Original Article

Determinants of Maternal Near Miss among Women in Northeast Iran: A Facility-Based Case-Control Study

Sedigheh Abdollahpour[1,2], Hamid Heidarian Miri[3], Elham Azmoude[4], Mahsa Pieranj[5], Maryam Kabirian[6]

[1]Ph.D. in Reproductive Health, School of Nursing and Midwifery, Torbat Heydariyeh University of Medical Sciences, [6]Ph.D. Student in Reproductive Health, School of Nursing and Midwifery, Torbat Heydariyeh University of Medical Sciences, Torbat Heydariyeh, [2]Nursing and Midwifery Care Research Center, Mashhad University of Medical Sciences, [3]Ph.D. Social Determinants of Health Research Center, Mashhad University of Medical Sciences, [5]Student Research Committee, Mashhad University of Medical Sciences, Mashhad, [4]Ph.D. Student in Reproductive Health, Department of Midwifery, Healthy Ageing Research Center, Neyshabur University of Medical Sciences, Neyshabur, Iran

Abstract

Background: The investigation of Maternal Near-Miss (MNM) risk factors is important for the global reduction of maternal mortality. This study aimed to identify the determinants of MNM among pregnant women in northeastern Iran. **Materials and Methods:** A prospective case-control study was conducted on 250 women referred to the maternity ward of Nohom-e-Dey hospital in Torbat-e Heydarieh, Iran, from June 2018 to May 2020. Applying the criteria of the World Health Organization tool, near-miss mothers were taken as cases, and mothers with normal obstetric outcomes were selected as controls with convenience sampling. Logistic regression models using Stata version 14.0 and odds ratios (95% confidence intervals) were reported. **Results:** A total of 123 MNM cases and 127 controls were included in the study. The multiple logistic regression represented that having had previous abortion, living in rural or urban areas, whether the mother went through C/S or vaginal delivery and level of prenatal education were associated with MNM. Besides, having experienced chronic medical diseases during pregnancy had the strongest association with MNM, and next were complications during childbirth and neonatal outcomes which were associated with MNM, although in terms of statistical association, only the first two mentioned factors were statistically significant. **Conclusions:** Determinants of MNM could be experiencing chronic medical disorders during maternal complications. Health providers need to carefully manage past medical history and adverse perinatal outcomes, especially in pregnant women who live in rural areas. Encouraging mothers to attend pregnancy training classes is effective in reducing MNM.

Keywords: *Maternal health, maternal health services, maternal morbidity, maternal mortality, public health*

Introduction

According to the perspective of the World Health Organization (WHO), the term "Maternal Near Miss" (MNM), which emerged in the content of maternal health lexicon for the evaluation of the quality of obstetric care,[1] often represents the stage that immediately precedes maternal death.[2,3] Accordingly, since Maternal Mortality (MM) reveals only the tip of the iceberg, research on MNM indicators has become important.[4] Women who experienced and survived a severe acute maternal morbidity are considered as near-miss cases.[5] Near-miss cases can directly show the barriers to prevention of an acute complication, because it shares many characteristics with maternal deaths.[6] Audition of risk factors of MNM allows for the initiation of corrective action to reduce related mortality.[7]

Low- and middle-income countries should develop systematic approaches to improve quality of care in health facilities to reduce experiences of the MNM event and maternal complications drastically.[8,9] The worldwide prevalence of MNM was 18.67/1000 Live Births (LB) in 2019.[8] MNM occurs incoherently in terms of statistics and varies according to the country and its state of development;[8] for example, by continents, the prevalence of MNM ranges from 3.10/1000 in Europe to 31.88/1000 LB in Africa.[8] The MNM incidence ratio, according to the WHO criteria, is about 3/1000 LB in Iran.[10]

MM and MNM have common risk factors. In maternal death cases, it is not possible to collect data from the mother, and near-miss mother is the closest source for investigating the rigorous information and analyzing maternal morbidity determinants.

How to cite this article: Abdollahpour S, Miri HH, Azmoude E, Pieranj M, Kabirian M. Determinants of maternal near miss among women in Northeast Iran: A facility-based case-control study. Iran J Nurs Midwifery Res 2023;28:244-9.

Submitted: 28-Jun-2021. **Revised:** 17-Nov- 2021. **Accepted:** 08-Feb-2023. **Published:** 21-Jun-2023.

