Delays associated with maternal near-miss cases admitted in Women's Health Hospital, Assiut University

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Introduction
Maternal near-miss (MNM) is recognized as a new concept and has emerged as an adjunct to investigation of maternal deaths as the two represent similar pathways. A conceptual model that had helped us to explain the underlying preventable causes of MNM by examining three phases of delay on maternal healthcare utilization was developed by Thaddeus and Maine. By identifying and reducing the three delays, we will have the greatest impact in reducing MNM and hence maternal deaths.

Aim
The aim of this study was to describe the extent, main types, and contributed factors for three delays in care associated with MNM among women admitted in Women's Health Hospital, Assiut University, Egypt.

Methods
A prospective case–control study was conducted over a period of 1 year from 1 May 2014 to 30 April 2015 at Women's Health Hospital, Assiut University; 342 MNM women and 684 age-matched control women were included in the study. The criteria we used for the identification of MNM were generally based on the presence of different levels of organ dysfunction, which have been identified as recommended by WHO. Data were collected through two approaches: record review and direct interview before discharge. Delays experienced by the study population were collected according to the three-delay model of Thaddeus and Maine.

Results
A high proportion of the MNM group had experienced delay irrespective of the type, with statically significant differences from their controls. Nearly 50% of near-miss cases were more likely to have experienced two or more types of delays compared with 7.7% of controls. Financial problems, fear of being maltreated in hospitals, lack of awareness about signs of obstetric complications, lack of participation in decision making, lack of antenatal care, negative attitude of healthcare worker, and lack of blood availability were associated with delays among MNM cases compared with controls. Having experienced third delay within the intermediate facilities (referral status) was the highest significant predictor that contributed to MNM by delay types.

Conclusion and recommendations
Third delay experienced by the women within the intermediate facilities (referral status) was the most prevalent delay among studied women. Reformation of healthcare system on multiple levels and improvement of the socioeconomic status of women are necessary in Upper Egypt to overcome causes of delay among MNM cases.

Keywords:
maternal delays, three delays, maternal near-miss, severe maternal morbidity, pregnancy complications, WHO

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Introduction

Pregnancy and childbirth remain serious life-threatening events. Over 1000 women still die from pregnancy-related complications everyday around the world and the vast majority of these deaths occur in developing countries [1]. Maternal health policies need to be concerned not only with averting the loss of life but also with ameliorating care of severe maternal complications at all levels, including primary care [2].

Maternal near-miss (MNM) is recognized as a new concept that has emerged as an adjunct to investigation of maternal deaths leading to severe maternal outcome. The WHO published MNM criteria based on markers of clinical, management, and organ dysfunction, which would enable identification and systematic data collection on near-miss [3]. MNM case is defined as 'a woman who nearly died but survived a complication

that occurred during pregnancy, childbirth, or within 42 days of termination of pregnancy' [4].

Being still alive and with higher numbers compared with maternal deaths, MNM cases can directly provide information on maternal healthcare problems anWd obstacles at all levels [5]. The MNM are characterized not only by the near-loss of a woman's life but also frequently by the loss of the newborn and by further significant disruptions in the women's lives [6].

Overall, 80% of MNM cases are preventable [7]. Thaddeus and Maine developed a conceptual model that explains the underlying preventable causes of MNM. It is a useful framework examining the relation of the three phases of delay and maternal healthcare utilization, which helps to understand the gaps in access to adequate management of obstetric care [8].

The three different levels of delays are as follows: (i) delay in deciding to seek care, (ii) delay in reaching an appropriate health facility, and (iii) delay in receiving quality obstetric care at the health facility. There are many factors that can contribute to each delay [9]. The first two delays are related directly to factors in the family and community, whereas the third delay is connected with factors related to health facility and quality of care [10]. In practical meaning, MNM cases could be further classified into two forms according to the presence of life-threatening criteria at admission that could suggest first or second delay, and the other form, which is developing after admission, mostly related to the third delay [11]. The third delay is the area that many planners feel is easiest to correct, as once a woman has actually reached an appropriate facility, many of the economic and sociocultural barriers have already been overcome.

