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The Impact of the COVID-19 Pandemic on Maternal Mortality: An Example From A Province

COVID-19 Pandemisinin Anne Ölümü Üzerine Etkisi: Bir İl Örneği

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ABSTRACT

Aim: The aim of this study is to investigate the impact of the COVID-19 pandemic on maternal mortality in Kayseri.

Material and Method: In this descriptive study examined maternal deaths that occurred in Kayseri between 2017-2021. The maternal mortality ratio was calculated for Kayseri as the maternal deaths per 100,000 live births based on the total number of live births and maternal deaths for each year. The ratios for Kayseri and Türkiye were visualized using a histogram and a box-plot graph. The statistical analyses were performed using the SPSS, and a P-value of <0.05 was considered statistically significant. The Student's t-test was used to evaluate the mean differences between groups.

Results: The maternal mortality ratio for Kayseri was 18.6 per 100,000 live births in 2017, and it increased to 80 per 100,000 live births in 2021. At least one pregnancy-related risk factor was present in 84.6% of the cases, with obesity being the most common risk factor (34.4%). COVID-19-related deaths (30.6%) were the leading cause of maternal death. According to provincial health department reports, 73.1% of deaths were classified as indirect and 38.5% as preventable.

Conclusion: In Kayseri, there was a significant and unusual increase in maternal mortality in 2021, especially during the year when the delta variant of COVID-19 was active. Indirect maternal deaths predominated, and most of these were reported to be unpreventable.

Key Words: Maternal mortality, COVID-19, Coronavirus

ÖZ

Amaç: Bu çalışmanın amacı, COVID-19 pandemisinin Kayseri'deki anne ölümleri üzerine olan etkisini araştırmaktır.

Gereç ve Yöntem: Bu tanımlayıcı çalışmada, 2017-2021 yılları arasında Kayseri'de meydana gelen anne ölümleri incelenmiştir. Anne ölüm oranı, her yıl için toplam canlı doğum ve anne ölümü sayıları temel alınarak 100.000 canlı doğum başına düşen anne ölümü olarak Kayseri için hesaplanmıştır. Kayseri ve Türkiye'ye ait oranlar histogram ve box-plot grafiği kullanılarak görselleştirilmiştir. İstatistiksel analizler SPSS kullanılarak gerçekleştirilmiş ve P<0.05 olması istatistiksel olarak anlamlı kabul edilmiştir. Gruplar arasındaki ortalama farklılıkları değerlendirmek için Student's t-testi kullanılmıştır.

Bulgular: Kayseri için anne ölüm oranı 2017 yılında 100.000 canlı doğumda 18,6 iken 2021 yılında 100.000 canlı doğumda 80'e yükselmiştir. Vakaların %84,6'sında gebelikle ilişkili en az bir risk faktörü mevcut olup, obezite en yaygın risk faktörüdür (%34,4). COVID-19'a bağlı ölümler (%30,6) anne ölümlerinin önde gelen nedenidir. İl sağlık müdürlüğü raporlarına göre, ölümlerin %73,1'i dolaylı ve %38,5'i önlenebilir olarak sınıflandırılmıştır.

Sonuç: Kayseri'de 2021 yılında, özellikle COVID-19'un delta varyantının aktif olduğu yıl boyunca, anne ölümlerinde önemli ve olağandışı bir artış olmuştur. Dolaylı anne ölümleri ön planda olup, bunların çoğunun önlenemez olduğu bildirilmiştir.

