Ruth Hitomi Osava[I]

Flora Maria Barbosa da Silva[I]

Sonia Maria Junqueira Vasconcellos de Oliveira[II]

Esteban Fernandez Tuesta[III]

Maria Clara Estanislau do Amaral[IV]

Meconium-stained amniotic fluid and maternal and neonatal factors associated

ABSTRACT

OBJECTIVE: To identify the frequency and maternal and neonatal factors associated with meconium-stained amniotic fluid at birth.

METHODS: Cross-sectional study carried out with 2,441 births at an in-hospital birth center in the city of São Paulo, Southeastern Brazil, in March and April, 2005. The association between meconium-stained amniotic fluid and the independent variables (maternal age, parity, previous c-section or not, gestational age, obstetric history, oxytocin use in the labor, cervical dilation at admission, mode of current delivery, newborn weight, Apgar score at the 1st and 5th minute) was expressed as prevalence ratio (PR).

RESULTS: Meconium-stained amniotic fluid was verified in 11.9% of the births; 68.2% of these were normal births and 38.8% c-sections. Meconium was associated with: primiparity (PR = 1.49 95%CI 1.29;1.73), gestational age ≥ 41 weeks (PR = 5.05, 95%CI 1.93;13.25), oxytocin in labor (PR = 1.83, 95%CI 1.60;2.10), c-section (PR = 2.65, 95%CI 2.17;3.24) and Apgar scores < 7 at the 5th minute (PR = 2.96, 95%CI 2.94;2.99). Neonatal mortality was 1.6/1,000 live births. Meconium-stained amniotic fluid was found in 50% of neonatal deaths and it was associated with higher rates of surgical deliveries.

CONCLUSIONS: Oxytocin use, worse conditions of the newborn after the delivery and increased c-section rates were factors associated with meconium-stained amniotic fluid. Routine use of oxytocin in the intrapartum period could be evaluated due to its association with meconium-stained amniotic fluid.

DESCRIPTORS: Meconium Aspiration Syndrome, epidemiology. Natural Childbirth. Obstetric Labor Complications. Cesarean Section. Cross-Sectional Studies.

[I] Curso de Obstetrícia. Escola de Artes, Ciências e Humanidades. Universidade de São Paulo. São Paulo, SP, Brasil

[II] Escola de Enfermagem. Universidade de São Paulo. São Paulo, SP, Brasil

[III] Curso de Sistemas de Informação. Escola de Artes, Ciências e Humanidades. Universidade de São Paulo. São Paulo, SP, Brasil

[IV] Departamento de Enfermagem. Faculdade de Ciências Médicas. Universidade Estadual de Campinas. Campinas, SP, Brasil

Correspondence:
Flora Maria Barbosa da Silva
Av. Arlindo Béttio, 1000 Ermelino Matarazzo
03828-000 São Paulo, SP, Brasil
E-mail: floramaria@usp.br

Received: 9/28/2011
Approved: 5/24/2012

Article available from: www.scielo.br/rsp

INTRODUCTION

The incidence of meconium in amniotic fluid (MAF) is between 10%[4] and 16%[1,15] of full-term births of women considered to be at normal risk. Meconium Aspiration Syndrome (MAS) is a complication present in MAF and constitutes an important cause of perinatal mortality. More advanced gestational age presents a greater risk of MAF occurring. An American study demonstrated a level of MAF six times greater among women at 42 weeks or more, compared with those at 37 weeks (18% versus 3%, respectively).[5]

The most common causes of MAF are: the gastrointestinal maturity of the foetuses, foetal response to hypoxia and intra-uterine infection. Elimination or thickening of meconium during the delivery means the new born (NB) has more than double the possibility of having pH < 7.1 in the umbilical artery blood and a 5 minute Apgar score of < 7, compared to clear fluid or meconium fluid during the whole labour.[17]

