

## Trends of Maternal Mortality in Nineveh Government (2018-2022) A time Series Analysis

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### ABSTRACT

**Aim:** To describe women death in Nineveh governorate 2018-2022.

**Methods:** A Biometry study used to review a record of 136 deceased mothers during 2018-2022 from 1st (Jan – July) during 2023, using standardized maternal mortality inquiry forms adopted by Ministry of Health consist from four section. Section I (maternal mortality surveillance system Questionnaire). Section II- decision of scientific committee for the study of maternal mortality) consist from 4 items. Section III The improvement plan. Section IV statistical form of maternal mortality contain the informative items. Using maternal mortality indicators (ratio, rate and proportional mortality) to measure trend of maternal death.

**Results:** Total number of deceased mothers were 163, the study revealed that 62.0% of deceased mothers in age group 20-34 years and no differences regarding residence. Half of dead mother were illiterate and had had primary education. Death in relation to delivery commonly seen during puerperium and mainly in 1st 24hrs with decreasing trend of death during puerperium and increasing death during pregnancy. Direct cause of death is more prevalent with trend of decrease unlike indirect cause had increasing trend. Death Can't be prevented in 2022. Maternal mortality indicators were fluctuated during last five years with trend to decrease toward 2022.

**Conclusion:** Although of maternal mortality trend was fluctuated in last five years in Nineveh government and the direction was slightly drop toward 2022 but didn't achieve the five Millennium Development Goals adopted by WHO.

### Keywords

Mother's death trend, deceased women, maternal mortality rate. A time Series Analysis

### Introduction

Maternal mortality is one of the fundamental components of population changes and good indicators of a population's standard

of living and health care, Women death due to pregnancy or labor complications is a tragic end because it can be prevented and treated [1]. To estimate levels of maternal mortality we can use census, household surveys, reproductive Age Mortality Study (RAMOS), coupled with record review and/or verbal autopsy and sisterhood method.

In Europe and the United States 2006-2010, surveillance methods for maternal mortality despite its limitations (e.g. underestimation, misclassification) and routine vital registration systems are the backbone of maternal mortality surveillance systems in developed countries [2]. Nowadays, improving maternal health is the priority of most communities and organizations, including the World Health Organization (WHO).

In Iraq, as in other developing countries, maternal mortality was usually underestimated [3]. Maternal mortality in Iraq 1990, was 117 per 100,000 live births, reduced to 84 in 2007 and to 36.1 in 2016 [4]. WHO 2009, declare that reduction rate was 3.8% per year, this is higher than the average worldwide reduction of 1.3% and lower than the target reduction according to fifth MDG (5.5%) [5]. Maternal mortality is the culmination of a series of detrimental events in a woman's life, pregnancy being the last one [6].

WHO defines maternal death as: the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from unintentional or incidental causes. According to that WHO classified maternal cause of death into a direct (are those "resulting from obstetric complications of the pregnant state (pregnancy, labor and puerperium), and from interventions, mismanagement and incorrect treatment) or indirect maternal cause (are those maternal deaths "resulting from previous existing disease or disease that developed during pregnancy aggravated by the physiologic effects of pregnancy) [1].

The health sectors in Mosul faces considerable and complex challenges, such as less access to quality health care, shortage of essential medicine and lack of equipment, in availability of diagnostics test, and ect., all above factors and others affect women health and increase morbidity and mortality.

## Aims

The aim of present study to describe the trend of maternal death in Nineveh governorate during 2018 -2022 to study causes and put strategy to prevent it as much as possible.

## Material and Method

**Administrative and ethical consideration:** Ethical and scientific approval was received from Nineveh Health Directory/ MOH/ Iraq licenses' Number session held on the date of the numbered research project. All work is approved by scientific the ethical committee of Nineveh Health Directory / MOH / Iraq by licenses' number (236) in date (27 Sep 2022) protocol research number 2022159. After taking the agreement of the Public Health Department/ Maternity and Child Unite and Planning Department / Health and Vital statistics section.

## Study setting

Public Health Department/ Maternity and Child Unite and Planning Department / Health and Vital Statistics Section.

## Study Design and Study Period

A Biometry study design was adopted to achieve the aim of the present study. Six months from 1st Jan - July during 2023.

## Study Sample and Study Sample Size

Review of records (all registered cases) of deceased mothers in child bearing age regardless age, education, parity, residence, religion, ethnicity and nationality and occurrence of death due to factors related to pregnancy, labour and puerperium or its complication and within 42 day after labor over the last five years from (2018 -2022). Total numbers of recorded cases 136 deceased mothers were founded during period from 2018-2022.

## Data Collection Form

Maternal mortality surveillance system form consist from four section adapted by Ministry of Health/ Maternity and Child Health Directorate since 2000 with minimal modification done in 2021.

## Section I: Maternal mortality surveillance system Questionnaire.

It consist from eight items as follow: (Appendix III)

- 1- General information.
- 2- Obstetrics history.
- 3- Labor information.
- 4- Hospital information.
- 5- Death information includes the following:
  - General information,
  - Direct cause of death includes: vaginal bleeding, antepartum, post-partum hemorrhage, blood pressure problem, unknown case of sepsis, complication of surgical intervention, sudden death of unknown causes and pulmonary embolism.
  - Indirect cause of death include: infectious disease, cancer, blood disease and immunity cancer, endocrine disease including DM, circulatory disease, respiratory disease, gastro-intestinal disease, muscle and bone disease, genito-urinary disease, nervous system disease, trauma, car-accident, poisoning and others.
  - non-medical causes of death include rejection to referral due (no facilities, no trustation to referral institution, lack of awareness of the family and relatives of the serious health condition of the deceased mother and Ignorance of health personnel of the seriousness of the situation
- 6- Level of delay
  - Delay in transportation Cause of delay in management in referral to other health institution: long distance between two institutions, lack in appropriate transporting vehicle.
  - Delay in provision of heath care services in referral hospital.
- 7- Information of now born baby

## Section II: Decision of Scientific Committee for the Study of Maternal Mortality: it consists from four part as follow:

1. Factors related to health care workers:
2. Factors related to deceased women and their relatives.
3. Factors related to heath care institution:
4. Others.