Anahtar Kelimeler: Anne ölümü, COVID-19, Koronavirüs

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Introduction

The immunological and physiological changes that occur during pregnancy make pregnant women more susceptible to respiratory infections and complications (1). In particular, the involvement of the cardiopulmonary system increases the susceptibility of pregnant individuals to infections and poses a risk in terms of respiratory failure. As a consequence of maternal respiratory failure, adverse pregnancy outcomes such as hypoxemia, fetal distress, miscarriage, and preterm birth can occur (2). When examining the impact of COVID-19 on pregnancy, it has been observed that COVID-19 positive pregnant women have a higher likelihood of preterm birth, admission to the intensive care unit, and admission of their babies to the neonatal intensive care unit compared to others. Additionally, an increased risk of maternal mortality has been observed (3). In pregnant women diagnosed with COVID-19, it has been found that there is an increased risk of maternal and perinatal mortality compared to those without the diagnosis. In pregnant women experiencing severe COVID-19 symptoms, the risk of serious maternal complications is 2.5 times higher, the risk of perinatal complications is 1.8 times higher, and the likelihood of referral to an intensive care unit, hospitalization, or death is increased by 11.8 times compared to non-pregnant individuals (4). Centers for Disease Control and Prevention (CDC) advises pregnant women to be aware of the potential risks associated with severe COVID-19 disease and to take all necessary precautions to avoid exposure to COVID-19 (5).

Direct maternal deaths are deaths caused by obstetric complications, medical interventions, negligence and improper treatment during pregnancy, birth and postpartum period. Indirect maternal deaths are deaths caused by a non-obstetric disease that existed before pregnancy or developed during pregnancy, exacerbated by the physiological changes of pregnancy (6). COVID-19 not only directly affects pregnant and postpartum women, leading to more severe illness and various complications but also indirectly impacts maternal health, increasing maternal mortality due to its secondary effects (7) . Indirect effects are caused by factors such as travel restrictions during the pandemic, limited availability of resources, inadequate infection control measures, individuals' reluctance to seek healthcare due to fear of contracting the infection, and disruptions in the routine functioning of healthcare systems, leading to challenges in healthcare service delivery. These factors contribute to the indirect impact of COVID-19 on maternal health (7, 8). World Health Organization (WHO), in a report related to the provision of essential healthcare services during the COVID-19 pandemic, has warned that all healthcare services, including essential healthcare services for maternal health, have been disrupted, and this situation could lead to an increase in maternal mortality (9). Due to the measures taken to protect individuals from COVID-19 and to treat those who are infected, pregnant women may face difficulties in accessing both essential and other healthcare services. This can increase the risk of mortality, especially for high-risk pregnancies and obstetric emergencies (7). In a study conducted in 118 countries, it has been estimated that a reduction in the coverage of maternal health services by 9.8% to 18.5% over six months during the COVID-19 pandemic would result in an additional 12,200 maternal deaths. Similarly, a more significant reduction in coverage by 39.3% to 51.9% would lead to an additional 56,700 maternal deaths. These additional deaths correspond to a monthly increase in maternal mortality ranging from 8.3% to 38.6% (10).

On the other hand, while research in many countries has concluded that maternal mortality ratios during the pandemic exceeded expectations, there are also publications suggesting that COVID-19 infection is associated with an increased risk of admission to intensive care and mechanical ventilation during pregnancy but may not be directly linked to an increased risk of mortality (11, 12) . To our knowledge, there have been only a few hospital-based studies on this topic in Türkiye, and these studies have not covered the entire province or region (13).

The aim of this study is to investigate the impact of the COVID-19 pandemic on maternal mortality in the province of Kayseri, Türkiye.

Material And Method

This descriptive study retrospectively examined maternal deaths in all healthcare institutions under the Kayseri Provincial Health Directorate between January 2017 and December 2021. This study utilized data from the 'Maternal Death Registration Forms' provided by the Kayseri Provincial Health Directorate. The research collected and analyzed data on particular sociodemographic factors, gravidity, parity, miscarriages, living children, prenatal care visits, and the duration between the last pregnancy and the current pregnancy. To present the findings, descriptive frequency tables were generated.

The maternal mortality ratio, defined as the number of maternal deaths per 100,000 live births, was calculated for Kayseri based on the total number of live births and maternal deaths for each year. The number of live births for each year is based on data from the Turkish Statistical Institute (14). Maternal mortality ratios for the entire country of Türkiye were obtained from the Health Statistics Yearbook for each year (15). Data for Kayseri and Türkiye were visualized using box-plot and histogram.

