Magnitude and pattern of maternal near-miss cases admitted to Women's Health Hospital, Assiut University

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Introduction
Maternal near-miss (MNM) is one of the related concepts to maternal mortality. MNM is a special category of survivors, whose stories provide unique insights and valuable information on maternal mortality. Measuring MNM beside maternal mortality and identifying its causes is essential, and should be calculated regularly for the purpose of planning, monitoring, and evaluation of provided maternal healthcare.

Objectives
The objectives of the study were to determine the magnitude and to identify the patterns of MNM among cases admitted to Women's Health Hospital, Assiut University, Egypt.

Methodology
This paper is a part of a larger case–control prospective study; however, for this analysis, we are presenting only the findings of the MNM cases. (The full profile of the cases and controls was presented in another paper.) The study was conducted at Women's Health Hospital, Assiut University and included 342 MNM cases by total coverage of all eligible cases who met the criteria of MNM identification published in WHO bulletin (2011) throughout the 12 months' period of the study. A checklist was used to collect data from the hospital records of eligible respondents.

Results
During the 12 months' period of the study, there were 17 503 deliveries and 16 972 live births. The maternal mortality ratio was 276 per 100 000 live births and the MNM incidence ratio was 20 per 1000 live births. This means that there was one maternal death for every seven cases of MNM. The mean age of MNM cases was 28.4 ± 8.5, whereas the mean gestational age of MNM was 35.66 ± 8.6 weeks. The main direct obstetric causes of MNM were hypertensive disorders of pregnancy (49.8%), obstetric hemorrhage (38.3%) and dystocia (32.5%). On the other hand, cardiovascular disorder was the most prevalent nonobstetric cause among MNM cases (48.8%). The peak frequency of the cases occurred during the summer season.

Conclusions and recommendations
MNM and maternal mortality are alarmingly high. Hypertensive disorders of pregnancy and obstetric hemorrhage were the two main direct obstetric causes of near misses that require strict and quick management protocols.

Keywords:
maternal near-miss, pregnancy complications, Severe maternal morbidity, WHO

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Introduction

Maternal mortality is a worldwide problem; however, over 99% of these maternal deaths (MDs) occur in developing countries, and many of these deaths can be avoided. Maternal mortality is 'Just the tip of iceberg'; the base to the iceberg is maternal near-miss (MNM) morbidity, which remains undescribed [1].

MNM is one of the related concepts to maternal mortality where women survive merely by chance, luck, or by good hospital care [2]. MNM has emerged as an adjunct to investigation of MDs, as the two represent similar pathological and circumstantial factors leading to severe maternal outcome [3]. MNM women are a special category of survivors, whose stories provide unique insights and valuable information on maternal mortality [4]. As near miss woman is still alive and precedes MD, the number of near-miss cases occur more often than the MDs, thus may directly provide more information on obstacles that had to be overcome during the process of healthcare, and promote further understanding of the maternal mortality determinants as the woman herself can be a source of data [5,3].

MNM is a promising indicator to improve the quality of obstetric care [6–8]. Therefore, measuring near misses beside maternal mortality and identifying its causes

is essential, and should be calculated regularly for the purpose of planning, monitoring, and assessment of provided maternal healthcare [9,10].

The WHO defines a MNM case as 'a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy' [8]. The WHO has proposed a package of 25 severity markers including combined different criteria based on clinical signs, laboratory tests, and management parameters that met the need for consensus criteria, which can be used all over the world. Standardization of the MNM definition established by WHO helps in better description of the MNM, especially in undeveloped countries [11].

The prevalence of MNM may vary depending on several factors [8]. In general, near misses were approximately five times as frequent as MDs [12]. However, some studies reported that they are 10–24 times more frequent than MDs [13].

In developing countries, MNM cases often arrive at referral hospitals in a critical condition [2]. Obstetric hemorrhage, hypertensive disorders of pregnancy, sepsis, embolism, and unsafe abortion are usually the main causes attributed to MNM conditions [14].