## Section III: The improvement plan proposed by the Scientific Committee for the Study of Maternal Mortality include: It consists

from four parts as follow:

1. Factors related to health care workers (training, Supervisor and disciplinary action).
2. Factors related to deceased women and their relatives (Health and media education).
3. Factors related to health care institution (blood supply, Medication supply, provision of medical supplies, Supply shortages in anesthesia (doctors-supplies).
4. Others.

**Section IV:** Statistical form of maternal mortality. The statistical form was adopted it since 2000 with minimal changes done during 2014, then 2017 and lastly in 2021.

Information was taken from interviews with: parents, relative, husband, friends, and providers of care during delivery and the postpartum period). Part of the information is to be taken from the death certificate, hospital medical record, and antenatal care record. At the end of each review, the committee gave a general assessment as to whether it was possible to prevent the death of the woman or not and categorize the level of prevention into three level: Delay one (D1) due to delay in seeking medical care due to factors related to mothers, her family and community, delay two (D2) due to delay in transportation and road problem, delay three (D3) delay in provision of health care services in health institution).

### Statistical Analysis

The information regarding each participant was transferred into a code sheet and data entry was done using computer Pentium IV. Statistical analysis was done using Statistical Package for Social Science (SPSS) version (26), Minitab version (19), Excel version (16) was considered.

The data were presented in suitable tables. Percentages were calculated for the various group variables.  $\chi^2$  continuity test for 2x2 table was used in comparing between two variables with 95% Confidence interval (CI).  $P$ -value  $\leq 0.05$  was considered significant throughout data analysis.

The maternal mortality ratio is calculated as:

All maternal deaths occurring within a reference period (usually 1 year) X 100000  
Total number of live births occurring within the reference period

The maternal mortality rate is calculated as:

All maternal deaths occurring within a reference period (usually 1 year) X 100000  
Total number of women in child bearing age within the reference period

The proportion maternal death (PM) is calculated as:

All maternal deaths occurring within a reference period (usually 1 year) X 100  
Total number deaths among women in child bearing age in that time

## Results

### Demographic Characters of Study Sample

Deceased mothers by their characteristics seen in (Table 1) more than half 84 (62.0%) of deceased mothers in age between 20-34 and no differences regarding residence. One-fifth 30 (22.1%) of dead mother were illiterate and commonly seen in 2020 and 2022, it was 9 (34.6%), 9 (45.0%) respectively. Unemployment state were 17 (77.3%), 32 (91.4%) and 20(100.0%) in 2018, 2021 and 2022, respectively.

More than one third 54 (39.7%) of deceased mothers who had four and more children mainly seen in 2020, it was 13(50.0%), presence of antenatal care among study dead women was 78 (57.3%) in general, highest record was 28(80.0%) in 2021 to leaser extend 4 (18.0%) in 2018. Moderate risk factors commonly see during 2021 and 2022 it was 18 (51.4%) and 11 (55.0%) respectively. Midwife intervention commonly seen during 2020, it was 7 (26.9%). This is clear in (Table 2).

### Pregnancy Outcome and Delivery

Table (3) depict that pregnancy outcome with a life baby were 17 (78%), 22 (67%), 15 (57.7%), 17 (48.6%) and 13 (65.0%) respectively 2018-2022. Half of them were male baby during 2018 and 2020 and nearly three fourth of pregnancy outcome were male during 2019. Delivery took place in health institution seen in 16 (73%), 26 (79%), 16 (61.5%) from 2018 to 2020 respectively. Death during pregnancy commonly seen during 2022, it was 30.0% and 54 (39.8%) of dead mothers delivered by cesarean section. This is seen in Table 3.

### Death of mother in relation to place, to delivery and puerperium:

Most common place of death was health institution as 106 (77.9%) and least recorded place in road it forms 9 (6.7%) these finding reported in Table 4.

Time of maternal death in relation to delivery was seen in (Table 5). Nearly three fourth 99 (72.8%) of maternal death occurs in puerperium mainly during 2018 and 2021, it was 20 (90.0%) and 25 (71.4%) respectively. Death during pregnancy was seen in 2022, it was 6 (30.0%) and in 2020 during labor 8 (30.8%).  $P$ -value = 0.003

The trend of maternal death in relation to delivery demonstrated in (Figure 1), it showed that there is drop in maternal death during puerperium by 22.2% during period from 2018 to 2022, at same time there is a increase in maternal death by six time during pregnancy in same period.

### Causes and trend of maternal death

Figure 2 revealed that commonest cause of death among mothers by clinical diagnoses.

Hemorrhage was direct cause of death of mothers in 2018, it was 11 (50.0%). Suspicious of pulmonary embolism seen in 2019,

**Table 1:** Percentage distribution of deceased mothers by their characteristics.

Category	2018 Total No. (22)	2019 Total No. (33)	2020 Total No. (26)	2021 Total No. (35)	2022 Total No. (20)	Grand Total Total No. (136)	
	%	%	%	%	%	No.	%
<b>Age groups in years</b>							
< 20	9.0	12.0	19.0	8.6	0.0	14	10.0
20-34	55.0	49.0	50.0	65.7	90.0	84	62.0
≥ 35	36.0	39.0	31.0	25.7	10.0	38	28.0
<b>Residence</b>							
Rural	41.0	52.0	38.5	65.7	60.0	73	54.0
Urban	50.0	45.0	53.8	34.3	40.0	58	42.0
Unknown	9.0	3.0	7.7	0.0	0.0	5	4.0
<b>Education</b>							
Illiterate	5.0	18.0	34.6	14.3	45.0	30	22.1
Primary	5.0	21.0	11.5	51.4	50.0	39	28.7
Secondary	5.0	6.0	15.4	34.3	5.0	20	14.7
University & Higher education	0.0	3.0	0.0	0.0	0.0	1	0.7
Unknown	85.0	52.0	38.5	0.0	0.0	46	33.8
<b>Occupation</b>							
Employed	9.1	3.0	3.8	8.6	0.0	7	5.0
Unemployed	77.3	52.0	61.5	91.4	100.0	102	75.0
Unknown	13.6	45.0	34.6	0.0	0.0	27	20.0

**Table 2:** Percentage distribution of deceased mothers by presence of antenatal care, risk factors and midwife intervention.