By identifying and reducing the three delays, especially the third delay, we will have the greatest impact in reducing MNM and deaths [12].

Taking into account the scarcity of published papers dealing with MNM cases in Egypt and specifically in Upper Egypt, this study is important in providing relevant information to policy makers and health system planners to improve obstetric care services offered at Women's Health Hospital through better identification of the three delays and the associated surrounding circumstances.

Aim

The present study aimed to describe the extent of the three types of delays and the distribution of the factors responsible for them in obstetric care among women admitted in Women's Health Hospital, Assiut University, Egypt.

Patients and methods

Study area

The present study was conducted in Women's Health Hospital.

Study design

The study design was a prospective case–control one.

Sampling methodology

The study included all near-miss cases admitted in Women's Health Hospital.

Study population

Two groups of women were recruited, cases and controls. The MNM case, defined as any woman who was admitted in Women's Health Hospital throughout a studied year and developed complications that fit the WHO criteria for MNM identification during her pregnancy, delivery, or within 42 days after delivery, was eligible to be included in the study; eligibility was not restricted by gestational age at which complications occur. On the other hand, the controls were defined as women who were admitted in the hospital during pregnancy, delivery, or during the 42 days after delivery and with the same age group as the near-misses, but did not meet any of the WHO near-miss criteria. For every near-miss case, two controls were selected within a defined time limit of 48 h around the near-miss case was identified. The total sample comprised 342 cases and 684 controls.

Data collection

Two forms of data collection tools were used: a checklist and a structured questionnaire. The questionnaire was completed through direct personal interviews and included data on sociodemographic characteristics, antenatal care visits, delay types, and contributed factors according to the three-delay model for those studied women who encountered delays. Fieldwork took place during the period from 1 May 2014 to 30 April 2015 after conducting a pilot study.

For the purpose of this study, we defined delays according to the three-delay model [13]; delay can occur at three different levels, which was adapted as follows:

(1) First delay: delay at home before deciding to go to the first health facility was defined as the number of hours between the onset of labor or complication and the decision to go to the first health facility
   (a) Accepted time is usually set not more than 24 h [14]
(2) Second delay: delay in reaching the first health facility was defined as the number of hours between leaving home and reaching the first health facility
   (a) Accepted time is set not more than 60 min [15,16]
(3) Third delay: delay within the health system was divided into two phases:
   (a) The first phase (referral status) corresponded to the period between arrival at the first health facility and arrival at the current studied hospital
      (i) Accepted time spent between arrival and the first examination is usually set not more than 60 min for audit purpose [17]
   (b) The second phase corresponded to the time spent between arrival at the final current studied hospital and the first examination, followed by the time spent between the first examination and receiving the first care
      (i) Accepted time spent between examination and receiving first care is usually set not more than 30 min for audit purpose [14,16].

Information on the first and second delays was obtained by interviewing the studied women or her close relatives, whereas information on the third delay was taken from the interviews and associated referral sheet if it was available with the medical records of the studied women.

The delay in referral from various health facilities and multiple referrals were included in the third delay within intermediate health facilities [14].

Ethical considerations

Formal administrative approvals were taken before the start of the study from the Ethical Review Committee at Faculty of Medicine, Assiut University, and from the director of the Women's Health Hospital. Informed consent was taken from the participants and privacy and confidentiality of data were assured.

Statistical analysis

The data were analyzed using SPSS, version 19 (IBM stastical sotware, USA). Descriptive statistics were calculated. Thereafter, cross tabulations and the χ^2-test were performed for categorical data. Two independent samples *t*-test was used for numerical data not normally distributed. To identify the correlates of MNM cases by the three delays types, binary logistic regression was conducted. The 0.05 level was chosen as the level of significance and 95% confidence interval (CI).