As pregnancy complications occur in 15% of women worldwide [14], any pregnant woman can develop life-threatening complications with little or no advance warning, and without the ability to identify and treat this women maternal mortality cannot be reduced [6].

Although the concept of MNM has started at the first of 19th and become increasingly important for those working in maternal health, as reported in several studies [2,6,8,12], to our knowledge few studies have been carried out for describing the magnitude or pattern of near-miss cases in Egypt.

The present study aspired to enhance the knowledge of the health practitioners about the nature of MNM problem. Concurrently, the outcome of the study provides a relevant source of information for administrative authority in the selection of priorities of maternal healthcare interventions that can save a significant number of mothers' lives at Women's Health Hospital and other tertiary care hospitals.

Aim of the study

The present study aimed to determine the magnitude, as well as to identify the pattern, of MNM among women admitted to Women's Health Hospital, Assiut University, Egypt.

Methodology

This paper is a part of a larger case–control prospective study; however, for this analysis, we are presenting only the findings of the MNM cases. (The full profile of the cases and controls was presented in another paper.) The present study was conducted at Women's Health Hospital, Assiut University, which is the biggest university hospital in Upper Egypt. It is the main referral hospital from Beni-Suef to Aswan governorates with a yearly flow of around 20 000 deliveries.

Operational definition for maternal near-miss case

Any woman who was admitted to Women's Health Hospital throughout a study period (complete calendar year from 1 May 2014 to 30 April 2015) and met at least one of the WHO criteria for MNM case identification during her pregnancy, delivery, or within 42 days after delivery was eligible in the study; eligibility was not restricted by gestational age at which complications occur (Panel A).

Panel A WHO criteria for maternal near-miss [8].

To collect data required to calculate the indices and to identify the pattern of MNM in this study, a checklist was constructed as a tool that included relevant items (admission circumstances, nature, causes of near misses and ICU stay, and so on). Data were obtained from medical records (registers of the hospital admissions and ICU records) of all the eligible women admitted to the studied hospital.

The proposal was reviewed by the Ethics Committee of Assiut – Faculty of Medicine. In addition, approval of Women's Health Hospital was obtained, and then a pilot study was conducted. All data were confidential and not used except for research purposes.

Actual data collection took place during the period from 1 May 2014 to 30 April 2015. All possible MNM cases admitted to the studied hospital were identified with assistance of the obstetricians or intensive care specialists. This was carried out by checking different sets of the WHO criteria for screening MNM cases through daily visits to obstetric wards, inpatient department, emergency unit, and ICU, provided that the case had fulfilled just one of the WHO MNM identification criteria (Panel A).

Organ dysfunction	Clinical criteria	Laboratory criteria	Management criteria
Cardiovascular	Shock Cardiac arrest	Severe hypoperfusion (lactate >5 mmol/l or >45 mg/dl) Severe acidosis pH <7.1	Use of continuous vasoactive drugs Cardiopulmonary resuscation
Respiratory	Acute cyanosis Gasping Severe tachypnea (breathing rate >40) Severe bradypnea (respiratory rate <6)	Severe hypoxemia Oxygen saturation<90% for >60 min	Intubation and ventilation for ≥60 min unrelated to anesthesia
Renal	Oliguria unresponsive to fluids or diuretics	Severe acute azotemia creatinine ≥300 μmol/ml or ≥3.5 mg/dl Presence of glucose and ketoacidosis in urine	Dialysis for acute renal failure
Coagulation	Failure to form clots	Severe acute thrombocytopenia (<50 000 platelets/ml)	Massive transfusion ≥5 U of blood or red blood cell concentrate
Hepatic	Jaundice concomitantly with pre-eclampsia	Severe acute hyperbilirubinemia (bilirubin >100 μmol/l or >6.0 mg/dl)	–
Neurologic	Prolonged unconsciousness/coma (lasting >12 h) Stroke Status epilepticus/uncontrollable fits or global paralysis	–	–
Uterine dysfunction/ hysterectomy	–	–	Puerperal hysterectomy due to infection or hemorrhage

Several procedures were adopted to ensure high-quality data and reliable information, including preparatory meetings, site visits, close monitoring of data collection and data entry, and double data collection for selected medical records by the researchers.