Category	2018 Total No. (22)	2019 Total No. (33)	2020 Total No. (26)	2021 Total No. (35)	2022 Total No. (20)	Grand Total No. (136)	
	%	%	%	%	%	No.	%
<b>Parity</b>							
No child	27	30	26.9	25.7	25	37	27.2
< 4	32	25	23.1	37.1	45	43	31.6
≥ 4	41	39	50.0	37.1	30	54	39.7
Unknown	0.0	6	0.0	0.0	0.0	2	1.5
<b>Presence of Antenatal Care</b>							
Yes	18.0	49.0	57.7	80.0	75	78	57.3
No	9.0	12.0	11.5	5.7	25	16	11.8
Unknown	73.0	39.0	30.8	14.3	0.0	42	30.9
<b>Scoring Risk Factors</b>							
No risk	0	0	7.7	11.4	10	8	5.9
Low risk (0-2)	40.9	54.5	69.2	28.6	35	62	45.6
Moderate risk (3-6)	40.9	42.4	15.4	51.4	55	56	41.1
High ≥7	9.09	0.0	0.0	8.6	0.0	5	3.7
Unknown	9.09	3.1	7.7	0.	0.0	5	3.7
<b>Midwife Intervention</b>							
Yes	14	15	26.9	2.9	5	17	12.5
No	73	85	69.2	77.1	95	108	79.4
Unknown	13	0	3.8	20.0	0.0	11	8.1

it was 8 (25.0%). Death of women due to unknown cause seen in 2020, it was 11 (42.30%). COVID -19 and its complication reported highest degree in 2021, it was 7 (20.3%). Myocardial infraction and heart failure as a cause of death was seen in 2022, it was 4 (20.0%).

Direct cause of death is more prevalent, it constitute 104 (76.4%) of study sample. This is seen in (Table 6).

Figure 3 revealed that direction of direct maternal death causes toward 2022 was less than 2018 by 24% while direction of indirect cause of maternal death was drop to zero in 2021 and retrain to usual level in 2022 by 10%.

### Maternal Death Prevention and Trend

Nearly three fourth 99 (72.8%) of maternal death can be prevented and commonly seen in 2019 as it represents 31 (93.9%), at same

**Table 3:** Deceased mothers by place, and type of delivery.

Category	2018 Total No. (22)	2019 Total No. (33)	2020 Total No. (26)	2021 Total No. (35)	2022 Total No. (20)	Grand Total (136)	
	%	%	%	%	%	No.	%
<b>Place of delivery</b>							
Health institution	73.0	79.0	61.5	68.6	60	94	69.1
House	18.0	6.0	19.2	5.7	10.0	15	11.0
Road	0.0	3.0	0.0	5.7	0.0	3	2.2
No labor	5.0	9.0	19.2	20.0	30.0	22	16.2
Unknown	5.0	3.0	0.0	0.0	0.0	2	1.5
<b>Type of delivery</b>							
NVD	54	49	42.3	25.7	40	56	41.2
C/S	36	39	34.6	51.4	30	54	39.8
Abortion	0.0	0.0	7.7	0.0	0	2	1.4
No labor	5	9	15.4	20.0	30	21	15.4
Unknown	5	3	0.0	2.9	0	3	2.2

**Table 4:** Distribution of deceased mothers by place of death.

Place of death	2018 Total No. (22)	2019 Total No. (33)	2020 Total No. (26)	2021 Total No. (35)	2022 Total No. (20)	Grand Total (136)	
	%	%	%	%	%	No.	%
Health institution	73.0	82.0	69.2	88.6	70.0	106	77.9
Home	18.0	12.0	19.2	11.4	15.0	20	14.7
Road	9.0	6.0	7.7	0.0	15.0	9	6.7
Unknown	0.0	0.0	3.8	0.0	0.0	1	0.7

**Table 5:** Time of death in relation to delivery.

*Death in relation to delivery	2018 Total No. (22)	2019 Total No. (33)	2020 Total No. (26)	2021 Total No. (35)	2022 Total No. (20)	Grand Total (136)	
	%	%	%	%	%	No.	%
During pregnancy	5.0	9.0	19.2	22.9	30.0	23	16.9
During labor	5.0	9.0	30.8	5.7	0.0	14	10.3
During puerperium	90.0	82.0	50.0	71.4	70.0	99	72.8

\*Using  $\chi^2$  (P- value = 0.003)

**Table 6:** Causes of maternal death.

Cause of death	2018 Total No. (22)	2019 Total No. (33)	2020 Total No. (26)	2021 Total No. (35)	2022 Total No. (20)	Grand Total (136)	
	%	%	%	%	%	No.	%
Direct	95	73	53.7	30	16	104	76.4
Indirect	5	6	4	0	2	7	5.2
Unknown	0	21	42.3	5	2	25	18.4

**Table 7:** Prevention of death among deceased women.

Prevention of death	2018 Total No. (22)	2019 Total No. (33)	2020 Total No. (26)	2021 Total No. (35)	2022 Total No. (20)	Grand Total (136)	
	%	%	%	%	%	No.	%
Yes	77.3	93.9	69.2	65.7	50.0	99	72.8
No	22.7	6.1	7.7	34.3	35.0	28	20.6
Unknown	0.0	0.0	23.1	0.0	15.0	9	6.6

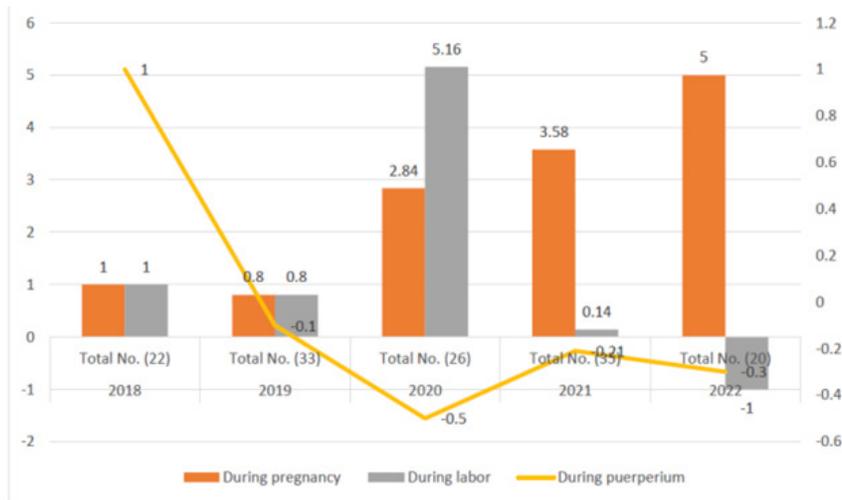


Figure 1: Trend of Death in Relation to Delivery.

