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Evaluation of stillbirths and infant mortality before and during the COVID-19 pandemic: a retrospective study

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ABSTRACT

Objective: The maternal-child health services remain an important indicator to look at how different countries have handled the pandemic. This study aims to investigate the effect of the COVID-19 pandemic on maternal and child healthcare use and evaluate data on stillbirths and infant mortality.

Methods: In this descriptive, cross-sectional study, a retrospective analysis was performed on 293 stillbirths and 324 infant deaths, which occurred in Samsun Province of Turkey between 1 March 2018 and 1 March 2021. The study period was examined in three groups as pre-pandemic period 1 (1 March 2018–28 February 2019), pre-pandemic period 2 (1 March 2019–29 February 2020) and pandemic period (1 March 2020–28 February 2021).

Results: The study found that the share of difficulties in delivering health-care services to the families (may be due to reasons such as difficulty in accessing health services for those living in rural areas, disruption of the referral chain) in stillbirths and infant deaths has decreased during the COVID-19 pandemic compared to previous years ($p = 0.037$ in stillbirths, $p = 0.002$ in infant deaths). The mean number of follow-up visits during pregnancy has partially reduced during the pandemic ($p > 0.05$). Other variables of the health-care services have remained similar to years before the pandemic ($p > 0.05$). The rate of families without health insurance ($p = 0.001$ in stillbirths, $p = 0.001$ in infant deaths) and unemployed persons contributing to family budget ($p = 0.012$ in stillbirths, $p = 0.016$ in infant deaths) has significantly decreased during the pandemic.

Conclusions: In our study, it was determined that the variables of stillbirth and infant mortality during the COVID-19 pandemic period, and maternal and child health services in primary care and hospitals continued to provide services in a similar way to the pre-pandemic period. Compared to pre-pandemic periods during the COVID-19 pandemic, it was found that while the number of stillbirths was similar, there was a significant decrease in infant mortality.

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COVID-19; infant mortality; stillbirth; pandemic; healthcare

Introduction

The maternal mortality ratio and the infant mortality rate are important indicators in determining the overall health status of countries in international comparisons. These parameters reflect the status of public health systems and the level of socioeconomic development in a particular country [1]. Infant deaths account for 75% of under-five deaths, 40% of these deaths occur in the neonatal period, and 75% of deaths in the neonatal period occur in the first week of life [2]. In 2019, approximately 80 million women gave birth in health-care facilities worldwide, and this number is three times the number of births in the health-care facilities in 2000 [3]. A substantial decrease has been observed in maternal deaths and perinatal and infant deaths in the last 20 years, which are among the essential indicators of health-care services because more women and their infants have accessed effective health-care services before, during, and after pregnancy [2]. The definition of perinatal deaths (stillbirths and neonatal deaths)

varies globally [4,5], so it may differ when comparing internationally. World Health Organization [6] defines a stillbirth as a baby born with no signs of life $\geq 28+0$ weeks' gestation, but Australia recognizes stillbirths from 20+ 0 weeks, whereas some countries (e.g. Italy) do not have a specific terminology for 'stillbirth,' instead using the broader 'intrauterine deaths.' Infant mortality in our country is defined as the death of a baby for any reason within 365 days after birth [6]. Stillbirth is defined as intrauterine fetal death after 22 weeks of gestation or intrauterine death of a fetus weighing at least 500 g [6]. A decrease has also been observed in recent years in the infant mortality rate in Turkey. The infant mortality rate in Turkey was 10.6 in 2011 and decreased to 9.1 in 2019. The mortality rate in Samsun Province was 8.6 deaths per thousand live births in 2019, and it is known that there has been a substantial decrease in the number of stillbirths and infant deaths in our province in recent years [7].

It is anticipated that the delivery of health-care services, including maternal and newborn health-care services, will be negatively affected by the COVID-19 pandemic in countries with limited resources [8]. Although restrictions have been imposed on elective and outpatient health-care services at the initial stages of the pandemic to reduce the burden of the outbreak on the health-care resources and place focus on the privileged areas such as emergency and basic clinical services, maternal and prenatal services have continued their usual activities during the pandemic [9]. Many modeling studies suggest that a 10% modest decrease in access to health-care services during pregnancy and infancy in relation to the COVID-19 pandemic would result in 168,000 additional infant deaths worldwide [10]. In an analysis using the Lives Saved Tool in 118 countries, it was estimated that an approximately 15% decrease in the coverage of health-care services over 6 months would cause 253,500 additional child deaths [11]. Also, many studies evaluating the factors affecting stillbirths and infant deaths in the first months of the pandemic have found no considerable change in the number of stillbirths and infant deaths [12,13]. Many studies have been conducted on the epidemiology, clinical characteristics, and the prevention of COVID-19 and the effective management of the treatment process. However, there is limited information in the literature regarding the factors associated with stillbirths and infant deaths, which are used as important outputs in determining the status of health-care services during the COVID-19 pandemic. This study aims to investigate the effect of the COVID-19 pandemic on maternal and child health-care use and evaluate data on stillbirths and infant mortality.