Descriptive and frequency tables were created for data related to maternal risk factors, timing of maternal deaths, and methods of pregnancy termination. Information regarding the locations of births and maternal deaths was collected. The number of prenatal care visits before and during the pandemic was obtained, the normal distribution of the data was tested using the Shapiro-Wilk test, and the mean differences between groups were evaluated using the Student's t-test. P-value of <0.05 was considered statistically significant.

The causes, types, and preventability status of maternal deaths were examined. While the types of deaths reported by the Ministry of Health (Central) and Provincial Health Directorate were categorized into three groups as direct, indirect, and unspecified, the causes of deaths were divided into three groups as preventable, non-preventable, and unknown. Deaths caused by the three delay models, consisting of reasons related to the expectant mother, problems related to transport to the health facility, and delays after transport to the health facility, were considered preventable, while the others were considered non-preventable (6). Those categorized as 'unknown' are cases where the reports have not yet been completed.

Written permission was obtained from Kayseri Provincial Health Directorate and ethical approval dated 02.08.23 and numbered 2023/99 was obtained from Erciyes University Clinical Research Ethics Committee. SPSS 20.0 statistical programme was used to evaluate the data.

Results

Between January 2017 and December 2021, 28 maternal deaths occurred in Kayseri, two of which were excluded from the evaluation as they were considered accidental. In the assessed maternal deaths, the average age of the mothers at the time of death was found to be 32.1± 6.6 years (min: 19, max: 44). Some sociodemographic characteristics, chronic medical conditions, obstetric histories and risk factors of the cases are presented in

Table 1. COVID-19 was the most common cause of death (33.3%, n:5) among mothers without chronic disease (n:15). Among mothers who died from COVID-19 (n:9), 55.5% (n:5) had no chronic disease. When investigating the risk factors associated with maternal mortality related to COVID-19, it is evident that the most significant factors are obesity (44.4%, n:4) and being above 35 years of age (44.4%, n:4).

Table 1. Some Sociodemographic Characteristics, Chronic Diseases, Obstetric Histories, Risk Factors of The Mothers.

Nationality	**Value**	**%**
Türkiye	23	88.5
Foreign	3	11.5
Educational Status		
Primary school	11	42.3
High school	9	34.6
University	3	11.5
Unknown (Refugee)	3	11.5
Chronic diseases		
Cardiovascular disease	4	15.4
Diabetes mellitus	1	3.8
Epilepsy	1	3.8
Asthma	1	3.8
None	15	57.7
Unknown	4	15.4
Total	26	100.0
Obstetric Histories	**Mean**	**SD**
Gravidaa	3.0	2.1
Parity	2.1	1.3
Number of miscarriage[a]	0.6	1.6
Number of living childrena	2.0	1.4
Number of prenatal visits	9.8	5.1
Interpregnancy interval (in months)	62.2	45.0
Risk Condition	**Value**	**%**
Present	22	84.6
Unknown	4	15.4
Total	26	100.0
Risk Factors[b]		
Obesity	9	34.4
Pregnancy after age 35	8	30.6
Rh incompatibility	5	19.1
History of previous C-section	5	19.1
Smoking	4	15.3
Cardiovascular disease	4	15.3
IVF pregnancy	2	7.6
Short inter-pregnancy interval (<2 years)	1	3.8
Others (asthma,DM,epilepsy)	3	11.5

[a]Data for three refugees were unavailable, leading to their exclusion from the analysis.
[b]Multiple risk factors may be present.

When examining the number of live births and maternal deaths in the Kayseri province by year; in 2017, there were 21,519 live births and 4 maternal deaths, in 2018, there were 20,770 live births and 2 maternal deaths, in 2019, there were 19,542 live births and 4 maternal deaths, in 2020, there were 18,070 live births and 2 maternal deaths, in 2021, there were 17,480 live births and 14 maternal deaths. Maternal mortality ratios were calculated using data obtained from recorded maternal deaths by year (Figure 1 and Figure 2).