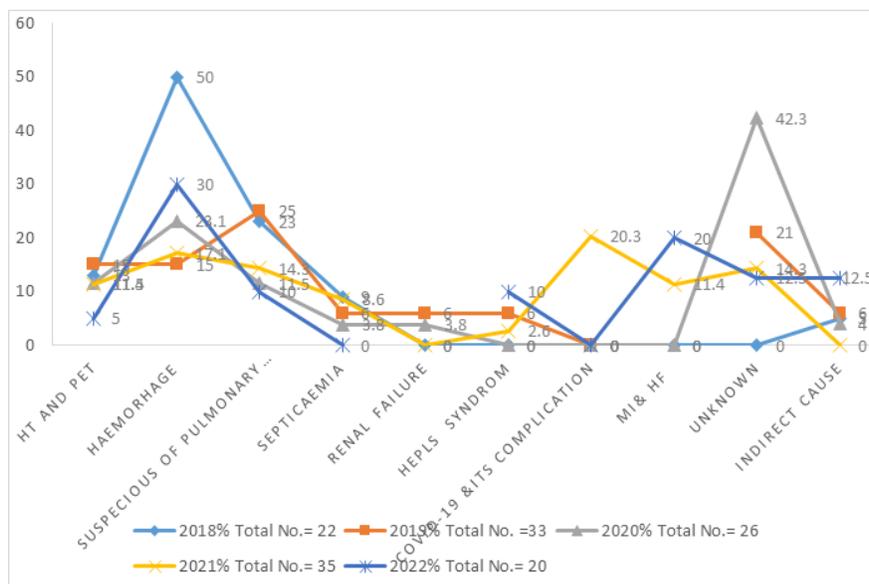


Figure 2: Distribution of deceased mothers by cause of death according to clinical diagnosis.

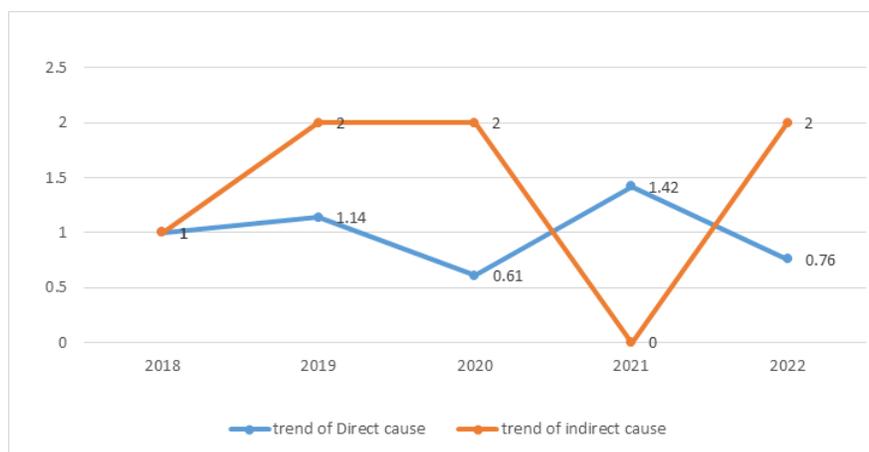


Figure 3: Trend of causes of maternal death.

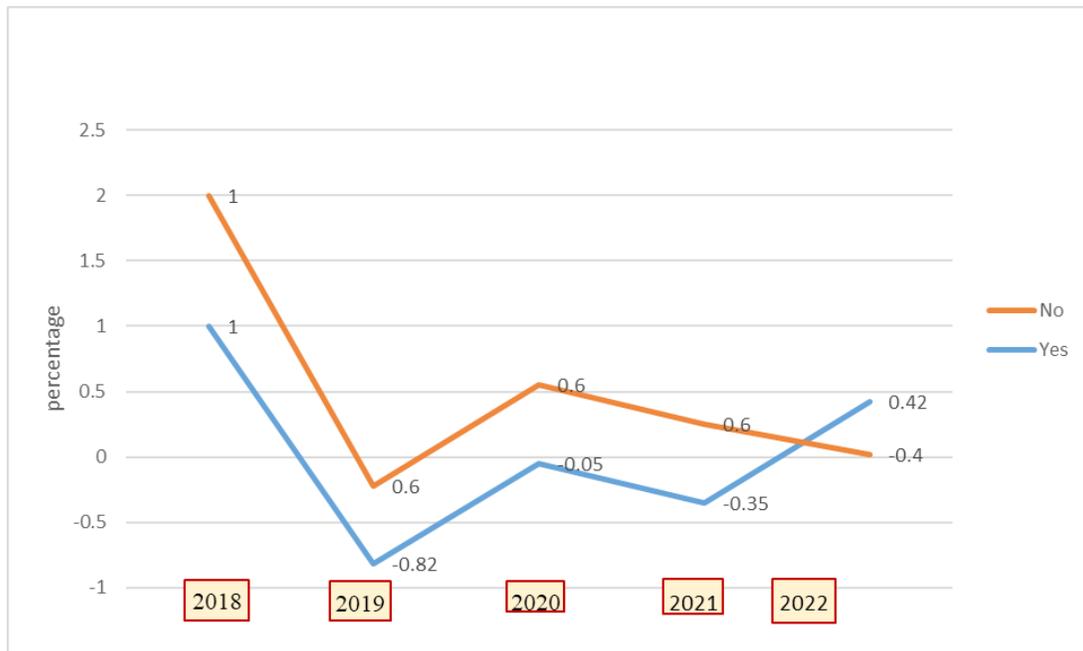


Figure 4: Trend of prevention of maternal death in 5 years interval.