Statistical analysis

The collected data were verified and coded. Data entry and analysis were done using SPSS program, version 19. Data were expressed in proportions for categorical variables and mean ± SD for continuous variables. Descriptive analysis was carried out for description of MNM indices and characteristics. Graphic presentations were performed using the Excel program.

The following indices were calculated [8].

- MNM incidence ratio: It is the number of MNM cases per 1000 live births
- Maternal mortality ratio: It is the number of MD cases per 100 000 live births. MNM and maternal mortality ratios were determined on the basis of the total number of live births that took place in the participating hospitals during the data collection period
- Severe maternal outcome ratio (SMOR): This is the number of life-threatening conditions (death + near miss)/number of live births × 1000
- MNM mortality ratio: It is the proportion ratio between MNM cases and MDs. Higher ratios indicate better care
- Mortality index: Mortality index is the number of MDs divided by the number of women with life-threatening conditions (MNM + MD), expressed as a percentage [MI = MD/(MNM + MD)×100]. The higher the index, the more women with life-threatening conditions die (low intrahospital quality of care), and vice versa.

Results

The study included 342 MNMs in the study; the mean age for the near misses was 28.46 ± 8.5 years. The mean gestational age for the MNMs at admission was 35.66 ± 8.6 weeks.

During the 12 months' period of the study, there were 17 503 deliveries, 16 972 live births, 342 MNM cases, and 47 MDs. The MNM incidence ratio and maternal mortality ratio were 20 per 1000 live births and 276/100 000 live births, respectively. This means that there was one MD for every seven cases of MNMs. The total mortality index for near-miss cases in the current study was 12% (Table 1).

Out of the 342 near-miss cases, 83% (283) of women met the MNM criteria already at admission, and further 17% (59) of near-miss cases were distributed: 10.3% developed near miss after admission within the first 12 h of the hospital admission, whereas occurrence of MNM after 12 h of the hospital admission was observed in 6.7% (24) of cases (Fig. 1).

Fig. 2 shows that more than half of the MNM cases (55.3%) were admitted to the hospital after delivery or postoperative outcomes. About 26% were admitted in

the third trimester phase of their pregnancy, whereas the remaining (18.4%) were admitted in the first or second trimester phases.

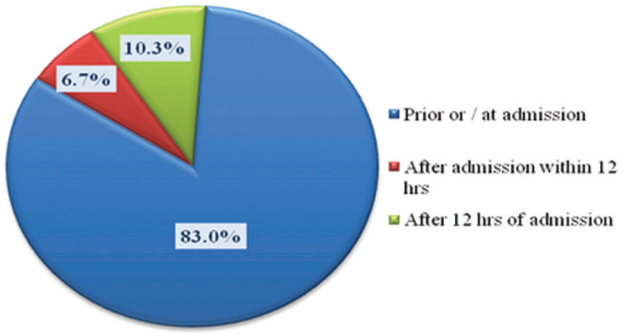
Fig. 3 reflected the monthly distribution of the MNM women admitted in Women's Health Hospital during the 12 months' study period. The peak frequency of MNM cases occurred during summer season more than the other seasons; July was the highest one (13%), followed by June and August (11%).