Results

During the study period from 1 May 2014 to 31 April 2015, there were 17 503 deliveries, 16 972 live births, 342 MNM cases, and 47 maternal deaths. The prevalence of near-misses was almost 19% of all deliveries. Almost four (83%) of five MNM women met the WHO MNM criteria at the time of admission.

Table 1 demonstrates the sociodemographic characteristics of the 1026 women who were enrolled in the study; 342 were near-miss cases and 684 were controls. The mean age was 28.46 ± 7.704 years for the near-miss cases and 28.30 ± 7.593 years for the controls, with no statistically significant difference.

The χ^2-test of association shows that the near-miss group was statistically significantly different from the control group in terms of residence (55.0% of near-miss group comprised rural residents vs. 48% of the control group, $P < 0.05$), living arrangement (28.1% of near-miss cases were living without their husbands vs. 10.5% of the controls, $P = 0.000$), women's education (23.7% of the near-miss cases were illiterate vs. 14% of the controls, $P = 0.000$), and their husbands' education (15.5% of the near-miss group were illiterate vs. 9.4% of the control group, $P = 0.000$).

Figure 1 summarizes the distribution of the sample by the governorates. MNM cases were living in seven governorates in Upper Egypt. About half of the MNM cases were from Assiut governorate (47.1%; $n = 160$) compared with the majority of the control sample (94.2%; $n = 644$). In all, 22% of the MNM cases (21.9%; $n = 75$) were from Qena governorate compared with 0.1% ($n = 1$) of the controls. Other governorates' distribution for MNM cases and their controls were included: Sohag (12%; $n = 41$ vs. 5.6%; $n = 38$, respectively) and Luxor (9.6%; $n = 34$ vs. 0.1%; $n = 1$, respectively). The Red sea, Aswan, and Menya governorates represent the least numbers of MNM cases (6.1%; $n = 21$, 2.6%; $n = 9$ and 1.2%; $n = 4$, respectively) versus none of the controls.

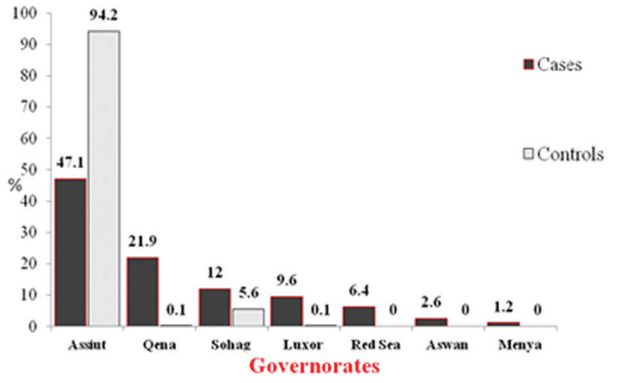
Data on delays experienced by the study participants were collected according to the three-delay model (Table 2).

Table 1 Sociodemographic characteristics of the study population admitted in Women's Health Hospital, Assiut University Hospitals, 2014-2015

Sociodemographic characteristics	Cases (*n*=342) (*n* (%))	Controls (*n*=684) (*n* (%))	*P*
Woman's age (years)			
<20	57 (16.7)	114 (16.7)	1.000
20<25	70 (20.5)	140 (20.5)	
25<35	135 (39.5)	270 (39.5)	
35+	80 (23.4)	160 (23.4)	
Mean±SD	28.46±7.704	28.30±7.593	0.809*
Age at marriage (years)			
Mean±SD	20.74±4.464	20.42±3.792	0.925*
Residence			
Rural	188 (55.0)	328 (48.0)	0.034
Urban	154 (45.0)	356 (52.0)	
Working status in the last 12 months			
Yes (working for cash)	147 (25.7)	161 (23.5)	0.440
No	254 (74.3)	523 (76.5)	
Family type			
Nuclear	226 (66.1)	421 (61.5)	0.088
Extended	116 (33.9)	263 (38.5)	
Living arrangement			
Living with her husband	246 (71. 9)	612 (89.5)	0.000
Living without her husband[a]	96 (28.1)	72 (10.5)	
Her husband's age (years)			
<30	69 (20.2)	171 (25.0)	0.127
30<40	145 (42.4)	252 (36.8)	
40+	128 (37.4)	261 (38.2)	
Mean±SD	36.98±8.69	36.66±8.48	0.541
Her education			
Illiterate	81 (23.7)	96 (14.0)	0.000
Read and write	28 (8.2)	24 (3.5)	
Basic	97 (28.4)	68 (9.9)	
Secondary	93 (27.2)	331 (48.4)	
Above secondary	43 (12.6)	165 (24.1)	
Her husband's education			
Illiterate	53 (15.5)	64 (9.4)	0.000
Read and write	14 (4.1)	19 (2.8)	
Basic	69 (20.2)	78 (11.4)	
Secondary	133 (38.9)	325 (47.5)	
Above secondary	73 (21.3)	198 (28.9)	