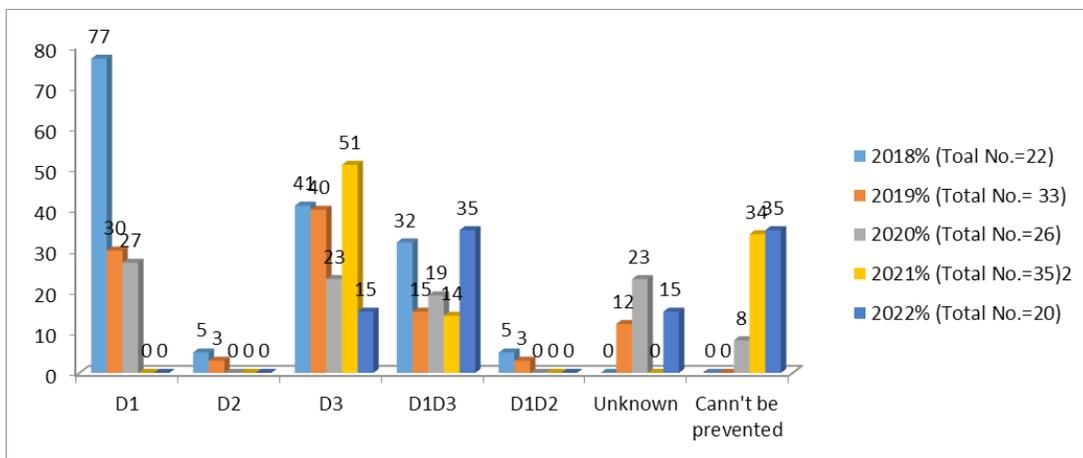


Figure 5: Prevention level.

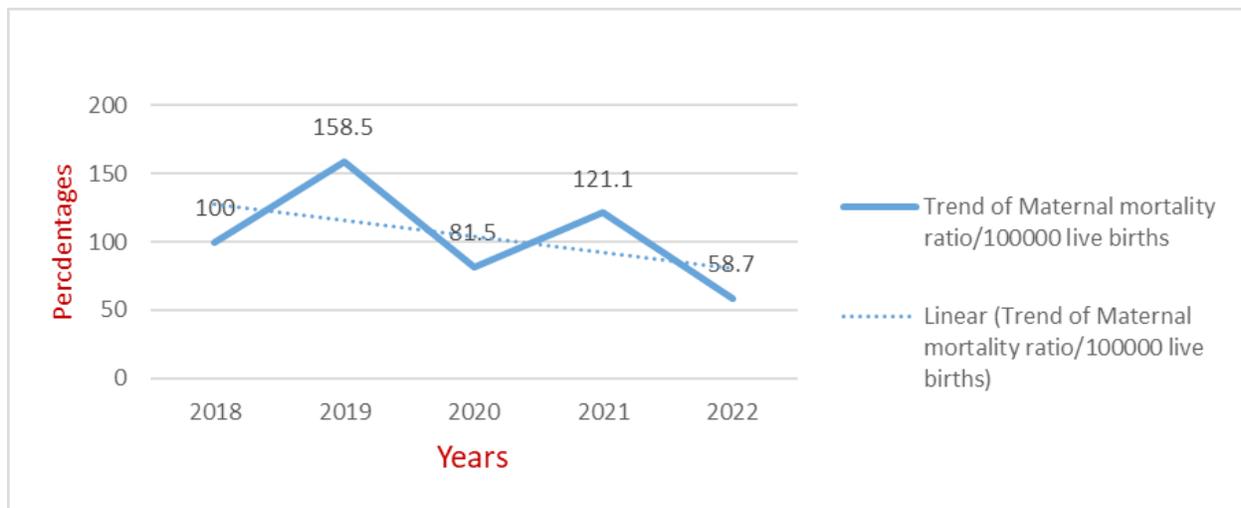
\*Multiple Response

Table 8a: Maternal mortality ratio, rate and proportional mortality in Nineveh governorate.

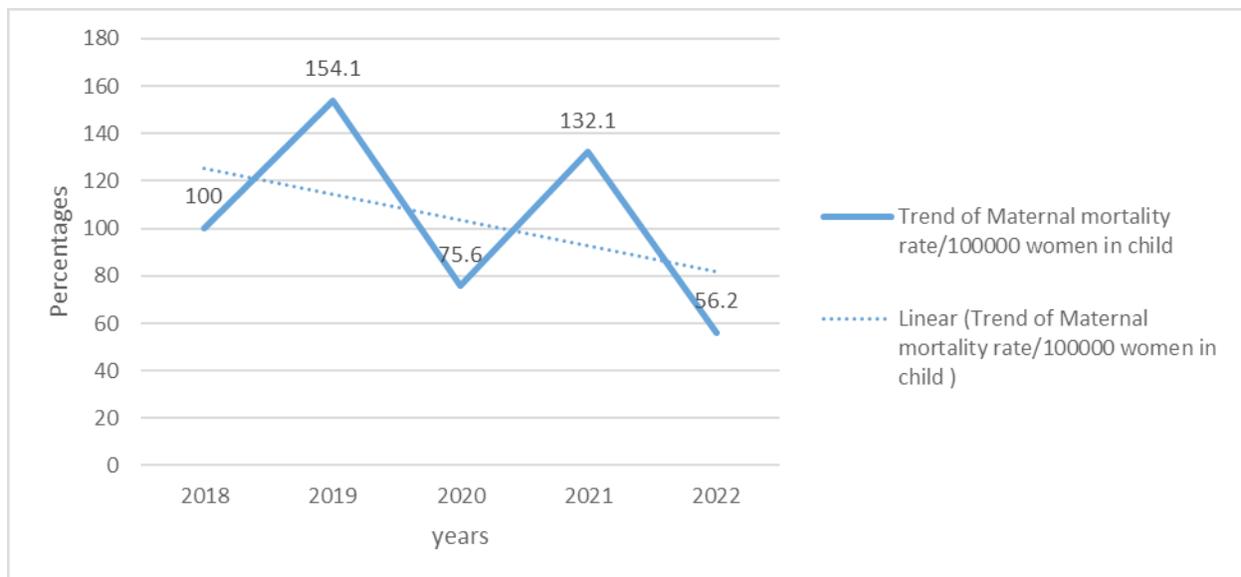
Years	No. of deceased mothers	No. of deceased mothers in childbearing age	No. of women in childbearing age	No. of live birth	Maternal mortality ratio/100000	Maternal mortality rate/100000	The proportion maternal death
2018	22	670	886533	89274	24.6	2.4	3.2
2019	33	538	886533	84434	39.0	3.7	6.2
2020	26	698	909698	81671	31.8	2.8	3.7
2021	35	574	933264	90822	38.5	3.7	6.1
2022	20	507	957243	88302	22.6	2.08	3.9
Grand mean	27	597	9146542	86901	31.3	2.9	4.5