Address for correspondence:
Dr. Maryam Kabirian, Ph.D. Student in Reproductive Health, School of Nursing and Midwifery, Torbat Heydariyeh University of Medical Sciences, Torbat Heydariyeh, Iran.
E-mail: kabirianm1@gmail.com

Access this article online

Website: https://journals.lww.com/jnmr

DOI: 10.4103/ijnmr.ijnmr_168_21

Quick Response Code:

Some of the determinants of MNM, hypertension, hemorrhage, and puerperal sepsis are listed;[4,11] for example, in Northern Ethiopia, among histories of chronic maternal medical problems, diseases such as hypertension and diabetes were reported in 55.3% of cases and 33.2% of controls,[12] or in Iran, lower gestational age, lower education level, and going through Cesarean delivery are determinants of MNM.[13] Due to the reason that Iran is a country with high economic disparity, and various levels of quality of care are offered in different provinces, it is difficult to accurately estimate the current MNM situation in different areas. According to the literature review, in the northeast of Iran, no study has determined the MNM risk factors with respect to the WHO criteria. This study aims to identify determinants of MNM among pregnant women in northeastern Iran.

Materials and Methods

A case-control study was conducted in education, research, and reference maternity hospital "Nohom-e-Dey" which is located in Razavi-Khorasan province, Torbat-e Heydarieh, northeastern Iran, between June 2018 and May 2020. This center is responsible for 1500 deliveries per month, is the reference maternity hospital for high-risk pregnancies, and has the only intensive care unit in the province that is staffed with specialists absorbed from other clinical and surgical centers offering obstetrical services. Also, it has teams of obstetricians, anesthesiologists, and neonatologists available on call and is equipped with blood bank, surgical, and neonatal intensive care unit. Case identification was prospective, and data collection was performed simultaneously while the mothers were being referred to the maternity ward for delivery. Applying convenience sampling, data were collected using a structured questionnaire and were administered in person by a midwife through the sociodemographic characteristics form and the 40-item checklist of the Ministry of Health which included variables such as maternity history and chronic medical diseases during pregnancy and information of delivery.

In this study, we entered all mothers who were admitted to the maternity ward and fulfilled the current criteria for MNM according to the WHO approach to maternal morbidity. The first requirement was to be pregnant, irrespective of the pregnancy condition, gestational age, or labor phase. Cases were identified by midwives or obstetricians who observed the mother's condition during her hospitalization in the maternity ward. MNM cases were selected from mothers who met the relevant criteria of the WHO [Table 1]. In other words, mothers who experienced life-threatening conditions were recruited consecutively as the case group, whereas controls were selected through systematic sampling. Controls were selected from mothers who had given low-risk birth or did not experience maternal morbidity. A control was selected for each case given that she had similarities in her medical record with the case in at least one of the following components: parity, age, and mode of delivery. When a case was identified, all eligible mothers of the control group were listed in order for the most-fitting control to be selected for each case. Mothers who came to the hospital aging within the same range as that of the cases and delivered without any complications were enrolled as controls. For each near-miss case, one control that occurred within the same day of the near-miss event was included. The sample size was calculated using Epi Info version 7 software package designed for an unmatched case-control study. This gave a total sample size of 240. The following assumptions were considered to calculate the sample size: power of 80% and confidence level of 95%. By taking a 10% nonresponse rate, the final sample size totaled 250 (case = 123, control = 127).

Table 1: Leading direct causes of MNM* outcomes according to the criteria of the WHO**

Direct causes MNM by condition	MNM (*n*=123) *n* (%)
Potential life-threatening conditions	
Severe postpartum hemorrhage	52 (20.80)
Severe pre-eclampsia	69 (27.60)
Eclampsia	2 (0.80)
Sepsis or severe systemic infection	0 (0.00)
Ruptured uterus	2 (0.80)
Severe complications of abortion	2 (0.80)
Admission to intensive care unit	0 (0.00)
Laparotomy	1 (0.40)
Use of blood products	6 (2.40)
Life-threatening conditions (organ failure)	
Cardiovascular dysfunction	1 (0.40)
Respiratory dysfunction	0 (0.00)
Renal dysfunction	2 (0.80)
Coagulation dysfunction	0
Hepatic dysfunction	0 (0.00)
Neurological dysfunction	1 (0.40)
Uterine dysfunction	0