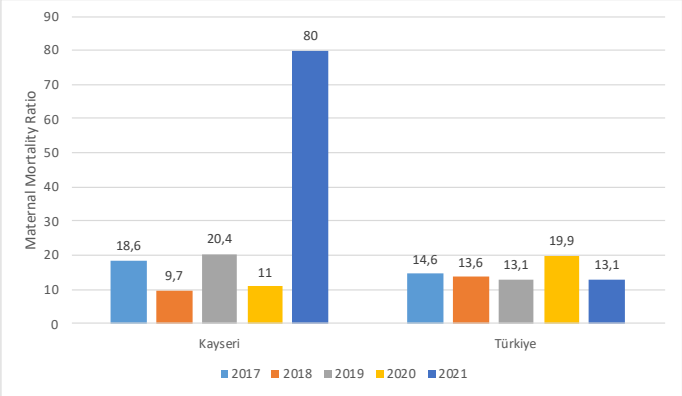

Figure 1. Distribution of Maternal Mortality Ratios in Kayseri and Türkiye Between 2017-2021

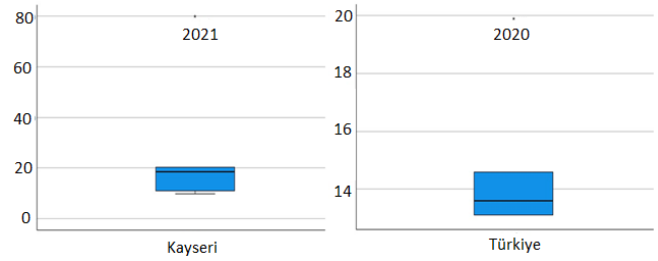

Figure 2. Box-Plot Representation of Maternal Mortality Ratios in Kayseri and Türkiye Between 2017-2021

Deaths occurred during the antepartum period in 7.7% (n:2) of cases and during the intrapartum period in 7.7% (n:2) of cases. The mean gestational age at death in the antepartum period was 28.0 ± 15.5 weeks. 73.1% (n:19) of maternal deaths occurred in the postpartum period, within 42 days, with a mean time to death in the postpartum period of 9.2 ± 11.4 days. Among those who died in the intrapartum-postpartum period, the most common type of abortion was C/S (65.3%, n:17) and the second most common type was vaginal delivery (7.7%, n:2). The most common pregnancy termination methods of mothers who died due to COVID-19 were C/S (55.5%, n:5) and vaginal delivery (22.2%, n:2), respectively.

Among the mothers who gave birth, third level health facilities were the most common place of delivery (85.7%, n:18), followed by second level health facilities (14.3%, n:3). Among mothers with a completed pregnancy, the mean gestational age at which the pregnancy ended was 31.2 ± 8.8 weeks. 71.4% (n:15) of newborns are alive at the end of pregnancy.

The places where maternal deaths occur most frequently are, respectively, third level health facilities (84.6%, n:22) and second level health facilities (3.8%, n:1). 11.5% (n:3) of the deaths occurred in unknown locations.

In terms of prenatal care (PNC), the average number of first level PNC visits is 2.8 ± 1.4, the average number of second level PNC visits is 3.0 ± 3.1, and the average number of third level PNC visits is 3.8 ± 3.7. When the number of prenatal care (PNC) visits was evaluated with reference to the year 2020, the year in

which the first case was seen in Türkiye, the average number of PNC visits before the pandemic (2017-2019) was 9.7 ± 6.3, while the average number of PNC visits during the pandemic (2020-2021) was 9.9 ± 4.2, and no statistically significant difference was observed between them. (P=0.94).