The χ^2-test was used with categorical variables. [a]Either separated, divorced, husband departed to another country, or husband lives with another wife. *Two Independent sample *t*-test (Mann-Whitney).

Figure 1



Distribution of the studied population according to their governorates, Women's Health Hospital, Assiut University Hospitals, 2014–2015.

As regards the first delay, women in the near-miss group who had not decided to go to the first place of care within 24 h of the start of labor or complication represented 48.5% (n = 166) compared with 23.2% (n = 159) of their controls (P = 0.000).

As regards the second delay, more than half of the women in the near-miss group took equal or longer than 1 h before reaching the first place of care compared with less than quarter of controls (55.3%; n = 189 vs. 22.8%; n = 156, respectively, P = 0.000).

As regards studied women who had experienced a third delay within the intermediate facilities (referral status), the mean time between making the first contact with health service at the first place of care and

Table 2 Types and characteristics of delays among studied women admitted in Women's Health Hospital, Assiut University Hospitals, 2014–2015

Types and characteristics of delays	Cases (*n*=342) (*n* (%))	Controls (*n*=684) (*n* (%))	*P*
Had experienced a first delay			
Within 24 h	176 (51.5)	525 (76.8)	
≥24 h	166 (48.5)	159 (23.2)	0.000
Mean±SD (min)	5.16±2.35	2.20±0.52	0.000
Had experienced a second delay			
<60 min	153 (44.7)	528 (77.2)	0.000
≥60 min	189 (55.3)	156 (22.8)	
Mean±SD (min)	135.16±120.35	42.20±30.52	0.000
Had experienced a third delay			
The experiences of women with the intermediate facilities (referral status)[a]			
Time			
Within 1 day	42 (16.8)	42 (44.2)	0.000
>1 day	208 (83.2)	53 (55.8)	
Mean±SD (days)	3.51±2.03	1.72±0.75	0.000
Range	1-10	1-4	
Late referral (delay in referral time after the healthcare provider decides)			
≥30 min	152 (60.8)	42 (25.3)	0.017
<30 min	98 (39.2)	53 (74.7)	
Mean±SD (min)	47.33±16.1	27.1±11.2	0.000
More than one referrals			
Yes	154 (61.6)	2 (2.1)	0.000
No	96 (38.4)	93 (97.9)	
Care after the woman was recruited at Women's Health Hospital			
Time spent between arrival and first examination			
<30 min	327 (95.6)	414 (60.5)	0.000
≥30 min	15 (4.4)	270 (39.5)	
Mean±SD (min)	14.04±12.2	46.58±27.4	0.000
Time spent between examination and receiving first care intervention			
<30 min	270 (78.9)	160 (23.4)	0.000
≥30 min	72 (21.1)	524 (76.6)	
Mean±SD (min)	7.23±5.1	19±13	0.000

[a]*n*, from referral cases only 250 cases and 95 controls.

arrival at Women's Health Hospital for women with near-miss was 3.51 ± 2.03 days and for the controls it was 1.72 ± 0.75 days with statistically significance differences. Late referral was recorded in both study groups, whereas it was much higher among referred MNM cases compared with controls (60.8%; *n* = 152 vs. 25.3%; *n* = 42, *P* = 0.017). Moreover, nearly two-thirds of the referred near-miss cases (61.6%; *n* = 154) encountered a third delay with many referrals compared with 2.1% (*n* = 2) of the referred controls.