The main complications arising from MAF is MAS. The mechanical and chemical effects and the inflammatory reactions caused by MAS may interfere with the normal transition to extrauterine life, causing airway obstructions, damage to lung tissue, inactivation of surfactats, chemical pneumonitis and decreased arterial oxygen pressure.[20] The impact of MAS on neonatal mortality varies widely: from a mortality rate of 5/1,000 live births in a case-control study in Jordan[23] to 96/1,000 live births in an Australian cohort with 2,490,862 live births.[7]

Studies have investigated obstetric care variables related to MAF and MAS (gestational age, mother's age and ethnicity) and the perinatal risk associated with these clinical events. Premature births have a lower incidence of MAF. A cohort study shows an increased risk of MAF for gestational ages above 38 weeks ($p < 0.001$).[5] Another retrospective cohort found a 1.55 ($p < 0.05$) increased risk of MAS at 40 weeks and of 2.12 ($p < 0.05$) in those at 41 weeks.[6] A U.S. population-based study found 40% greater risk of MAS in pregnancies over 41 weeks.[22] A Lebanese study of 972 women compared the maternal and foetal results for adult and adolescent mothers and found no difference in the rate of MAF between the groups.[20] Infants of black mothers eliminate MAF earlier than those of mothers of other ethnicities, though they require hospitalization in a neonatal unit less often.[20]

An investigation of the factors associated with the elimination of MAF may contribute to improving treatment and prognosis of the infants and, eventually, prevent MAS. We did not find any Brazilian studies respecting this clinical condition in normal birthing centres.

This study aimed to analyse the incidence and maternal and neonatal factors associated with MAF in a normal hospital birthing centre, with care provided exclusively by midwives.

METHODS

This is a hospital based transversal study, with retrospectively collected data from the medical records of 2,441 pregnant women and their NBs in a normal birthing centre in Sao Paulo, SP, which treats women with normal risk pregnancies, between March and April 2005. The team in the maternity unit aimed to promote normal birth in a therapeutic environment with a companion present, use of non-medicinal means of pain relief, encouraging active movement and a light diet. Care during labour is provided exclusively by midwives during normal birth and postpartum, and the team of obstetricians was responsible for admitting the mother, for caesarean deliveries and for attending to clinical and obstetric alterations.

No complications were recorded, nor was it possible to identify MAF recorded in four cases. These cases were excluded, resulting in a sample of 2,437 pregnant women. One case of intrauterine foetal death was excluded for the analysis of neonatal deaths.

We carried out a manual revision of the medical records, using a questionnaire developed for this study. The presence of meconium was deemed to be an independent variable and defined by being recorded in at least one part of the medical record: 1) printed in the description of normal birth, completed by the midwife; 2) in the NB care form from the delivery room, filled in by the Neonatologist and 3) in the form describing Caesarean section, completed by the obstetrician. Ten variable associated with the presence of MAF were evaluated: 1) mother's age (> 20 years old; from 20 to 34 years old; ≥ 35 years old), 2) births (primiparous, multiparous), 3) previous caesarean (yes; no), 4) gestational age (< 37weeks; from 37 to 41weeks; > than 41weeks), 5) previous obstetric history (no prior birth; normal birth; caesarean; caesarean; normal birth), 6) use of oxytocin during the labour (yes; no), 7) cervical dilation on admission (undilated; 1 < 4 cm, 5 < 9 cm, 10 cm), 8) actual delivery (caesarean; normal), 9) weight of NB (< 2,500 g; 2,500 to 2,999 g; 3,000 g to 3,499 g; 3,500 g to 3,999 g; ≥ 4,000 g), 10) Apgar score at 1st and 5th minute (≥ 7 and ≥ 7; < 7 and ≥ 7; < 7 and < 7).

The variables associated with the type of delivery were placed into four categories: demographic, past and current obstetric history (Table 1); intra-partum care (Table 2) and neonatal outcomes related to the presence or absence of MAF (Table 3). The degree of association between the dependent variable and the independent was expressed by the prevalence ratio (PR).