Table 1 Maternal near-miss indices, Women's Health Hospital, Assiut University Hospitals, during the study period from 1 May 2014-30 April 2015

Maternal near-miss indices	*N*
Total number of deliveries	17 503
Total number of live births	16 972
Total number of maternal near-miss cases	342
Total number of maternal deaths	47
Maternal near-miss incidence ratio	20/1000
Maternal mortality ratio	276/100 000
Severe maternal outcome ratio	22/1000
Maternal near-miss mortality ratio (MNM : 1 MD)	1 : 7
Mortality index (%)	12

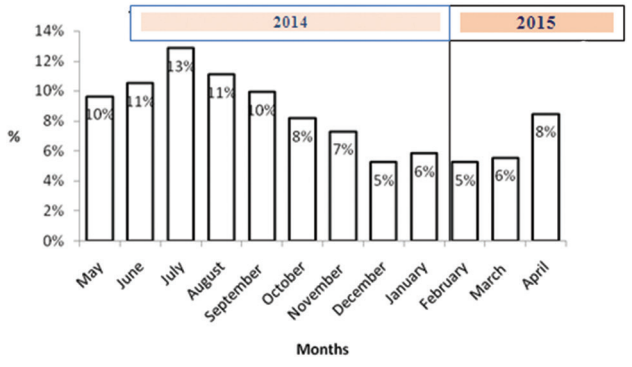
MD, maternal death; MNM, maternal near-miss.

Figure 1



Distribution of maternal near-miss women according to the presence of any WHO near-miss criteria on admission to the Women's Health Hospital, Assiut University Hospitals, 2014–2015.

Figure 3

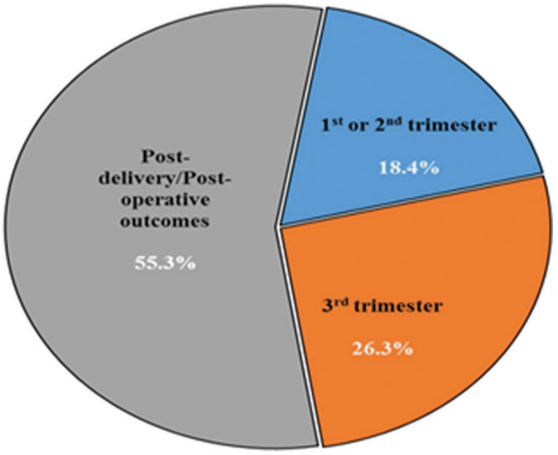


Monthly admitted maternal near misses at Women's Health Hospital, Assiut University Hospitals, 2014–2015.

On evaluating the leading causes of MNM, they fall under the three diagnostic categories of obstetric, nonobstetric, and both obstetric and nonobstetric disorders. Obstetric disorders were the most common type among affected women (74.0%), whereas 12.0% had nonobstetric type. Both obstetric and nonobstetric types of MNM conditions occurred in 14.0% of the near misses (Fig. 4).

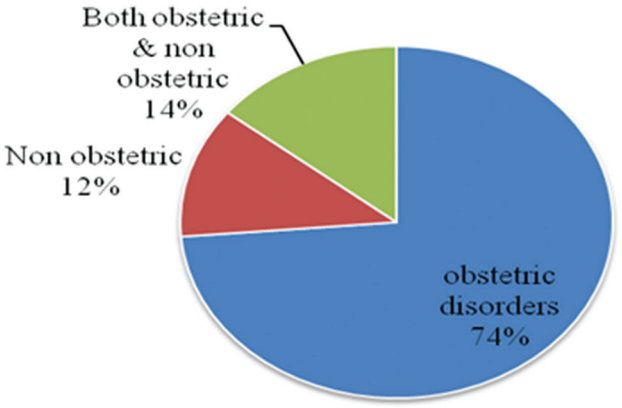
Among obstetric type of MNM conditions in the current study, hypertensive disorders of pregnancy were the most frequent direct complications associated with MNM (60.5%), followed by obstetric hemorrhage (49.8%), and dystocia accounted for 32.5% of complications. Unanticipated complications of management were responsible for 27.3% of the near misses (Table 2). On the other hand, cardiac disorders were the most frequently occurring nonobstetric complications (48.8%) (Table 3).

Figure 2



Distribution of maternal near-miss women according to the gestational time on admission to the Women's Health Hospital, Assiut University Hospitals, 2014–2015.

Figure 4



Distribution of maternal near-miss cases admitted, according to type of disorders, to the Women's Health Hospital, Assiut University Hospitals, 2014–2015.