**Table 8b:** Trend of maternal mortality ratio, rate and proportional mortality in Nineveh governorate.

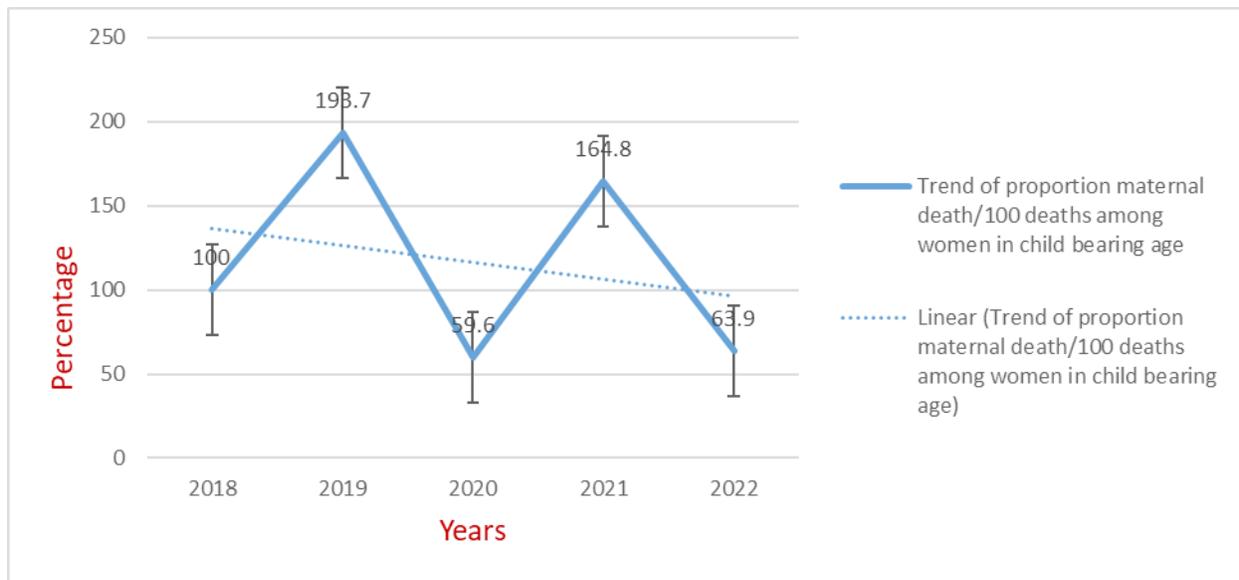
Years	Maternal mortality ratio/100000 live births	Trend of Maternal mortality ratio/100000 live births	Maternal mortality rate/100000 women in child bearing age	Trend of Maternal mortality rate/100000 women in child	The proportion maternal death/100 deaths among women in child bearing age	Trend of proportion maternal death/100 deaths among women in child bearing age
2018	24.6	100.0	2.4	100.0	3.2	100.0
2019	39.0	158.5	3.7	154.1	6.2	193.7
2020	31.8	81.5	2.8	75.6	3.7	59.6
2021	38.5	121.1	3.7	132.1	6.1	164.8
2022	22.6	58.7	2.08	56.2	3.9	63.9



**Figure 6:** Trend of Maternal mortality ratio/100000 live births.



**Figure 7:** Trend of Maternal mortality rate/100000 women in child bearing age.



**Figure 8:** Trend of proportion maternal death/100 dead women in child bearing age.

time 7 (35%) of death can't be prevented in 2022. This is clear in Table 7.

In spite of rising prevention level of maternal death in 2022 to 0.42, but still below the level of 2019. This is seen in Figure 4, in addition to that there is drop in prevention level by 0.82, 0.05, 0.35 during 2019- 2021.

Delay in seeking medical care due to factors related to mothers, her family and community (D1), more common 17 (77%) during 2018 if compared with year 2019 and 2020 as cause of mothers' death due to delay at D1 level was 10(30%), 7(27.0%) respectively this is clear in Figure 5. Delay of provision in medical care was seen in 2021, it represents 18 (51.0%). Death can't be prevented during 2021 and 2022 it forms 12 (34.0%) and 7 (35.0%) respectively.

### Maternal mortality ratio, rate and proportional mortality in Nineveh governorate

Table 8 revealed that maternal mortality ratio per 100000 live birth ranging from 24.6 to 39.0 and maternal mortality rate per 100000 women in childbearing age was 2.4 to 3.7 in last five years in Nineveh governorate. Grand mean assessment of proportional mortality rate was 4.5%

Although there is fluctuation in direction of maternal death ratio, rate and proportional rate in last five years in Nineveh governorate, but there is drop in direction of trend of maternal mortality from 2018 toward 2022. This is seen in Table (8.a) and Figure (5-8) respectively.

### Discussion

The data collected from record and the following are limitations in knowing defects at which level to be prevented and predisposing factors for the first level (education, occupation, economic status, and antenatal care exact cause unknown (ignorance of important

of antenatal care, insufficient or even absence of the survivors in PHCCs, socio-cultural barrier,...). Second level is the access to health facilities includes: (lack of access to transportation means and/or long distance to maternity centers in addition to major obstacles such as political instability, military checkpoints and the construction of the separation wall causing delay in prevention of maternal death, all above factors not reported in the record form of deceased women result in under estimating the actual level of prevention. In addition to that minimum period for trend analysis study and in presence of under estimation of maternal mortality in our community due to socio-culture barrier and unprecise in registration and diagnostic inaccuracy as in any developing country [7].

In spite of all above limitations the result of present study of value in determining the actual factor of maternal mortality and their trend and expectation in future years to put strategy to overcome the problem and improve women health in Nineveh governorate.