The research was approved by the Nursing Committee for Ethical Research in Human Beings of the Escola de Enfermagem. Universidade de São Paulo (nº 526/2006) and authorized by the supervisory and Technical Directors of the institution studied.

RESULTS

The incidence of MAF was 11.9% (289/2,437). The mother's age and previous caesarean showed no link to MAF during delivery. There was a positive correlation between MAF, first pregnancy and gestational age > 41 weeks. We did not find a correlation between gestational age up to 40 weeks and MAF (data not shown in table). MAF was not associated in pregnancies up to 40 weeks. History of only normal births diminished the risk of MAF by 45%. Being multiparous was associated as a protective factor against the presence of MAF (33% lower risk), but only for women with a history of normal births and not for those with a history of normal and caesarean deliveries (Table 1).

Table 1. Number, percentage, ratio of prevalence (RP) and confidence interval (CI) of 95% of meconium in the amniotic fluid (MAF), according to sociodemographic variables, prior and current history in the normal birthing centre. São Paulo, Southeastern Brazil, 2005.

Variables	Total	MAF	%	RP	95%CI	p*
Mothers' age (years) (n = 2,436)						
< 20	660	78	11.8	1.01	0.79;1.29	0.8300
20 to 34	1,627	191	11.7	1	-	
≥ 35	149	20	13.5	1.14	0.74;1.76	
Births (n = 2,400)						
Primiparous	1,222	175	14.3	1	-	0.0001
Multiparous	1,178	113	9.6	0.67	0.54;0.84	
Previous caesarean (n = 2,400)						
No	2,117	254	12.0	1	-	0.9900
Yes	283	34	12.0	1.00	0.72;1.4	
Gestational age in weeks (n = 2,409)						
< 37	98	4	4.2	0.37	0.14;0.97	0.0001
37 to 41	2,020	224	11.2	1	-	
> 41	291	60	20.6	1.86	1.44;2.40	
Previous obstetric history (n = 2,400)						
No prior birth	1,311	190	14.5	1	-	0.0001
Normal birth	806	64	7.9	0.55	0.42;0.72	
Caesarean	197	27	13.7	0.95	0.65;1.37	
Caesarean and normal birth	86	7	8.1	0.56	0.27;1.16	

*Chi-squared test

Table 2. Number, percentage, ratio of prevalence (RP) and confidence interval (CI) of 95% of meconium in the amniotic fluid (MAF), according to intrapartum care variables in the normal birthing centre. São Paulo, Southeastern Brazil, 2005.

Variables	Total	MAF	%	RP	95%CI	p*
Oxytocin (n = 2,420)						
No	1,417	125	8.8	1	-	0.0001
Yes	1,003	162	16.2	1.83	1.47;2.28	
Cervical dilation upon admission (n = 2,367)						
Undilated	64	3	4.7	0.47	0.15;1.46	0.0340
Between1 and 4 cm	1,509	200	13.3	1.33	1.03;1.73	
Between 5 and 9 cm	707	70	9.9	1	-	
10 cm	87	12	13.8	1.39	0.79;2.46	
Actual delivery (n = 2,437)						
Caesarean	365	92	25.2	1	-	0.0001
Normal	2,072	197	9.5	0.38	0.30;0.48	

*Chi-squared test

Table 3. Ratio of prevalence (RP) and confidence interval (CI) of 95% of meconium in the amniotic fluid (MAF), according to neonatal results in the normal birthing centre. São Paulo, Southeastern Brazil, 2005.