Fig. 5 highlights the organ dysfunctions experienced by near-miss women, such as cardiovascular dysfunctions (39.5%), neurologic dysfunction (30.1%), respiratory dysfunction (28.7%), coagulation dysfunction (26.3%), hepatic dysfunction (21.1%), renal dysfunction (19.6%), and uterine dysfunction (19.6%). On the other hand, there were 55.6% near-miss women who suffered from multiple-organ dysfunctions.

In Table 4, it was clear that among 285 cases admitted to the ICU almost half of them (54.4%) were admitted to the ICU at the postdelivery phase, and 33.7% were admitted during pregnancy. Postabortion or postectopic conditions constituted about 11.9% of admitted cases.

Table 2 Distribution of maternal near-miss cases who presented with obstetric complications to the Women's Health Hospital, Assiut University Hospitals, 2014-2015

Type of complication of maternal near-miss cases[a]	Frequency (*N*=342) (*n* (%))
Obstetric disorders (direct causes)	252 (74)
Hypertensive disorders of pregnancy	181 (60.5)
Antepartum eclampsia	55 (30.4)
HELLP syndrome	52 (28.7)
Postpartum eclampsia	37 (20.4)
Severe pre-eclampsia	35 (19.3)
Hypertensive encephalopathy	2 (1.1)
Hemorrhagic disorders of pregnancy	150 (49.8)
Postpartum hemorrhage	68 45.3()
Bleeding in early pregnancy	61 (40.7)
Antepartum hemorrhage	21 (14)
Dystocia	82 (32.5)
Preuterine rupture	50 (61)
Uterine rupture	32 (39)
Anesthetic complication	29 (9.6)
Pregnancy-related infection	24 (8.0)
Pulmonary embolism	19 (6.4)
Acute fatty liver of pregnancy	17 (5.6)
Unanticipated complications of management (medical and surgical complication including cesarean section complications)	82 (27.2)

[a]Percentages are not mutually exclusive as near-misses may have multiple complications.

Table 3 Distribution of maternal near-miss cases who presented with nonobstetric complications to the Women's Health Hospital, Assiut University Hospitals, 2014-2015

Type of complication of maternal near-miss cases[a]	Frequency (*N*=342) (*n* (%))
Nonobstetric (indirect causes)	43 (12.0)
Cardiac disorders	42 (48.8)
Metabolic disorder (diabetic ketoacidosis)	28 (31.5)
Respiratory disorder	22 (25.6)
Hepatic disorder	21 (24.4)
Renal disorder	12 (14.0)
Immunological disorder (systemic lupus)	10 (11.6)
Neurological disorder	2 (2.3)

[a]Results are not mutually exclusive, as near misses may have multiple complications.

The main reasons responsible for ICU admission were cardiovascular dysfunctions and respiratory dysfunctions (33.7 and 30.5%, respectively). The mean of ICU admission duration in days was 7.36 ± 4.34.

Discussion

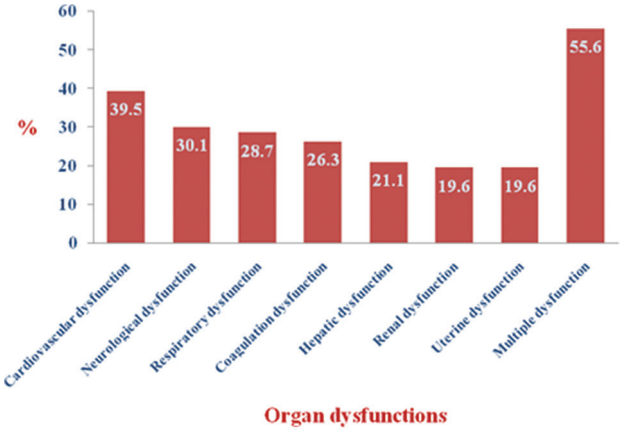
Investigating MNM in any setting is a newly recognized tool that identifies women at highest risk of MD and helps allocate resources well especially in low-income countries [15,16].