*MNM: Maternal near miss ** WHO: World Health Organization

After obtaining written consent from mothers, researchers conducted data required for the study through a questionnaire that was developed to collect the mother's personal medical information including sociodemographics, prenatal data, parity, and type of delivery. The questionnaire was based on tools validated by the WHO and on the medical information of mothers referring to the maternity ward, including demographics, perinatal outcomes, pregnancy, childbirth, and infant's condition; the data were previously registered in the Iranian national program of motherhood and documented in patients' medical records.[1] Data were entered into a computer database using SPSS version 21. The statistical analysis was performed using Stata version 14.

Statistical analysis included descriptive measures like mean and standard deviation for continuous variables, and frequency and ratio for qualitative variables. Association

of variables with the MNM was assessed using simple and multiple logistic regression models, and crude and adjusted odds ratios (95% confidence intervals) were reported, respectively. Variables with a *p* value less than 0.25 in simple models were entered in the multiple models. The fitness of the multiple logistic model was assessed using area under the ROC curve. The authors used the Strengthening the Reporting of Observational Studies in Epidemiology statement and revised the paper accordingly.

Ethical considerations

This study was approved by the Ethics Committee in Research of the Torbat Heydarieh University of Medical Sciences (number: IR.THUMS.REC.1397.0017). At the beginning, when participants were completing the questionnaires, the purpose of the study was explained to them and the principle of confidentiality of specifications was observed.

Results

Table 1 shows the distribution of WHO's criteria for MNM in the sample of the study. In Table 2, comparison of MNM cases and controls indicates that the odds of MNM occurrence were 2.81 times in women with one previous abortion, 2.23 times in women who live in rural areas, and 3.22 times in women who went through C/S delivery, compared to the control group.

Table 3 indicates the results of the multiple logistic regression model. Indeed, variables that showed some association (p value less than 0.20) with MNM in univariate analysis [Table 2] were included in this model in respect of the multifactorial outlook toward the etiology of MNM and adjustment for potential confounding. The results show that after adjustment for other variables, one previous abortion, prenatal educational sessions, and mode of delivery are still associated with MNM. To assess the goodness of fit for this model, the probability of MNM was calculated based on the model, and then the ROC analysis showed that the area under the curve was 0.76 with 95% CI (0.70–0.82). This means that the included variables are able to correctly predict the MNM with a probability of 76%.

Table 4 indicates the crude and adjusted association of experiencing chronic medical diseases during pregnancy, complications during childbirth, and neonatal outcomes with MNM.

Table 2: Comparison between Near Miss Mother(NMM) cases and controls in demographic and pregnancy characteristics association of demographic and pregnancy characteristics with Maternal Near Miss (MNM) using univariate logistic regression

Variables	Cases *n* (%)	Controls *n* (%)	Crude OR (95% CI)	*z*-Statistics	*p*
Age (years)					
<20	8 (6.50)	9 (7.09)	Reference*		
20-35	89 (72.36)	102 (80.31)	0.98 (0.36-2.65)	−0.04	0.971
>35	26 (21.14)	16 (12.60)	1.82 (0.58-2.70)	1.04	0.299
Gravidity					
1	38 (30.89)	49 (38.58)	Reference		
2	58 (47.15)	61 (48.03)	1.22 (0.70-2.13)	0.72	0.472
3	27 (21.95)	17 (13.39)	2.04 (0.97-4.29)	1.90	0.058
Previous abortion					
0	96 (78.05)	110 (86.61)	Reference		
1	22 (17.89)	9 (7.09)	2.80 (1.23-6.37)	2.45	0.014
2 and more	5 (4.07)	8 (6.30)	0.71 (0.22-2.26)	−0.57	0.560
Prenatal educational sessions					
0	103 (83.74)	62 (48.82)	Reference		
2	10 (8.13)	25 (19.69)	0.24 (0.10-0.53)	−3.50	*p* <0.001
2-5	9 (7.32)	28 (22.05)	0.19 (0.08-0.43)	−3.95	*p* <0.001
5-8	1 (0.81)	12 (9.45)	0.05 (0.006-0.39)	−2.84	0.004
Previous Stillbirth					
No	119 (96.75)	123 (96.85)	Reference		
Yes	4 (3.25)	4 (3.15)	1.03 (0.25-4.22)	0.05	0.963
Place of residency					
Urban	37 (30.08)	58 (45.67)	Reference		
Rural	86 (69.92)	69 (54.33)	0.51 (0.30-0.86)	−2.52	0.012
Mode of delivery					
Vaginal	86 (71.07)	111 (88.80)	Reference		
Cesarean section	35 (28.93)	14 (11.20)	3.22 (1.63-6.37)	3.37	0.001