Variables	Total	MAF	%	RP	95%CI	p*
Birthweight (g) (n = 2,367)						
< 2,500	76	6	7.9	0.61	0.28;1.34	0.0100
2,500 to 2,999	616	53	8.6	0.67	0.50;0.90	
3,000 to 3,499	1,142	147	12.9	1	-	
3,500 to 3,999	513	66	12.9	0.99	0.76;1.31	
≥ 4,000	90	17	18.9	1.47	0.93;2.31	
Apgar Score at 1º and 5º min (n = 2,428)						
≥ 7 and ≥ 7	2,303	259	11.3	1	-	0.0001
< 7 and ≥ 7	122	29	23.8	2.11	1.51;2.96	
< 7 and < 7	3	1	33.3	2.96	0.59;14.75	

*Chi-squared test

Being admitted at the start of labour, with cervix dilated up to 4cm represented a 33% greater chance of MAF during the delivery (63.7% of women had this condition). There was a positive correlation between using oxytocin during labour and the presence of MAF (41.1% of the pregnant received oxytocin intravenously). Having MAF during the delivery meant a 62% lower chance of normal delivery. The proportion of caesareans among women with MAF (31.8%) was more than double that of those with clear amniotic fluid (12.7%) (Table 2).

Newborns which weigh between 2,500 g and 2,999 g had a 33% lower chance of MAF during the delivery and 7.9% of those weighing less than 2,500 g were registered as having MAF in the delivery. An Apgar star of < 7 in the first minute of life was associated with the presence of MAF (Table 3).

There were five deaths of newborns in the period, four born normally and one caesarean, which corresponds to an intra-hospital neonatal mortality rate of 1.6/1,000 live births during the period of the study. There was no correlation between neonatal death and the type of delivery (p = 0.5566), number of pregnancies (0.6800), gestational age (0.7000) and MAF (0.1101).

DISCUSSION

The degrees of correlation between exposure to risk factors and the outcomes can be presented in transversal studies as *odds ratio* (OR) or prevalence ratio (PR). When the prevalence of the dependent variable is high (> 10%, for example), the OR overestimates the PR.[3] Therefore, we decided to use PR to measure correlation, as in this study the incidence of MAF was higher than 10%.

The presence of MAF during delivery varied between 10% and 16.6% in low risk pregnancies.[2] The low incidence of MAF in our study may be explained by the fact that the majority of the women had a gestational age of 41 weeks and below. An American study observed 5.8% decline in MAS to 1.5%, attributing this to the 33% reduction in the number of deliveries at more than 41 weeks.[9]

There was a strong correlation between MAF and gestational age > 41 weeks, no correlation was noted between gestational ages < 40 weeks and MAF. The pathophysiology of MAS in prolonged pregnancies has been well established. Systematic revision found a lower perinatal mortality risk with elective induced labours; relative risk (RR): 0.30; confidence interval 95%: 0.09;0.99 and also risk of MAS (RR: 0.61; 95%CI 0.40;0.92) in pregnancies of 41 weeks or more without induction.[10] A study of a cohort of 2,527,766 women observed that infants of pregnancies of more than 41 weeks were at greater risk of being big for their gestational age (OR = 1.27; 95%CI 1.17;1.37) and at greater risk of MAS (OR = 2.12; 95%CI 1.91;2.35).[6]

The increased incidence of MAF and MAS with increased gestational age has been confirmed by another population-based study of a North American cohort which analysed births between 1995 and 2001. The authors observed higher rates of MAS at greater gestational ages and the OR for MAS at 39, 40 and 41 weeks was 0.7, 1 (reference) and 1.4 respectively.[2]

In this study, there was no correlation found between the mother's age and the presence of MAF, as was also found in a case control study of 50 women in Turkey[18] and in a transversal Israeli study of 37,085 births.[16] However, an English multicenter study of 499,096 newborns observed that women aged between 30 and 39 years old and aged 40 and over had an increased risk of MAF of 11% and 26% respectively, even when there was no association with poor perinatal outcomes (Apgar score of < 7 in the 1st or 5th, or both, minutes, newborn transferred to a neonatal unit or early neonatal death).[1] Older pregnant women may be more likely to exhibit comorbidities such as high blood pressure, diabetes and

obesity. These complications may influence the duration of the labour and the release of MAF.