MNM indicators are new indicators of maternal care and they reflect the quality of care provided by a health facility and could be used to compare improvements in healthcare more accurately than mortality indicators alone among different hospitals and countries [17,18]. Unfortunately, data about such indicators in Egyptian hospitals are scarce [19].

In the current study, we compared our results with those studies that identified near-miss cases according to WHO MNM criteria, as we had done.

The incidence of near misses in the present study was 20 per 1000 live births (Table 1), which was much higher than14.5, 12.9, 12.1, and 4.3 per 1000 live births, as reported in a study conducted in four Arab major tertiary care hospitals in Syria, Palestine Egypt, and Lebanon, respectively [20]. In addition, the incidence ratio was higher than 12 per 1000 births in the Moroccon study [11] and higher than 8.3 per 1000 births in the study by Souza *et al.* [6]. In addition, these rates are definitely very high when compared with other high-income countries; it showed that the incidence ratios for near misses in Scotland and Italy were 3.8 and 2.1 per 1000 births, respectively [21]. However,

Figure 5



Distribution of maternal near-miss women who experienced organ dysfunctions at Women's Health Hospital, Assiut University Hospitals, 2014–2015.

Table 4 Profile of maternal near-miss cases admitted to ICU at the Women's Health Hospital, Assiut University Hospitals, 2014-2015

ICU admission	Frequency (*n* (%))
Critical ICU admission	285 (83.3)
Time of ICU admission	
While still pregnant	96 (33.7)
Following abortion/ectopic	34 (11.9)
Postdelivery	155 (54.4)
Main reasons of ICU admission	
Cardiovascular dysfunction	96 (33.7)
Respiratory dysfunction	87 (30.5)
Neurological dysfunction	56 (19.6)
Coagulation dysfunction	20 (7.1)
Hepatic dysfunction	14 (4.9)
Renal dysfunction	12 (4.2)
Duration of ICU admission (days)	
Mean±SD	7.36±4.34
Range	1-38

our results are much lower than the high estimated MNM ratios that have been found in Southeast Iran [22] and India [23]; the estimated ratio ranged from 25.2–105 to 33–120 per 1000 births, respectively. This variation might be reflecting the underutilization of maternal health services and obstetric delay, which may be because of low literacy, poor health-seeking behavior, delayed decision at family level, and poor transportation facility [23].

Another finding in the current study is the high level of the maternal mortality index (12). It is recommended by the WHO that the maternal mortality index should be less than 5% to ensure that women received adequate emergency obstetric care [8]. The fact that the study hospital had a higher mortality index indicates possibly lower quality of care (i.e., more women with life-threatening conditions die) [24]. This finding reflects unacceptably high maternal mortality ratio in the studied hospital (276 per 100 000 live births); this high ratio has been previously observed in the same hospital (225/100 000 live births) in the study by El-Gazzar, and in Alexandria tertiary hospitals (201 per 100 000 live births). This extremely exceeded Egypt's national level, which reached 52/100 000 in the year 2015 [25]. This could partially be explained by the fact that the studied hospital deals with high-risk cases, as it is the main tertiary referral hospital because a high proportion of the women referred to the hospital in a deteriorated critical condition. It is also worth mentioning that poverty and illiteracy in Upper Egypt are more prevalent, which could add to the increased level of MDs. In addition, this may signify a poor response of the healthcare system to modify the obstetric complications or perhaps substandard care where no audit has been performed [19].

In the present study, SMOR (22/1000 live births) was found to be higher when compared with the SMOR that was found in the Egyptian (13.3/1000 live births) and Palestinian (12.9/1000 live births) hospitals, which was reported in the study by Bashour *et al.* [20].