### Sociodemographic Characters of Deceased Mothers

As nearly two thirds 84 (62.0%) of deceased mothers in age 20-34 and no differences regarding residence. More than one fifth of dead mothers were illiterate and commonly seen during 2022 as 9 (45.0%), three fourth (104) of dead mothers were unemployed. Deceased mothers with antenatal care 78 (57.3%) more prevalent during 2021 it was 28 (80.0%) and dead mothers who had moderate risk factors was 56 (41.1%). Midwife intervention 7 (12.5%) frequently seen during 2020 it was 7 (26.9%). Education and employment make women to delay marriage, use contraceptives, reduce fertility, increase women's mobility and enable them to acquire greater capacities and skills, and in particular greater economic independence, which can in turn enable them to have greater access to health care [8,9].

WHO 2018, revealed that age, education, socioeconomic status, parity and others are contributing factors of maternal death, women

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in child bearing age specially in their twenties tend to have fewer complications during pregnancy than younger or older women in presence of adequate quantity and quality of health services [8]. In Kurdistan region 2015, the percentage of death among younger females was 11 % for women aged less than 24 year [9]. In spite of 95% of births occurred by well-trained health personnel [10].

Probability of mother's death during pregnancy labor and puerperium increase with increasing scoring risk factors, maternal death surveillance and response Iraq 2013, revealed that women with more than 30 years, multigravida, low educational status, inadequate antenatal care were at risk to die [11]. A similar finding was seen in a study in south-east Asia and middle Africa 2015 [12], and a household survey maternal in select districts of Iraq 2018 [10].

The coverage percentage of 4<sup>th</sup> antenatal visit in Iraq it was 50% according to MICS4 2011, the required recommended antenatal visit by Ministry of Iraqi Health/ maternal and child health department at least 4 visit during pregnancy, this low coverage rate due to inadequate knowledge regarding importance of antenatal visits and/or lack of confidence in PHC services [13], while in Erbil city 2015, prenatal health care was accessible to 100 % of women and 73 % to postnatal care [9]. The birth assessed by health personnel was 100% in Erbil and it was 85% in Al-Sulaymania [10]. In Mosul city 2020- 2022 the coverage percent of 4th antenatal visit, it was 7% as a result to emerging new CORONA virus and application of strict social isolation in addition to damaging infrastructure of most health institution during war liberation [14-16].

Midwife intervention increase from 3(14%) in 2018 to 7 (26.9%) during 2020 due to utilization of hospital by new emerging COVID-19 make shifting of pregnant mothers to birth attendance. Maternal death surveillance and response Iraq, showed that mean percent of traditional birth attendance(TBA) interference was 25.1% during 2010-2012 [11], this result was increase to 36% according to annual report of maternal mortality in Iraq 2013-2015 as a result of activation of maternal death surveillance inquiry form to register all maternal death by MoH [5]. Trained TBAs in sub-Sahara Africa 2013, have positive impact on reducing maternal death, because TBAs can help to break socio-cultural barriers on intervention on reproductive health programmes [17]. Another study among 78 low-moderate level country 2014, found that midwifery with family planning prevent a total of 83% of all maternal deaths [18].

### **Place, Mode of Delivery and Death of Deceased Mothers**

Delivery and death of women took place in health institution. Delivery in health institution were more frequent in 2019 than 2018 and to lesser extent during 2022. Caesarian section commonest mode of delivery seen during 2021 it was 51.4%. More than three fourth of death occurs in health institution frequently seen in 2021 Three fourth of death occurs in 1<sup>st</sup> 24 hrs during puerperium during 2018 and after 24 hrs seen during 2021.

During 2019 there were improvement of socio-economic condition of people in Mosul city after liberation process and stabilization of political condition of the city, health authorities with non-Governmental organization start to work tirelessly hard with to restore, rehabilitate and rebuild the health system and infrastructure [19]. While during 2020 as a result of spread of Corona virus cause shifting of labor to TBS (home deliver) and decrease admission and consultation to health institution, resulting of delivery by caesarian section was less in 2020 than 2019 and 2018. Caesarian section is one of method should be done to safe mother and fetus but in life saving condition used to save any one of them [20], WHO reported that caesarian section should not exceed 15% of delivery [21].

The risk of death from caesarian section in developed countries is rare if it compare with undeveloped countries but still higher than vaginal delivery, it is found that maternal mortality is 2.2 per 100,000 for C-sections and 0.2 per 100,000 for vaginal births [8]. WHO 2009, reported the direct risk of death due to pulmonary embolism usually associated with CS in 1<sup>st</sup> few hours [21], this is also reported by maternal death surveillance and response Iraq 2013 [11], and a study in low- and middle-income countries 2015 [12]. In Pakistan 2015, the active surveillance system showed that quality of obstetric care is less effective in saving mother's life among those with delay in seeking medical advice due to starting of un reversible pathological changed since pregnancy [22]. One way to reduce maternal mortality is by improving the availability, accessibility and quality of services for the treatment of complication that arise during pregnancy and childbirth [21]. Such services if provided universally can reduce MM by 90% or even more [23].

### **Trend of Death in Relation to Delivery and Puerperium**

There is drop in maternal death during puerperium by 22.2% during period from 2018 to 2022, at same time there is an increase in maternal death by six time during pregnancy in same period. There is drop in maternal death by 57% in 2020 and there is a slight rise to 47% in 2022 but still less than 2018, it was 10%.

Maternal death was fluctuating in Mosul city during 2018-2022 with trend of reduction during puerperium as a result of improving socio-economic condition of population in Mosul after liberation from Daesh and growth and rehabilitation of health institutions specially 2020, at same time emerging new Corona virus and its effect on health specially during pregnancy affect women health with improper availability of life saving equipment in health institution and lack of knowledge in addition to ignorance of deceased mothers and their relative to the importance of utilization of antenatal and family planning services with improving of maternal death surveillance at public health department with frequent follow up from them with consciousness, acceptance and awareness of deceased mother's relatives of importance of reporting maternal death specially for un clear cases. In a study done by Al-Samak 2018, reported that most countries unable to meet their MDG5 target and Iraq is one of them [24].

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Maternal mortality in Basra city from 2014 to 2018, total No.(206) revealed that although there is fluctuating in maternal death in that period of time and peak during 2016, but one third of death occur during pregnancy and half of them in third trimester [25].