Having given birth before and having experienced only normal births in previous pregnancies has shown itself to be a protective factor against incidence of MAF. A similar finding was observed in the Israeli study, in which first time births was associated with MAF in the delivery.[16] On the other hand, in a different study, birth history did not correlate with MAF.[1] Women who had previously had a vaginal birth tended to experience shorter labour with fewer interventions such as using oxytocin. Moreover, women who had given birth before tended to be admitted with the cervix more dilated as they were already familiar with the symptoms of labour.

There are some behaviours which can reduce the risk of MAS during labour. Inducing labour in prolonged pregnancies may diminish the incidence of MAF. This practice must be carefully monitored, as it may lead to foetal hypoxia and increase the risk of MAF.[12] In this study almost half the women received oxytocin, which is linked to the presence of MAF in the delivery. A transversal Brazilian study which collected retrospective data in a birthing centre investigated interventions during labour in women who underwent a caesarean. There was no statistical difference between the groups with and without MAF and the use of oxytocin (62.2% and 56.8% respectively), though the findings point in this direction.[8]

A systematic[13] revision which included 17 studies and 2,566 women did not find a correlation between the use of amniotomy and oxytocin combined as a way of inducing birth and incidence of MAF. However, the authors stated that, due to the use of oxytocin not being standardised between these studies, this revision does not provide clear conclusions with respect to the safety and effectiveness of using oxytocin and amniotomy to induce birth. As this study is transversal, it is difficult to define whether oxytocin was used to accelerate births with MAF or whether MAF was a consequence of using this drug.

The dilation of the women's cervix at time of admission was not associated with MAF. Admitting a woman at the start of labour is associated with a greater number of interventions such as using oxytocin, amniotomy and analgesia. Systematic revision[14] found that women placed into the group of the labour evaluating programme spent less time in hospital (an average difference of 5h20min; 95%CI 7.06;3.34) and received less oxytocin (OR = 0.45; 95%CI 0.25;0.80) and analgesia (OR = 0.36; 95%CI 0.16;0.78).

In this study, early admission predominate: more than half the women were admitted with up to 4 cm dilation. Research carried out in the same hospital in 2001 found that average cervical dilation at that time was 4.0 cm and 44.4% were nulliparous.[2] Early admission seems to be a feature of care in this institution.

The treatment is conservative in the incidence of MAF in the institution where the study was carried out. The presence of MAF is not the only condition for a caesarean to be selected. Other variables are taken into account when deciding on the method of delivery, such as the progression of the cervical dilation, previous births and foetal vitality. If foetal vitality is maintained and the labour proceeding normally, treatment is to await normal birth. However, a larger proportion of caesareans occur in women with MAF, also verified in a retrospective of 11,226 births which found a rate of caesareans of 13.9% and 9.6% respectively in cases with and without MAF.[4] These findings indicate that the incidence of MAF is associated with worse conditions of foetal vitality, which justifies the greater frequency of surgical intervention in the birth in order to prevent MAS.

Babies weighing less than three kilos had a smaller risk of having MAF. However, low birth weight tends to be associated with placental insufficiency, which favours the incidence of MAF.[11] Newborns with very low birth weight are subject to adverse outcomes, as there is a greater need for resuscitative measures and the risk of developing server intracranial haemorrages in incidence of MAF.

The neonatal death we encountered in this study was lower than that verified in a prospective study carried out in Jordan, in which perinatal mortality in births with clear fluid was 2.0/1,000 live births and increased to 10.0/1,000 in the presence of MAF.[23] This demonstrates the need to closely monitor situations in which the presence of MAF is detected, as this is related to worse neonatal outcomes. Lower Apgar scores in the first minute were correlated with the presence of MAF in delivery in this study.

There were five deaths, four in normal births and one in a caesarean. Of the babies who were born normally and died, two had MAF (one liquid and one thick). These deaths were for various reasons: congenital heart disease, cardiogenic shock and hypoxic-ischemic asphyxia. In the fourth newborn death the mother had given birth before and was admitted during delivery with thick meconium. In the post-caesarean death, the newborn was premature and the caesarean an emergency surgical procedure, with the baby in breech and a rupture of the membranes having occurred a week before. This newborn died of neonatal sepsis. X-ray examinations of the chests of the infants who had meconium provided no confirmation of SAM in any of the deaths of babies with MLA.