MNM events must be counted separately for those who already met MNM criteria on admission and those developed after admission – the first as a good indicator of the effectiveness of emergency referrals and the second as a potential tool for monitoring the performance of obstetric services [2]. As shown in the current results (Fig. 1), 83% of MNM cases were admitted at the studied hospital already in a near-miss state, which strongly suggested a delay in optimal obstetric care mainly at the primary source. The study result is consistent with that observed in other Arab studies [15,20,26–28]. The reduction of the present high near-miss admitted rates may be achieved by improving the resources at the primary sources for adequate management of severe morbidities such as proper provision and admission to ICU with adequate number of beds, blood bank, and theater rooms beside well-defined strict policies for early referral [29].

In the present study, nearly three-quarters (74%) of near-miss cases were due to direct obstetric causes (Table 2). Hypertensive disorders of pregnancy were the first most common direct causes of near miss (60.5%), whereas hemorrhagic disorders of pregnancy were the second observed causes (49.8%). This finding is in agreement with other studies in Egypt [5,26], in some developing countries [3,30,31], and in developed countries [32]. However, this is inconsistent with the result of the study by El-Gazzar [19] conducted in the same studied hospital, as well as the result of Kasr Al-Aini Hospital, in which obstetric hemorrhage was the first main cause of MD [28]. The high precentages of hypertensive disorders and obstetric hemorrhage cases are probably due to deficiency of magnesium sulfate, lack of availability of proper amount of blood, and delay in management [28]. However, Qayed *et al.* [33] reported that nearly one-quarter of the MDs in Assiut governorate were due to hypertensive diseases of pregnancy.

Cardiac disorder was the most common indirect cause of MNM (48.8%) (Table 3). This is consistent with studies of developing countries [30,32]. Special care management is needed for those suffering from pre-existing comorbidities.

All MNM cases developed organ dysfunctions, which are basic criteria of WHO categories for classifying MNM cases. By investigating the organ dysfunctions developed among studied cases (Fig. 5),

the study results revealed that cardiovascular and respiratory dysfunctions were the main dysfunctions that occurred (33.7 and 30.5%, respectively), whereas multiple-organ dysfunctions represented about half of all cases and these results are consistent with those found in some studies conducted in Arab [20,26,27] and developing countries [7,14].

In the present study (Table 4), ICU admission rate was higher among near-miss cases (83.3%). This is probably because the women referred to the hospital in a deteriorated critical condition, which brings the attention of the hospital to the amount of the critical care needed for near-miss cases with organ dysfunctions [34].

Moreover, the peak frequency of MNM women occurred during summer season compared with rest of the other seasons during the whole studied year (Fig. 3). This may be because of the absence of a portion of the working force, and this definitely would affect the quality of care as well; this finding may be because of the high frequent number of marriages during the same period each year.

Conclusions and recommendations

MNM incidence ratio and maternal mortality ratio in Women's Health Hospital, Assiut University during the12-month period of the study were alarmingly high (20/1000 births and 276/100 000 live births respectively), which is triggering the need for improvement of the provided obstetric care. MNM problem should not be neglected from the health authorities, and more researches addressing different issues of the provided obstetric care should be conducted to solve this problem. As obstetric disorders such as hypertensive disorders, obstetric hemorrhage, and dystocia were the main direct obstetric causes leading to MNM, more attention should be provided to high-risk pregnant women by informing the healthcare providers regarding proper dealing with hypertensive cases, indication, and management of cesarean section, and stressing on the related services such as blood bank services. More than half of MNM women suffered from multiple-organ dysfunctions, leading to the majority of MNM cases being admitted to the ICU; communication and link with other specialties should be improved in the healthcare system, especially those experienced in management plan for those cases that require multispecialist care management. The high incidence of MNM in this study highlighted the attention to definitely applying standardized guidelines in emergency and admission rooms depending on the proper functioning of the WHO MNM approach with wide proper detection of MNM cases and address their challenges in all tertiary hospital serving such cases; this will lead to saving lives of many women.

Limitations of the study

The MNM cases identified were hospital-based, and thus results cannot be generalized to the whole population in addition to difficulties in obtaining complete full data from some poor-quality medical records.

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Conflicts of interest

There are no conflicts of interest.

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