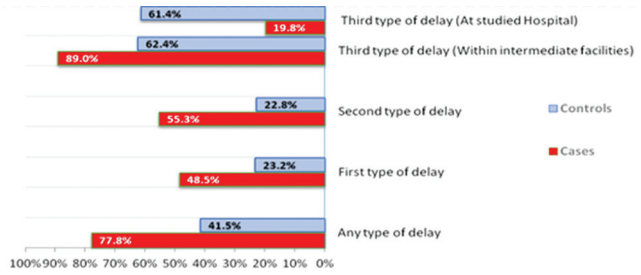
Concerning the third delay, which was experienced by the studied sample at Women's Health Hospital, it was observed that the mean time spent between arrival and the first examination for the near-miss group was 14.04 ± 12.22 min and that for the controls was 46.58 ± 27.4 min. Moreover, a lower proportion of women in the near-miss group received first care at the study hospital after more than 30 min compared with the controls (21.1%; *n* = 71 vs. 76.6%; *n* = 542, *P* = 0.000).

Analysis of the types of the three delays related to MNM showed that nearly four-fifths of MNM cases (77.8%; *n* = 266) compared with two-fifths of their controls (41.5%; *n* = 283) experienced a delay irrespective of its type (Fig. 2).

Third delay within intermediate facilities was found to be the most frequent delay in both groups (89% of cases; *n* = 304 vs. 62.4% of controls; *n* = 426), followed by the second delay (55.3% of cases; *n* = 189 vs. 22.8% of controls; *n* = 156), whereas the least frequent one among MNM cases was the first delay (84.5% of cases; *n* = 166 vs. 23.2% of controls; *n* = 159).

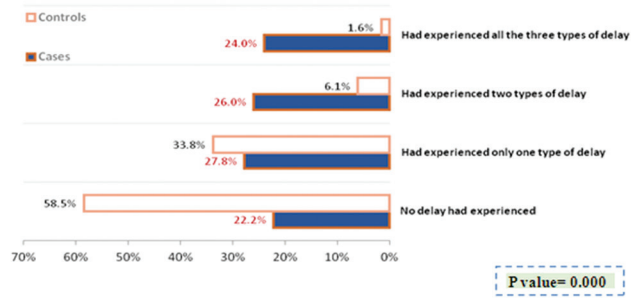
Among the studied women admitted in hospital, Fig. 3 shows that the near-miss group was significantly different from the control group as regards the number of experienced delays. Near-miss cases were more likely to experience two or more types of delay compared with controls (50%; *n* = 171 vs. 7.7%; *n* = 52, respectively,

Figure 2



Type of delays experienced by studied women admitted in Women's Health Hospital, Assiut University Hospitals, 2014–2015.

Figure 3



Number of delays experienced by studied women admitted in Women's Health Hospital, Assiut University Hospitals, 2014–2015.

P = 0.000). However, the controls encountering only one type of delay whatever it was were more frequent compared with the near-miss cases.

Table 3 reveals the responsible factors of the encountered three delays associated with MNM. The main factors related to the first delay were lack of financial resources to pay for medical expenses (68.7% for cases vs. 56.6% for controls), fear of being maltreated in the health facility (68.1% for cases vs. 56.6% for controls), inability to recognize danger signs for obstetric complications (60.2% for cases vs. 26.4% for controls), lack of participation in the decision-making process (57.8% for cases vs. 24.5% for controls), antenatal care less than four visits (54.8% for cases vs. 31.3% for controls), no available person to take care of the children, and or the home and livestock (54.2% for cases vs. 27.0% for controls), inadequate birth preparedness (53.6% for cases vs. 24.5% for controls), and lack of companion in going to the health facility (53.6% for cases vs. 22% for controls). With regard to the second delay in access to obstetric care, the lack of financial resources to pay for cost of transportation and the difficulty in finding transportation were the two factors reported by both the case and control groups without statically significant differences. However, negative attitude of the healthcare workers (72.1% of cases compared with 36.4% of controls), lack of blood at health facility (70.0% of cases compared with 22.7% of controls), and delay in surgical intervention (69.6% of cases compared with 85.2% of controls) were the most frequently reported factors related to the third delays by MNM cases versus controls with a statically significant difference.