The five neonatal deaths had the following causes: perinatal infection (one case), severe asphyxia (two cases), congenital anomaly (one case) and undetermined cause

of death (one case). There were no cases of extreme prematurity. In the two asphyxia cases, death occurred at age two weeks and in the other cases within the infants' first few days.

Asphyxia is a significant cause of death in babies with birth weight > 2,500 g. A retrospective study of a cohort in Belo Horizonte showed that around ¼ of the infants weighed > 2,500 g and intra-partum asphyxia was the main cause of death in this group (34.9%). Around 60% of neonatal deaths were avoidable.[14]

Our study was not designed to verify a correlation between neonatal death and the presence of MAF. The presence of MAF does not unequivocally mean foetal distress, but is a warning sign for those accompanying the mother and foetus. Special attention should be paid to those mothers who receive oxytocin during the labour, as well as those with a prolonged pregnancy, especially those in excess 41 weeks.

The great demand for maternity services favoured the inclusion of a significant number of cases. The fact that the data collection spanned two months may have excluded situations in which the presence of MAF may have significantly influenced perinatal outcomes. Randomised studies are necessary in order to evaluate the treatments in deliveries with MAF, especially in pregnancies of over 41 weeks. Results of MAF cases are a good indicator of the quality of care provided.

The factors associated with MAF were the use of oxytocin, worse newborn conditions after the birth and increased rates of caesareans. Using oxytocin during the delivery may be reviewed due to its association with MAF. High rates of administering this drug in an institution increase the controllable risk of MAF. This study aims to support investigations into the safety of care given to the foetus and the newborn in birthing centres and collaborate with the creation or updating of protocols for managing deliveries when MAF is present.