Table 2. Causes, Types and Preventability of Maternal Deaths

Causes of death[a]	Value	%
COVID-19	9	30.6
DIC	4	13.6
Hypertensive disorder	3	10.2
Amniotic fluid embolism	2	6.8
Cardiac disorder	2	6.8
HELLP syndrome	1	3.4
Viral pneumonia (COVID-19 Compatible Chest CT)	1	3.4
Pulmonary embolism	1	3.4
Obstetric haemorrhage	1	3.4
Unknown	5	17.0
According to the decision of the Central Committee on Maternal Death, the type of death		
İndirect	7	26.9
Direct	7	26.9
Unspecified	12	46.2
According to the decision of the Central Committee on Maternal Death, preventability status		
Unpreventable	10	38.5
Preventable	4	15.4
Unknown	12	46.2
According to the decision of the Provincial Committee on Maternal Death, the type of death		
İndirect	19	73.1
Direct	4	15.4
Unspecified	3	11.5
According to the decision of the Provincial Committee on Maternal Death, preventability status		
Unpreventable	13	50.0
Preventable	10	38.5
Unknown	3	11.5
Total	26	100.0

[a] Multiple causes of death may exist.

The causes, types and preventability of maternal deaths are examined in Table 2. The leading cause of death is COVID-19-related deaths (30.6%). In Kayseri, 64.3% (n:9) of deaths in 2021, at the peak of maternal mortality, were due to COVID-19. All of the COVID-19-related deaths occurred in the year 2021. According to the Ministry of Health's report, both direct and indirect maternal deaths were found to have a ratio of 26.9%, and it was determined that 15.4% of the deaths were preventable. According to the Provincial Directorate of Health, 73.1% of deaths are indirect. 38.5% of these are preventable.

Discussion

According to the results of our study, maternal mortality ratios in the Kayseri province followed a normal trend up until the year 2020, which is considered the beginning of the pandemic in Türkiye. However, in 2021, there was a sudden increase, reaching 80 per 100,000 live births. When looking at the overall trend in Türkiye, there was an unusual increase in 2020 (19.9 per 100,000 live births), but in 2021, it appeared to be similar to the pre-pandemic period (13.1 per 100,000 live births).

The difference in trends between Kayseri and Türkiye as a whole may be influenced by the variation in the distribution of COVID-19 cases across provinces and over time in Türkiye. According to the Health Statistics Yearbook, the maternal mortality ratio in the Central Anatolia region, which includes Kayseri, is higher compared to the Turkish average (16). Additionally, Türkiye implemented comprehensive restriction measures even when the number of COVID-19 cases was relatively low due to the declaration of the pandemic, effectively preventing rapid spread of the virus. Consequently, the impact of the pandemic became evident in our country towards the end of 2020 and the beginning of 2021(17). On the other hand, the identification of the delta variant as a genetic variant of SARS-CoV-2 in May 2021, and its documented effect in increasing maternal mortality ratios in the literature, also support this situation (13, 18) .

In a study conducted, it was observed that maternal deaths in Colombia in 2020 were 12.6% higher than expected (12) . When looking at U.S. data, there was an 18.4% increase in maternal deaths in 2020 compared to the previous two years (19). A similar increase in Türkiye can also be attributed to the impact of the COVID-19 pandemic on maternal mortality ratios. In Brazil, it was reported that there was a 223% increase in maternal deaths related to COVID-19 in 2021 compared to 2020 (20). Similarly, in Kayseri province, there was a peak in maternal mortality ratios in 2021. This finding may also support the effect of the pandemic in increasing maternal mortality ratios. In Türkiye, despite the increase observed in 2020, the return of maternal mortality ratios to their normal levels in 2021 may have been influenced by the positive effects of vaccination. COVID-19 vaccination in Türkiye began on January 14, 2021, and vaccination ratios steadily increased. As of May 24, 2021, the proportion of the population who received the first dose of the vaccine was 19.1%, and as of August 14, 2021, this ratio was calculated to be 70.6% (21, 22) . Indeed, it is known that women who have been vaccinated have a reduced risk of severe symptoms, complications, and death (4). On the other hand, in one study, the fact that the median vaccine coverage rate in Kayseri in July 2021 was lower than that of Türkiye as a whole can be reconciled with the dramatic increase in maternal mortality in Kayseri in 2021, unlike Türkiye as a whole (23).