Materials and methods

In this descriptive, cross-sectional study, 293 stillbirths and 324 infant deaths that occurred in Samsun Province of Turkey between 1 March 2018 and 1 March 2021 were evaluated. Samsun Province is located in the Central Black Sea region in the north of Turkey and has a population of 1.4 million people. The demographic structure and health statistics of the society in our city are close to the Turkey average [14]. It can be said that the health services in Samsun are qualitatively similar to other regions of Turkey. The data on deaths were retrieved from a retrospective record-based data of the Provincial Health Directorate 'Perinatal and Infant Mortality Information Form' [15] and the 'Provincial Infant Mortality Investigation Commission Study Form' [15]. In addition, the data were confirmed by the information provided in the 'Death Reporting System' (DRS). The DRS is a web-based application allowing data exchange among the relevant units of the Turkish Ministry of Health, General Directorate of Civil Registration and Citizenship, and Turkish Statistical Institute for thorough, rapid, and quality compilation of death statistics [16]. The study was approved by the Ondokuz Mayıs University Clinical Trials Ethics Committee and Samsun Provincial Health Directorate. The dates of birth and death, information about health-care services (health-care facility where pregnancy follow-ups have been undertaken, number of pregnancy follow-ups, place and facility where the child was delivered, follow-up visits of the infant, etc.), maternal and pregnancy data (type of

pregnancy, duration of pregnancy, maternal age at the time of delivery, consanguinity between parents, blood incompatibility between mother and father, maternal educational level, etc.), information about the infant (gender, birth weight, presence of a congenital anomaly, jaundice in the infant, vaccination status, and nutritional status of the infant, etc.) on the Perinatal and Infant Mortality Information Form were recorded. The study data were compared in three groups as pre-pandemic control period 1–2 and pandemic period.

March 2018–February 2019 (Group 1); Stillbirths and infant deaths between 1 March 2018 and 28 February 2019.

March 2019–February 2020 (Group 2); Stillbirths and infant deaths between 1 March 2019 and 29 February 2020.

March 2020–February 2021 (Group 3, The period of COVID-19 pandemic); Stillbirths and infant deaths between 1 March 2020 and 28 February 2021.

Definitions

Prematurity is defined as childbirth before the completion of 37 weeks of gestation [5,15].

The presence of high-risk pregnancy is defined as complications (hemorrhage, preeclampsia–eclampsia, gestational diabetes, thrombosis, embolism) occurring during pregnancy and the presence of high risk in prenatal screening tests (double test, triple test) [17].

Statistical analysis

The study data were analyzed using IBM Statistical Package for the Social Sciences (SPSS) for Windows 21.0 software package (Statistical Package for the Social Sciences, Chicago, IL, ABD). The discrete data were expressed as frequency and percentage. The continuous data were expressed as mean and standard deviation. A Mann–Whitney *U* test was used to compare the mean values between the groups. A Pearson's chi-square test or Fischer's exact test was used to compare categorical variables. A *p*-value of less than 0.05 was considered significant in all tests.

Results

In the dates determined in the study, there were 13,905 live births in pre-pandemic period-1, 14,116 live births in pre-pandemic period-2, and 13,607 live births in the pandemic period. The number of stillbirths was 91 (stillbirth rate 6.5 per 1000 live births), and the number of infant deaths was 126 (infant mortality rate 9.1 per 1000 live births) in Group 1. The number of stillbirths was 102 (stillbirth rate 7.2 per 1000 live births), and the number of infant deaths was 108 (infant mortality rate 7.6 per 1000 live births) in Group 2. During the COVID-19 pandemic (Group 3), the number of stillbirths was 100 (stillbirth rate 7.3 per 1000 live births), and the number of infant deaths was 90 (infant mortality rate 6.6 per 1000 live births). There was a significant decrease in the number of infant deaths during the COVID-19 pandemic ($p < 0.001$).