Figure 4 illustrates the referral status to Women's Health Hospital reported by study participants, 342 near-miss cases and 684 controls. A total of 72% (n = 250) of cases versus 28% (n = 95) of controls were referred to the studied hospital from other health facilities. The study noted that unavailable ICU was the most frequently repeated cause by referred near-miss cases (70%; n = 175) compared with few number of referred controls (11%; n = 10). However, nearly one-third of MNM cases and one-fourth of controls answered that they do not know why they were referred (30%; n = 75 vs. 23%; n = 21, respectively).

As shown in Table 4, all three types of delays were significant correlates of MNM cases. However, women who experience delay in the referral from the intermediate facilities to Women's Health Hospital were six times more likely to have MNM condition compared with women who did not [odds ratio (OR)=6.19, 95% CI = 2.88–10.35], followed by those with first delay (OR = 3.43, 95% CI = 1.54–7.52) and those with second delay (OR = 2.51, 95% CI = 1.11–5.68).

Discussion

Reviewing of MNM cases provides significant information about women's delays in obstetric care [5]. Discussion of the results of the three-delay model provides insight for program approaches to improve access to care and care-seeking practices [18].

The occurrence of delays irrespective of the type and number was apparent in nearly 80% of MNM cases compared with 41.5% of the controls (Fig. 2), and this is similar to the findings of Okusanya *et al.* [19], which revealed that 78% of life-threatened mothers had one or more types of delays.

Moreover, nearly half of the MNM cases suffered from multiple delays versus 7.7% of controls (Fig. 3). Another hospital-based study on maternal mortality in Menya, Egypt, revealed a similar picture, wherein all maternal deaths had multiple delays [9]. Shah *et al.* [20] also observed multiple delays in two-thirds of life-threatened mothers.

Third delay within intermediate facilities (delay within the referral system) was the most frequent type

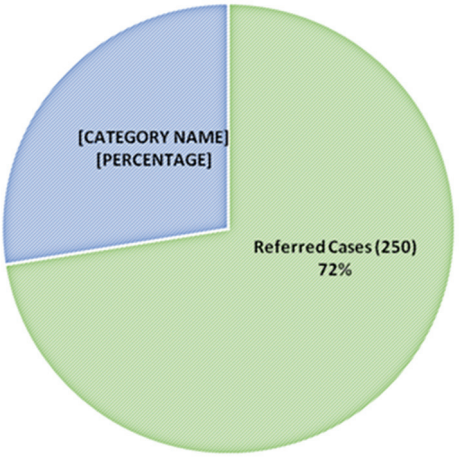
Table 3 The associated factors responsible for the 'three delays' among women admitted in Women's Health Hospital, Assiut University Hospitals, 2014-2015