When examining the causes of maternal mortality, it is observed that in recent years, indirect causes have become one of the leading causes of maternal deaths in various parts of the world (24). In Türkiye, over the years, while the role of direct causes among the causes of maternal mortality has decreased, the influence of indirect causes has proportionally increased (6). According to the results of our study, when looking at commission reports in Kayseri province, it is similarly evident that indirect causes of maternal mortality are prominent. According to the Central Review Commission data, both indirect and direct causes of maternal mortality are equally represented (Table 2). The difference may be due to maternal deaths reported as unknown or unspecified causes.

According to WHO data, most maternal deaths that occurred in 2020 were due to preventable causes (25). However, according

to our study, both pre-pandemic and pandemic-related maternal deaths, as reported in both the Central Review Commission and Kayseri province commission reports, are largely not preventable (Table 2). Despite the relatively high maternal mortality ratios in our country compared to the average maternal mortality ratio in developed countries, the fact that the majority of maternal deaths are attributed to non-preventable causes raises questions about the need to reevaluate measures against maternal mortality in Türkiye (26).

According to the The Turkey National Maternal Mortality Study Report for the year 2019, the most common causes of maternal mortality in Türkiye were cardiovascular diseases (29%), embolism (16.1%), hypertension (14.2%), and hemorrhage (10.3%) (6). However, in our study, it is observed that COVID-19-related deaths were the most common cause. Despite our study's time frame (2017-2021) encompassing the pre-pandemic period, the fact that COVID-19 ranks first among the causes of death may indicate its direct impact on maternal mortality.

It is known that the COVID-19 pandemic has created challenges for the clinical management of pregnant women, not only due to its direct effects but also because of its impact on the provision of regular antenatal care (27). Indeed, at the beginning of the pandemic, such concerns were evaluated in the literature, and it was reported that even pregnant women who reached healthcare facilities could not receive timely care (28) . It is also known that the quality of antenatal care, including access to antenatal care and health services, affects maternal mortality ratios. Therefore, studies have been conducted in this regard, and the pandemic has been shown to further affect the utilization of healthcare services for women, especially in regions with high maternal mortality ratios, such as sub-Saharan Africa (10, 29). It should be noted that not only developing countries but also developed countries have faced challenges in dealing with the COVID-19 pandemic. Among the reasons cited for these challenges are the inability of primary healthcare services to meet the demands of patients and insufficient intensive care unit (ICU) and bed capacities relative to the population (30). However, our study shows that the average number of antenatal visits, which is an indicator of the quality of antenatal care, was not affected by the pandemic, indicating that efforts were made to maintain basic healthcare services in our country. Türkiye is known to have one of the best ICU capacities among OECD countries (31). The dedicated work of healthcare professionals and sufficient bed capacity likely contributed to the continuation of basic healthcare services under challenging conditions such as the pandemic. Furthermore, this situation raises the possibility that the increased maternal mortality ratio observed in our country and specifically in Kayseri province during the pandemic may have stemmed from the direct impact of the COVID-19 pandemic.

Conclusion

In Kayseri province, there has been a significant increase in maternal mortality ratios, especially during the year 2021, when the delta variant of COVID-19 was active. Indirect maternal deaths have been predominant, and most of them have been reported as non-preventable. The increased deaths are thought to be related to the direct impact of COVID-19. The vaccination status of the cases is unknown, and in future studies, when evaluated in conjunction with immunity status and other potential confounding factors, a more detailed assessment of the impact of COVID-19 on maternal mortality can be conducted.

Limitations And Suggestions

The fact that our study was conducted in only one city may be a limitation in generalizing to the whole community. In future studies, it would be useful to make evaluations based on a larger population.

CONFLICT OF INTEREST

No conflict of interest.

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Ethics Committee Approval

Written permission was obtained from Kayseri Provincial Health Directorate and ethical approval dated 02.08.23 and numbered 2023/99 was obtained from Erciyes University Clinical Research Ethics Committee.

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