As shown in Tables 1 and 2, the mothers suffering a stillbirth or the death of their babies during the COVID-19 pandemic had been most commonly followed up by the

Table 1. Variables of health care in stillbirths.

	Stillbirths			<i>p</i>
	March 2018– February 2019, <i>n</i> (%)	March 2019– February 2020, <i>n</i> (%)	March 2020– February 2021 (The Period of COVID-19 Pandemic), <i>n</i> (%)	
The type of facilities following the mothers				0.206*
Primary health-care center	82(31.1)	93(35.2)	89(33.7)	
Public hospital	1(8.3)	3(25.0)	8(66.7)	
Private hospital, clinic & sector	3(33.3)	3(33.3)	3(33.3)	
Number of follow-ups of the mother during pregnancy				0.128*
No visit	1(50.0)	1(50.0)	0(0.0)	
1–3 visits	44(24.9)	64(36.2)	69(39.0)	
>4 visits	40(38.1)	35(33.3)	30(28.6)	
Number of follow-ups of the mother during pregnancy (mean ± SD) ^a	4.08 ± 2.61	3.67 ± 2.50	3.45 ± 1.83	0.019**
The difficulties experienced by the families in accessing health-care services				0.037*
Yes	0(0.0)	5(83.3)	1(16.7)	
No	88(31.2)	95(33.7)	99(35.1%)	
Place of delivery/death				0.368*
Healthcare facility	90(31.0)	102(35.2)	98(33.8)	
Home – without health personnel	1(33.3)	0(0.0)	2(66.7)	
Health facility where delivery/death took place				0.255*
Secondary and tertiary public hospital	39(31.2)	49(39.2)	38(29.6)	
University hospital	23(25.3)	33(36.3)	35(38.5)	
Private hospital, clinic & sector	28(38.4)	20(27.4)	25(34.2)	
The presence of high-risk pregnancy				<0.001*
Yes	2(5.7)	1(2.9)	32(91.4)	
No	86(34.3)	97(38.6)	68(27.1)	
Type of delivery				0.821*
Vaginal	38(28.8)	49(37.1)	45(34.1)	
Cesarean section	46(30.3)	51(33.6)	55(36.2)	

*Ki-kare test, **Mann-Whitney-*U* test. Mann-Whitney *U* test with Bonferroni's correction, a; Number of follow-ups of the mother during pregnancy Grup 1-Grup 2; *p* = 0.423, Grup 1-Grup 3; *p* = 0.022, Grup 2-Grup 3; *p* = 0.231.

primary care facilities during their pregnancy, but the type of facilities following the mothers ($p = 0.206$) and the number of follow-ups ($p = 0.128$) were similar to those in years before the pandemic. All mothers suffering a stillbirth or the death of their infants during the COVID-19 pandemic had undergone pregnancy follow-up. The difficulties experienced by the families in accessing health-care services were the most common in 2019 (stillbirth 83.5%, infant death 88.9%) and the least common (stillbirth 16.7%, infant death 0.0%) during the COVID-19 pandemic ($p = 0.002$ for stillbirth, $p = 0.037$ for infant death) (Tables 1 and 2). Among the stillbirths occurring during the COVID-19 pandemic, the rate of home birth without the assistance of health-care staff (66.7%) was higher than the rates in years before the pandemic (33.3% in 2018 and 0.0% in 2019), but the difference was not statistically significant ($p = 0.368$) (Table 1). In the analysis of stillbirths and infant deaths, the time interval between the last childbirth and the index pregnancy was higher during the COVID-19 pandemic than in other years ($p < 0.001$ and $p = 0.002$, respectively) (Tables 3 and 4).

The ratio of female infant deaths gradually decreased over the years, and the mortality rate in female infants was the lowest (23.3%) during the COVID-19 pandemic (47.3% in 2018 and 29.5% in 2019) ($p = 0.019$) (Table 4). The rate of congenital

anomalies was higher among the infant deaths occurring during the COVID-19 pandemic (51.7%) than in previous years (34.5% in 2018 and 13.8% in 2019) ($p = 0.006$) (Table 4). The analysis of maternal education level revealed that the rate of illiterate mothers was lower during the COVID-19 pandemic than in previous years (20.0% in stillbirths, $p = 0.672$; 9.1% in infant deaths, $p = 0.034$). The rate of unemployment among persons who typically contribute to family income and the rate of families without social security were higher in 2018 [(75.0%) for stillbirths, (100.0%) for infant deaths] and 2019 [(25.0%) for stillbirths, (0.0%) for infant deaths] and significantly decreased during the COVID-19 pandemic [(0.0%) for stillbirths, (0.0%) for infant deaths] ($p = 0.012$ and $p = 0.001$ for stillbirths; $p = 0.016$ and $p = 0.001$ for infant deaths) (Tables 3 and 4). The ratio of fully vaccinated infants decreased (25.5%) among the infant deaths occurring during the COVID-19 pandemic, whereas the ratio of non-vaccinated infants increased (40.0%) ($p = 0.122$) (Table 4).