Factors associated with delaysa	Cases (*n* (%))	Controls (*n* (%))	*P*
First delay			
Financial problem/inability to pay for medical expenses	114 (68.7)	90 (56.6)	0.024
Fear of being maltreated in the health facility	113 (68.1)	90 (56.6)	0.033
Lack of awareness about danger signs of obstetric complications	100 (60.2)	42 (26.4)	0.000
Lack of participation in the decision-making process to go to a health facility	96 (57.8)	36 (24.5)	0.000
Belief in alternative care (relying on traditional healers or natural remedies)	94 (56.6)	92 (57.9)	0.822
Noncompliance for antenatal care (less than four visits)	91 (54.8)	49 (31.1)	0.041
No available person to take care of the children, and or the home and livestock	90 (54.2)	43 (27.0)	0.002
Inadequate birth preparedness	89 (53.6)	63 (39.6)	0.083
Lack of companion in going to the health facility	89 (53.6)	35 (22.0)	0.000
Thinking no need for seeking care	75 (45.2)	53 (33.3)	0.059
Refusal of treatment for an unwanted pregnancy	70 (42.2)	86 (42.8)	0.913
Reluctance from her or her family due to cultural constraints[b]	25 (15.1)	27 (16.9)	0.933
Lack of awareness of existing services	16 (9.6)	22 (13.8)	0.092
Total	166	159	
Second delay			
Inability to pay for cost of transportation	116 (61.1)	97 (62.2)	0.830
Difficulty in finding transportation	94 (49.5)	79 (50.6)	0.829
Total	189	156	
Third delay			
Negative attitude of healthcare workers	173 (72.1)	32 (36.4)	0.000
Lack of blood availability at health facility	168 (70.0)	20 (22.7)	0.000
Delay in surgical intervention (delay in investigations, delay in anesthetist response, and operating room busy)	167 (69.6)	75 (85.2)	0.034
Lack of appropriate treatment	114 (47.5)	44 (50.0)	0.103
Unavailability of healthcare personnel	113 (47.0)	56 (63.6)	0.072
Total	240	88	

[a]Results are not mutually exclusive; some respondents reported more than one delay. [b]Lack of community support, preferences for privacy, modesty, and female attendants.

associated with almost all MNM women (89%) and their controls (62.4%). Similar results were obtained from other studies in Egypt [9] and in Ethiopia [21], wherein 79 and 88% of the maternal deaths, respectively, could be attributed to third delay.

Figure 4



Referral status by study participants, Women's Health Hospital, Assiut University Hospitals, 2014–2015.

The high percentage of referrals could be attributed to unavailable ICU, which was the most frequently reported cause of referral by 70% of MNM cases compared with 11% of their controls. A shortage of ICU beds leading to women taken care of without admission to ICU may also contribute to a high proportion of severe maternal outcomes (Jabir *et al.*, 2013) [22]. The high proportion of referred cases highlighted the necessity of improving referral system techniques between the primary maternity facilities in the governorate and the tertiary ones. This could be achieved by improving communication tools between the healthcare providers in the area, implementation of standard protocols, application of the auditing standards, improved reporting of the incidents, and increased number of staff serving in the hospital.

In addition, possible limitations in the referral system result in a very high proportion of women presenting in a severe health condition. In the present study, women who experienced delay in referral from an intermediate facility to the Women Health Hospital had a six-fold risk (OR = 6. 19) of experiencing MNM compared with women who did not experience delay in referral. Similar results (OR = 3.84) were reported in the study by Adeoye *et al.* [23]. This delay in referral can be attributed to the negative attitude of healthcare providers as perceived by the study participants. Another study that was conducted in Upper Egypt highlighted that substandard care in the form of lack of agreed protocols in different settings and poor communications inside and between hospitals were the most frequent reasons for the third delay [9].

This is in contrast to other studies in which delay in seeking care was the most frequently reported delay, such as the studies conducted in Egypt [9],

Table 4 Logistic regression analysis of the determinants of maternal near-miss cases by the three types of delays, Women's Health Hospital, Assiut University Hospitals, 2014-2015

Variables	Adjusted OR	*P*	95% CI	
			Lower	Upper
Had experienced a first delay (Ref.=no)				
Yes	3.43	0.003	1.54	7.52
Had experienced a second delay (Ref.=no)				
Yes	2.51	0.028	1.11	5.68
Had experienced a third delay within the intermediate facilities (referral status) (Ref.=no)				
Yes	6.19	0.004	2.88	10.35
Had experienced a third delay at Women's Health Hospital (Ref.=no)				
Yes	0.031	0.000	0.13	0.78
Constant	**1.49**	**0.024**		

CI, confidence interval; OR, odds ratio.