*Reference: The variables that are considered as the base and according to this variable, the odds of NMM is occurrence in other variables is estimated

The area under the ROC curve for multiple logistic regression model in Table 4 was 0.74 with 95% CI (0.68–0.80). If the variables of the model in Table 3 are added to this model, the area under the ROC curve would increase up to 0.84 with 95% CI (0.79–0.89). This could be regarded as a sign that the model is acceptably fitted and predictive.

Discussion

This study aims to identify determinants of MNM among pregnant women in northeastern Iran. According to the WHO criteria for MNM, in this study, the major causes of near-miss event were preeclampsia and postpartum hemorrhage, which is consistent with the results of many other articles.[4,13-15]

In this study, having experienced abortion previously, living in rural areas, going through C/S delivery, and lacking sufficient prenatal education were significantly associated with MNMs. This finding is consistent with studies in Ethiopia whose result is related to the level of access to health care and basic education.[16,17] Also, in this study, having experienced chronic medical conditions during pregnancy had the strongest association with MNM. Results of the present study are in line with the results of Mekango's study, which suggests that lack of formal education, history of chronic medical conditions, and C-section are determinants of MNM.[12] Also, according to the results of the present study, chronic hypertension is associated with MNM which is in line with a study in Nigeria,[18] stating that the mother's underlying diseases or the mother's less access to medical facilities evidently increase the risk of maternal complications.

In this study, there was no significant relationship between age and MNM. This may be due to the distribution of risk factors of MNM in both older and younger ages. In this regard, a study in Brazil mentioned that it could be due to the fact that older women acquire chronic diseases and have an increased chance of complications.[19]

Another result of this study showed that complications during childbirth are significantly associated with MNMs. These variables include early rupture of membranes, transfusion of blood products, dystocia during labor, mode of delivery (emergency cesarean section), giving birth to twins, and pregnancy preterm labor (gestational age ≤34 weeks). In similar studies, each variable was examined separately and the classification of related factors was not reported. However, most of these variables were consistent with their results. For example, a study in Iran indicated that preterm birth has the most prominent association with MNM[20] or a study in Brazil stated that Caesarean delivery and hypertension is associated with MNM.[19]

Table 3: Association of demographic and pregnancy characteristics with Maternal Near Miss (MNM) using multiple logistic regression model

Variables	Adjusted OR (95% CI)	*z*-Statistics	*p*
Gravidity			
1	Reference*		
2	0.83 (0.43-1.62)	−0.52	0.602
3	1.11 (0.39-3.13)	0.20	0.843
Previous abortion			
0	Reference		
1	2.83 (1.03-7.77)	2.02	0.044
2 and more	0.38 (0.09-1.62)	−1.29	0.195
Educational sessions for pregnancy			
0	Reference		
2	0.28 (0.12-0.67)	−2.88	0.004
2-5	0.19 (0.08-0.48)	−3.57	<0.001
5-8	0.05 (0.007-0.47)	−2.65	0.008
Address			
Urban	Reference		
Rural	0.62 (0.34-1.14)	−1.51	0.130
Mode of delivery			
Vaginal	Reference		
Cesarean section	2.92 (1.39-6.14)	2.84	0.005

*Reference: The variables that are considered as the base and according to this variable, the odds of NMM is occurrence in other variables is estimated

Table 4: Association of chronic medical disorders during pregnancy, complications during childbirth, and neonatal outcomes with Maternal Near Miss (MNM) using logistic regression

Variables	MNM Mean (SD)	Controls Mean (SD)	Crude OR (95% CI)	*z*-Statistics	*p*	Adjusted OR (95% CI)	*z*-Statistics	*p*
Chronic medical disorders during pregnancy*	0.62 (.64)	0.17 (.45)	4.45 (2.61-7.58)	5.50	<0.001	3.53 (2.05-6.08)	4.57	*p* <0.001
Complications during childbirth**	0.52 (0.70)	0.15 (0.38)	3.30 (1.96-5.56)	4.50	<0.001	2.63 (1.47-4.70)	3.29	0.001
Neonatal outcomes***	1.00 (0.70)	0.77 (0.70)	1.58 (1.10-2.26)	2.52	0.012	1.29 (0.86-1.93)	1.24	0.217