### Causes of Maternal Death

Hemorrhage was direct cause of death of mothers in 2018, it was 11 (50.0%). Suspicious of pulmonary embolism seen in 2019, it was 8 (25.0%). Death of women due to unknown cause seen in 2020, it was 11 (42.30%). COVID -19 and its complication reported highest degree in 2021, it was 7 (20.3%). Myocardial infraction and heart failure as a cause of death was seen in 2022, it was 4 (20.0%). Direct cause of death is more prevalent, it constitute 104 (76.4%) of study sample. Direction of direct maternal death causes toward 2022 was less than 2018 by 24% while direction of indirect cause of maternal death was drop to zero in 2021 and retrain to usual level in 2022 by 10%. According to annual report in MM in Iraq for a period 2013-2015, 70% of death due to direct cause such as hemorrhage, pulmonary embolism and complication of hypertensive disorder, the mean percent were 20%, 16%, 9% respectively [5]. WHO 2014, systematic analysis revealed that the hemorrhage, hypertensive disorders, and sepsis were responsible for more than half of maternal deaths worldwide and more than a quarter of deaths were due to indirect causes [26].

Reviewing the causes of maternal mortality globally, according to the WHO report in 2005 “Make Every Mother and Child Count”, it was found clear that bleeding was the most common cause of maternal mortality (25%), followed by infection (13%), unsafe abortion (13%), eclampsia (12%), and obstructed labor (8%). In addition, 20% of maternal deaths were due to indirect causes such as: malaria, anemia, heart disease, and AIDS [27]. Egyptian national study on maternal mortality indicated that 77% of deaths were due to direct causes and 20% to indirect causes. Bleeding was the most common direct cause (43%) and heart disease was the most common indirect cause [28]. WHO 2005, an estimated 289,000 died in 2013 in pregnancy and childbirth, 52% of maternal deaths (in pregnancy, at or soon childbirth) are attributable to three leading preventable causes hemorrhage, sepsis, and hypertensive disorders, 28% of maternal mortality results from non-obstetric causes such as malaria [29]. A similar finding was seen in study done in Egypt 2014, as maternal death attributed to avoidable causes in particular the substandard care and lack of supplies necessary for management of life threatening pregnancy-related complications [30].

In many developing nations lack adequate health care and family planning, and pregnant women have minimal access to skilled labor and emergency care and obstetric interventions, such as antibiotics, oxytocics, anticonvulsants, manual removal of placenta, and instrumented vaginal delivery, are vital to improve the chance of survival. In fact, it is possible to prevent or manage most direct causes when appropriate health policies and an integrated health system are in place [2]. Unlike in developed countries, the indirect causes are the highest, such as heart disease this is due to advancements in technology, anesthesia and medications, in

addition to advancements in the use of protocols for management of complications [2]. As in UK 2003-2005, deaths due to indirect causes were more prevalent than those due to direct causes 7.71/100,000 live births and 6.24/100,000 live births respectively [31,32].

### Prevention Level and Trend of Maternal Mortality Rate, Ratio and Proportional Mortality Rate

In general, nearly three fourth of maternal death can be prevented and there is drop in prevention level by 0.82, 0.05, 0.35 during 2019-2021. Delay in seeking medical care due to factors related to mothers, her family and community (D1), more common during 2018, Delay of provision in medical care was seen in 2021. One third of death can't be prevented during 2022. Although there is fluctuation in direction of maternal death ratio, rate and proportional rate in last five years in Nineveh governorate, but in general there is drop in direction of trend of maternal mortality from 2018 toward 2022. WHO strategies by 2030, global reduction of MM to 70/ 100000 live birth [29]. Trends in maternal mortality in low- and middle-income countries from 2010 to 2013, we observed an improvement in the total MMR from 166 in 2010 to 126 in 2013. The MMR in Latin American sites (91) was lower than the MMR in Asian (178) and African sites (125) [12].

Egyptian study 2014, showed that there is a declined in trend of MMR that caused by avoidable factors like PPH due to wide coverage and utilization of the antenatal care services at same time sizable portion of MMR is attributed to substandard care and lack of supplies necessary for management of life-threatening pregnancy-related complications resulting in un achieving the MDG5 [30].

A similar finding was seen in Malawi 2017, which study application of the three delays model in MM showed that 39.7% of maternal death cause due to delay at level one and remaining (long waiting hours before receiving treatment at a healthcare facility, multiple delays at the time of admission, shortage of drugs, non-availability and incompetence of skilled staff ) delay at level three [33].

In study in Ogun state, Southwest Nigeria 2019, the direct cause of maternal death mainly due to Haemorrhage and pre-eclampsia or eclampsia account for 43.4 and 36.9% of causes respectively and mainly can be prevented at level one and two [34].

In 2017, Mosul was liberated and became a symbol of the fight against intolerance and repression. The maternal mortality rate is 39.6 deaths per 100,000 live births, higher than the national rate of 31.5 deaths. The slow pace of reconstruction in the health sector and the failure to expand the provision of health care services through health centers in rural areas help explain why provincial health indicators are low [35]. WHO report in Iraq, 2023 reported that risk factors of women death were early age of marriage, adolescent pregnancy, no or less education level, inequity between urban and rural and in adequate antenatal, postnatal and family planning survives. The Direct causes of maternal mortality according to Ministry of Health statistics for 2017 were: haemorrhage (32.4%),

pre-eclampsia/eclampsia (14.5%), thromboembolism (14.4%), rupture uterus (4.7%) and sepsis (4.4%). most of these losses are preventable with high-quality, evidence-based interventions delivered before and during pregnancy, during labour and childbirth, and in the crucial hours and days after birth [36].

The finding of present study was agreed by study in Al-Basrah 2019 [37], and in Baghdad Al-Yarmouk teaching hospital 2020 [38], both of them revealed that Maternal death is of still a problem and of preventable types due to lack of health care services at tertiary level hospitals.

## Conclusion

Maternal death commonly seen during puerperium and mainly in 1st 24hrs with decreasing trend of death during puerperium and increasing death during pregnancy.

Direct cause of death is more prevalent with trend of decrease unlike indirect cause had increasing trend.

Three quarter of death can be prevented with trend of increase prevention level specially at level three during 2021. Death can't be prevented during 2022.

Maternal mortality indicators were fluctuated during last five years with trend to decrease toward 2022.

## Limitation of Present Study

Maternal mortality is the tip of iceberg' as it represents the result of cumulative unpleasant events. Behind the causes of maternal mortality lies important other factors such as poverty, illiteracy, culture, malnutrition, chronic diseases and inadequate care during pregnancy.

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