Pakistan [20], Mozambique [2], and Nigeria [19] among maternal life-threatened cases (71, 71, 63.8, and 57%, respectively). The results of the current study showed that first delay was the least frequent type among the three types of delays (48.5% of cases and 23.2% of controls). Moreover, this figure is extremely high when compared with 14.5% in Brazil [24] and 28% in Liberia (Lori and Starke, 2012) [25].

In agreement with the results of a study conducted in Morocco [14], this study showed that women who took more than 24 h (first delay) to reach the first facility were 3.5 times (OR = 3.43) more likely to experience MNM (Table 4).

There are a number of factors affecting whether or not a woman will seek, reach, and receive care during an obstetric emergency [18]. In the current study, financial problems, fear of being maltreated in hospitals, lack of awareness about signs of obstetric problems, and lack of participation in decision making were the main factors that forced women to wait instead of going to the hospital with notable significant differences between cases and controls ($P < 0.05$). In agreement with other studies [2,9,20], living conditions and culture factors are the common factors responsible for first delay associated with MNM morbidity. USAID [18] stated that lack of knowledge of women about dangerous signs of pregnancy and lack of access to information as well are prevalent among less-educated women, and as seen in Table 1 nearly one-fourth of the near-miss women (23.7%) were illiterate.

On the basis of our second delay result, 55.3% of MNM women and 22.8% of controls noted that it took them more than 60 min to reach the first facility. The prevalence of second delay in the current study is considered high if compared with other studies; 21.3% in Mozambique [2] and 40% in Upper Egypt [9]. However, some studies observed that second delay was the most prevalent delay; 75 and 65% in the study by Shah *et al.* [20] and Hirose *et al.* [15], respectively. Second delay was mostly emphasizing the importance of distance, availability of transportations, and lack of money for transportation [2].

As shown in Fig. 4, there were 72% of MNM cases versus 28% of controls who had been referred from different health facilities in Upper Egypt governorates. Only 47% of MNM cases came from Assiut governorate (Fig. 1), whereas the rest of the cases were referred from other governorates where it can take up to at least 2–3 h to reach the studied hospital. This could have been responsible for some mothers experiencing MNM [20].

In addition to late referral from the different health facilities, the mean referral time for the MNM women after the healthcare provider decided was 47 versus 27 min for controls (Table 2). Multiple referrals were also a significant item in some cases that were referred to current hospital after having been to a number of different hospitals, either private or general. This finding is in agreement with other studies [9,14,20]. Evidently, strengthening the referral system must be addressed in the context of low-resourced communities.

With regard to timing of care within Women Health Hospital, control sample cited delay of care they had received as three times frequent as near-miss sample (61.4 and 19.8%, respectively). This is in agreement with a study conducted in Morocco [14]. This finding is not surprising, as more than 80% of MNM women admitted in current studied hospital already with near-miss status, and they were in deteriorated critical condition need mostly admission in intensive care which urged the attention of hospital team to the necessity of the amount of critical care needed in a proper time [26]. Specifically, in developing countries, about 75–90% of women with MNM morbidity were in a critical condition upon arrival, thus underscoring the significance of the first and second delays [23,27–29]. It is also crucial that MNM patients should not have to wait for unreasonable length of time to be attended by a hospital provider as observed for around one-fifth of MNM in this study. More studies are needed to assess the quality of the care given to women with delay-related MNM.

This study can serve as a preliminary study to be followed by other large-scale community-based case–control studies, which can provide the required

data to the healthcare authorities for helping them to plan appropriate interventions for the reduction of MNM morbidity and mortality.

Conclusion and recommendations

A high proportion of near-miss sample was associated with delay in their obstetric management, which might be significantly related to many factors. Half of the near-miss cases had multiple delays and the third delay was found to be the most frequent and most significant predictor of MNM. By improving health maternity care system, improving the resources at the primary sources with adequate blood banks and operating theaters, improving staff communication skills, and improving referral systems, causes of delays among MNM cases could be prevented.

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Conflicts of interest

There are no conflicts of interest.

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