*Chronic hypertension, cardiac disease hypothyroidism, hepatitis B, AIDS, chorioamniontitis, urinary tract infection, gestational diabetes, preeclampsia, eclampsia, and hemoglobin less than 7 at the time of admission, smoking, and drugs in the mother or her partner. **Early rupture of membranes, transfusion of blood products, dystocia during labor, mode of delivery (emergency cesarean section), twins, and pregnancy preterm labor (gestational age=less than 34 weeks or more than). ***Gender of the baby, fetal presentation, first minute Apgar score, infant CPR, neonatal outcome (with the mother or transfer to another ward), birth injuries, abnormalities, and skin contact (less than or more than 15 min)

However, neonatal outcomes were not significantly associated with MNM. Previous similar studies have also found no statistically significant association between neonatal outcomes and MNM.[21] As shown in Table 4, after adjustment, the association of complications during childbirth (OR: 2.63) and chronic medical disorders during pregnancy (OR: 3.53) with MNM remained significant and the association of neonatal outcomes was no longer significant. This could have happened because there is a time lag between these variables from chronic medical diseases during pregnancy to complications during childbirth and then neonatal outcomes. In such situations, former variables act as confounders for the effect of latter variables and latter variables act as intermediates for the effect of former ones. Overall, adjustment on a confounder with the same direction of association with both the risk factor and the outcome, like this situation, pulls the measure of effect toward the null. The same is true in adjustment on an intermediate. This is why the adjusted OR of all three variables in Table 4 is reduced in comparison to their crude ones. In other words, neonatal outcomes can be the result of longer outcomes that are closely related to MNM.

One of the strengths of this study is that the prospective sampling helped with overcoming the rare nature of MNM. Second, in this study, many variables such as neonatal outcomes were collected that were not addressed in previous studies. Third, the diagnostic criteria for MNM cases were selected according to the definition of the WHO of this event. The only limitation of this study was that it was not possible to run the study in multiple hospitals as a multicenter study.

Conclusion

Women with prior history of chronic medical diseases and complications during pregnancy and childbirth have shown vulnerability to develop MNM. Encouraging mothers to attend pregnancy training classes and preparing for childbirth is effective in reducing MNM. Thus, increasing the quality of services in rural areas to prevent delays in midwifery emergencies should be on the agenda of policy makers. Interventions aimed at improving access to medical care for pregnant women, especially those living in rural areas, are extremely important. Healthcare providers need to carefully plan and manage women while taking their adverse medical history into account. MNM is clearly associated with the quality of care provided for high-risk pregnancy cases. Therefore, in order to improve the quality of care, and consequently avert adverse maternal and perinatal outcomes, analyzing relevant data in a more frequent and consistent manner with special attention to previous adverse events is suggested.

Acknowledgments

Researchers would like to express their thanks to the personnel working in postpartum ward and women for their willingness to participate in this study (ID = A101302-3). This study was approved by the Ethics Committee in Research of the Torbat Heydarieh University of Medical Sciences (number: IR.THUMS.REC.1397.0017).

Financial support and sponsorship

Torbat Heydarieh University of Medical Sciences, Iran

Conflicts of interest

Nothing to declare.