REFERENCES

1. Balchin I, Whittaker JC, Lamont RF, Steer PJ. Maternal and fetal characteristics associated with meconium-stained amniotic fluid. *Obstet Gynecol.* 2011;117(4):828-35. DOI:10.1097/AOG.0b013e3182117a26
2. Barbosa da Silva FM, Koiffman MD, Osava RH, Junqueira SMVO, Gonzalez Riesco ML. Centro de Parto Normal como estratégia de incentivo del parto normal: estudo descriptivo. *Enferm Glob*. 2008;(14):1-13.
3. Barros AJ, Hirakata VN. Alternatives for logistic regression in cross-sectional studies: an empirical comparison of models that directly estimate the prevalence ratio. *BMC Med Res Methodol.* 2003;3(21):1-13. DOI:10.1186/1471-2281-3-21
4. Becker S, Solomayer E, Dogan C, Wallwiener D, Fehm T. Meconium-stained amniotic fluid - Perinatal outcome and obstetrical management in a low-risk suburban population. *Eur J Obstet Gynecol Reprod Biol.* 2007;132(1):46-50. DOI:10.1016/j.ejogrb.2006.05.032
5. Caughey AB, Musci TJ. Complications of term pregnancies beyond 37 weeks of gestation. *Obstet Gynecol.* 2004;103(1):57-62. DOI:10.1097/01.AOG.0000109216.24211.D4
6. Cheng YW, Nicholson JM, Nakagawa S, Bruckner TA, Washington AE, Caughey AB. Perinatal outcomes in low-risk term pregnancies: do they differ by week of gestation? *Am J Obstet Gynecol.* 2008;199(4):329-31. DOI:10.1016/j.ajog.2008.08.008
7. Dargaville PA, Copnell B, Australian New Zealand Neonatal N. The epidemiology of meconium aspiration syndrome: incidence, risk factors, therapies, and outcome. *Pediatrics*. 2006;117(5):1712-21. DOI:10.1052/peds.2005-2215
8. Fogaça VD, Schneck CA, Riesco MLG. Intervenções obstétricas no trabalho de parto em mulheres submetidas à cesariana. *Cogitare Enferm.* 2007;12(3):296-305.
9. Gelfand SL, Fanaroff JM, Walsh MC. Controversies in the treatment of meconium aspiration syndrome. *Clin Perinatol.* 2004;31(3):445-52. DOI:10.1016/j.clp.2004.03.020
10. Gülmezoglu AM, Crowther CA, Middleton P, Heatley E. Induction of labour for improving birth outcomes for women at or beyond term. *Cochrane Database Syst Rev.* 2012(12): CD004945. DOI:10.1002/14651858.CD004945.pub4
11. Henry JA, Baker RW, Yanowitz TD. The in utero passage of meconium by very low birth weight infants: a marker for adverse outcomes. *J Perinatol.* 2006;26(2):125-9. DOI:10.1038/sj.jp.7211435
12. Hofmeyr GJ. What (not) to do before delivery? Prevention of fetal meconium release and its consequences. *Early Hum Dev.* 2009;85(10):611-5. DOI:10.1016/j.earlhumdev.2009.09.010
13. Howarth G, Botha DJ. Amniotomy plus intravenous oxytocin for induction of labour. *Cochrane Database Syst Rev.* 2001;(3):CD003250. DOI:10.1002/14651858.CD003250.pub3
14. Lansky S, França E, Leal MdC. Mortes perinatais evitáveis em Belo Horizonte, Minas Gerais, Brasil, 1999. *Cad Saude Publica*. 2002;18(5):1389-400. DOI:10.1590/S0102-311X2002000500031
15. Lauzon L, Hodnett ED. Labour assessment programs to delay admission to labour wards. *Cochrane Database Syst Rev.* 2004:(3):CD000936. DOI:10.1002/14651858.CD000936.pub4
16. Maymon E, Chaim W, Furman B, Ghezzi F, Vardi IS, Mazor M. Meconium stained amniotic fluid in very low risk pregnancies at term gestation. *Eur J Obstet Gynecol Reprod Biol.* 1998;80(2):169-73. DOI:10.1016/S0301-2115(98)00122-5
17. Poggi SH, Ghidini A. Pathophysiology of meconium passage into the amniotic fluid. *Early Hum Dev.* 2009;85(10):607-10. DOI: http:10.1016/j.earlhumdev.2009.09.011
18. Simsek A, Celen S, Islimye M, Danisman N, Buyukkagnici U. A long-standing incomprehensible matter of obstetrics: meconium-stained amniotic fluid, a new approach to reason. *Arch Gynecol Obstet.* 2008;278(6):559-63. DOI:10.1007/s00404-008-0627-2
19. Steer P. The epidemiology of preterm labor - a global perspective. *J Perinat Med.* 2005;33(4):273-6. DOI:10.1515/JPM.2005.053
20. Usta IM, Zoorob D, Abu-Musa A, Naassan G, Nassar AH. Obstetric outcome of teenage pregnancies compared with adult pregnancies. *Acta Obstet Gynecol Scand.* 2008;87(2):178-83. DOI:10.1080/00016340701803282
21. van Ierland Y, de Beaufort AJ. Why does meconium cause meconium aspiration syndrome? Current concepts of MAS pathophysiology. *Early Hum Dev.* 2009;85(10):617-20. DOI:10.1016/j.earlhumdev.2009.09.009
22. Zhang X, Kramer MS. Variations in mortality and morbidity by gestational age among infants born at term. *J Pediatr.* 2009;154(3):358-62. DOI:10.1016/j.jpeds.2008.09.013
23. Ziadeh SM, Sunna E. Obstetric and perinatal outcome of pregnancies with term labour and meconium-stained amniotic fluid. *Arch Gynecol Obstet.* 2000;264(2):84-7. DOI:10.1007/s004040000088

The authors declare that there were no conflicts of interest.