeks or doxycycline for 6 weeks and streptomycin for the first 2-3 weeks or gentamicin for first week (9). If mothers breastfeed, it is a general opinion that breastfeeding should be discontinued until the completion of treatment. Based on the previous experiences, in that case therapy with combination of ceftriaxone and rifampicin should be a reasonable choice (29). Also, it has been recently published by American Academy of Pediatrics that doxycycline is a favorable drug for maximum of 3 weeks of therapy, even in infants and children below 8 years of age (74). Thus, the question addressed to the authorities for brucellosis treatment could be weather this regiment should be reconsidered in some of combination varieties.

Prevention

In the absence of an adequate vaccine for human use, non-specific measures like screening and education of pregnant women and testing of suspicious cases may help to prevent the disease and its complications during pregnancy. In endemic regions pregnant women should be routinely tested for brucellosis (21, 24, 59). Also, in these areas women of childbearing age should be educated what brucellosis is; i.e. the ways of acquiring the disease, what the main clinical

manifestations are, how it is diagnosed and the possible consequences if left untreated (22, 24). Lastly, in endemic areas, brucellosis should be thought of in differential diagnosis of all pregnant women with febrile disease with/without persistence of unspecific symptoms including affection of various organs and systems. Likewise, all cases with unexplained spontaneous abortion, IUFD, preterm delivery, LBW, fetal death, or previous history for these conditions should be tested for brucellosis (9, 20, 24, 57).

CONCLUSION

Brucellosis can be found among pregnant women with significant frequency in endemic regions. The incidence of adverse obstetric outcomes in women with brucellosis exceeds the rates among general population. Also, brucellosis during pregnancy might have negative influence on the newborns' health and might cause delivery team infection. Early recognition of the disease and timely administration of antimicrobial therapy can significantly decrease the risk of unfavorable obstetric, neonatal, maternal and delivery team outcomes. Screening and education of pregnant women as well as all women of childbearing age should be compulsory measures to prevent the disease in endemic regions for brucellosis.

ACKNOWLEDGMENTS

We thank to dr. Željana Sulaver for diligent proofreading of this paper. J.A. is supported by the Federal Ministry of Science and Education (B&H), project FMON 2018.

DECLARATION OF INTERESTS

The authors declare no conflict of interests.

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TABLES

TABLE 1. Diagnostic criteria for seroprevalence of human brucellosis in pregnancy	
Study	**Microbiological diagnostic test**
Abo-Shehada and Abu-Halaweh 2011	CFT >17 IU/ml and RBPT
Sharif, Reyes et al. 1990	STA > 1:160
Madkour 2001	SAT ≥1:160 and blood cultures
Khan, Mah et al. 2001	SAT ≥1:320 and blood cultures
Elshamy and Ahmed 2008	STA ≥1:160
Kurdoglu, Adali et al. 2010	STA ≥1:160 and blood cultures
Buzgan, Karahocagil et al. 2010	STA ≥1:160 and blood cultures
Roushan, Baiani et al. 2011	STA ≥1:160 and blood cultures
Ali, Akhter et al. 2016	RBPT and blood cultures
Glick, Levin et al. 2016	Blood cultures
Inan, Erdem et al. 2019	STA ≥1:160, ELISA, RBT and blood cultures
*Complement fixation test (CFT); Enzyme linked immunosorbent assay (ELISA); Rose Bengal plate test (RBPT); Standard tube agglutination (STA); Serum agglutinin test (SAT)	

TABLE 2. Adverse obstetric outcomes in pregnant women with and without brucellosis				
Author	Pregnant women	Spontaneous abortion N (%)	IUFD N (%)	Preterm labour N (%)
Elshamy and Ahmed 2008	Pregnant with brucellosis (n=55)	15 (27.3)	7 (12.7)	6 (10.9)*
	Healthy pregnant (n=395)	60 (15.8)	15 (3.8)	35 (8.9)*
Khan et al. 2001	Pregnant with brucellosis (n=92)	40 (43.5)	2 (2.2)	ND
	Healthy pregnant (n=25540)	710 (2.8)	66 (0.3)	ND
Kurdoglu et al. 2010	Pregnant with brucellosis (n=29)	7 (24.1)	1 (3.4)	2 (6.9%)
	Healthy pregnant (n=33,936)	2577 (7.6)	76 (0.2)	643 (2.0%)
No data, ND; * Not significant, N.S.				

TABLE 3. Outcomes in pregnant women with brucellosis	
A. Obstetric outcomes	Full-term (mature) delivery
	Spontaneous abortion
	IUFD
	Preterm (premature) delivery
B. Outcomes for infant INFECTED - congenital / neonatal brucellosis UNINFECTED	Favorable
	Death
	Low birth weight
	Development delay & congenital malformations
C. Outcomes for pregnant woman	General
	Obstetric
D. Outcome for medical personnel	Delivery team infection