References

1. WHO. Evaluating the quality of care for severe pregnancy complications: The WHO near-miss approach for maternal health. 2011. Available from: https://www.who.int/publicationsdetail-redirect/9789241502221. [Last accessed on 2011 Mar 25].
2. Abdollahpour S, Heydari A, Ebrahimipour H, Faridhosseini F, Khadivzadeh T. The needs of women who have experienced "Maternal Near Miss": A systematic review of literature. Iran J Nurs Midwifery Res 2019;24:417-27.
3. Souza JP, Cecatti JG, Parpinelli MA, Krupa F, Osis MJ. An emerging "maternal near-miss syndrome": Narratives of women who almost died during pregnancy and childbirth. Birth (Berkeley, Calif) 2009;36:149-58.
4. Iwuh I, Fawcus S, Schoeman L. Maternal near-miss audit in the Metro West maternity service, Cape Town, South Africa: A retrospective observational study. S Afr Med J 2018;108:171-5.
5. Say L, Souza JP, Pattinson RC. Maternal near miss–towards a standard tool for monitoring quality of maternal health care. Best Pract Res Clin Obstet Gynaecol 2009;23:287-96.
6. Pattinson RC, Buchmann E, Mantel G, Schoon M, Rees H. Can enquiries into severe acute maternal morbidity act as a surrogate for maternal death enquiries? BJOG 2003;110:889-93.
7. Fouly H, Abdou FA, Abbas AM, Omar AM. Audit for quality of care and fate of maternal critical cases at Women's Health Hospital. Appl Nurs Res 2018;39:175-81.
8. Abdollahpour S, Heidarian Miri H, Khadivzadeh T. The global prevalence of maternal near miss: A systematic review and meta-analysis. Health Promot Perspect 2019;9:255-62.
9. Abdollahpour S, Heidarian Miri H, Khademol Khamse F, Khadivzadeh T. The relationship between global gender equality with maternal and neonatal health indicators: An ecological study. J Matern Fetal Neonatal Med 2022;35:1093-9.
10. Abdollahpour S, Miri HH, Khadivzadeh T. The maternal near miss incidence ratio with WHO approach in Iran: A systematic review and meta-analysis. Iran J Nurs Midwifery Res 2019;24:159-66.
11. de Lima THB, Amorim MM, Kassar SB, Katz L. Maternal near miss determinants at a maternity hospital for high-risk pregnancy in northeastern Brazil: A prospective study. BMC Pregnancy Childbirth 2019;19:271.
12. Mekango DE, Alemayehu M, Gebregergs GB, Medhanyie AA, Goba G. Determinants of maternal near miss among women in public hospital maternity wards in Northern Ethiopia: A facility based case-control study. PLoS One 2017;12:e0183886.
13. Hashemi SN, Afshari P, Javadnoori M, Saki Malehi A. Prevalence and related factors of maternal severe complications "Maternal Near Miss" in Ahvaz, 2016. Iran J Obstet Gynecol Infertil 2020;23:78-87.
14. Jayaratnam S, Burton A, Connan KF, de Costa C. Maternal "near

miss’ at Royal Darwin Hospital: An analysis of severe maternal morbidity at an Australian regional tertiary maternity unit. Aust N Z J Obstetr Gynaecol 2016;56:381-6.

15. Karimzaei T, Zareban I, Jamalzae AQ, Darban F, Bakhshani KD, Balouchi A. Frequency of maternal mortality in urban and rural areas of iranshahr county (Southeast of Iran) in 2009-2013: A retrospective study. J Clin Diagn Res 2016;10:QC14-7.
16. Liyew EF, Yalew AW, Afework MF, Essén B. Distant and proximate factors associated with maternal near-miss: A nested case-control study in selected public hospitals of Addis Ababa, Ethiopia. BMC Womens Health 2018;18:28.
17. Turi E, Fekadu G, Taye B, Kejela G, Desalegn M, Mosisa G *et al*. The impact of Antenatal care on maternal near-miss events in Ethiopia: A systematic review and meta-analysis. Int J Afr Nurs Sci 2020;13:100246.
18. Adeoye IA, Onayade AA, Fatusi AO. Incidence, determinants and perinatal outcomes of near miss maternal morbidity in Ile-Ife Nigeria: A prospective case control study. BMC Pregnancy Childbirth 2013;13:93.
19. Galvão LPL, Alvim-Pereira F, de Mendonça CMM, Menezes FEF, do Nascimento Góis KA, Ribeiro Jr RF, *et al*. The prevalence of severe maternal morbidity and near miss and associated factors in Sergipe, Northeast Brazil. BMC Pregnancy Childbirth 2014;14:25.
20. Mohammadi S, Essén B, Fallahian M, Taheripanah R, Saleh Gargari S, Källestål C. Maternal near-miss at university hospitals with cesarean overuse: An incident case-control study. Acta obstetricia et gynecologica Scandinavica 2016;95:777-86.
21. Oliveira LC, Costa AARd. Fetal and neonatal deaths among cases of maternal near miss. Rev Assoc Méd Bras 2013;59:487-94.