Discussion

Maternal and child health is an important parameter in determining the extent and characteristics of the problems in the healthcare system, monitoring and evaluating health-care

Table 2. Variables of health care in infant mortality.

	Infant mortality			<i>p</i>
	March 2018– February 2019, <i>n</i> (%)	March 2019– February 2020, <i>n</i> (%)	March 2020– February 2021 (The Period of COVID-19 Pandemic), <i>n</i> (%)	
The type of facilities following the mothers				0.570*
Primary health-care center	119(38.6)	102(33.1)	87(28.2)	
Public hospital	2(40.0)	2(40.0)	1(20.0)	
Private hospital, clinic & sector	0(0.0)	1(33.3)	2(66.7)	
Number of follow-ups of the mother during pregnancy				0.628*
No visit	0(0.0)	0(0.0)	0(0.0)	
1–3 visits	71(37.6)	64(33.9)	55(28.6)	
>4 visit	49(39.2)	41(32.8)	35(28.0)	
Number of follow-ups of the mother during pregnancy (mean ± SD)	3.59 ± 2.14	3.78 ± 2.77	3.24 ± 1.63	0.248**
The difficulties experienced by the families in accessing healthcare services				0.002*
Yes	1(11.1)	8(88.9)	0(0.0)	
No	117(38.7)	96(31.8)	89(29.5)	
Place of delivery				
Healthcare facility	126(38.9)	108(33.3)	90(27.8)	
The presence of high-risk pregnancy				<0.001*
Yes	5(20.0)	1(4.0)	19(76.0)	
No	113(39.5)	103(36.0)	70(24.5)	
Type of delivery				0.450*
Vaginal	21(33.9)	25(40.3)	16(25.8)	
Cesarean section	101(39.3)	82(31.9)	74(28.8)	
The type of facilities following the baby				0.001*
Primary health care center	21(52.5)	10(25.0)	9(22.5)	
Secondary and tertiary public hospital	4(14.3)	7(25.0)	17(60.7)	
University Hospital	8(21.1%)	9(23.7)	21(55.3)	
Private hospital, clinic & sector	10(22.7%)	6(13.6)	28(63.6)	
Referral to a higher-level facility				<0.001*
Yes	6(19.4)	7(22.6)	18(58.1)	
No	108(40.0)	97(35.9)	65(24.1)	
Place of death				0.993*
Healthcare facility	116(39.2)	98(33.1)	82(27.7)	
Home – without health personnel	10(35.7)	10(35.7)	8(28.6)	
Health facility where death took place				0.370*
Secondary and tertiary public hospital	14(29.8)	16(34.0)	17(36.2)	
University Hospital	53(40.5)	47(35.9)	31(23.7)	
Private hospital, clinic & sector	49(41.9)	34(29.1)	34(29.1)	

*Ki-kare test, **Mann–Whitney *U* test.

services, prospectively developing policies, and implementing preventive measures [17–19]. The health-care services have interrupted during the COVID-19 pandemic in many countries, and it was demonstrated that the disease outbreak had caused an increase in infant deaths [19]. It is known that the follow-up of pregnant women and maternal and child health-care services in Turkey have continued as usual during the pandemic. In 2020, the infant mortality rate was 7.2 per thousand live births in Samsun Province, showing a decrease compared to previous years [20]. For an effective planning of health-care services, it is important to know the variables related to health-care services and maternal and child health care that might have affected stillbirths and infant deaths during the COVID-19 pandemic.

In our study, it was found that the number of stillbirths and infant deaths decreased during the pandemic compared to

previous years. According to our results, the fact that families have fewer difficulties in accessing health services in our province during the pandemic period, the facility where the pregnancy follow-up of mothers is carried out is similar over the years, the fact that the number of follow-ups of the mother during pregnancy did not change during the COVID-19 period may have contributed positively to the decrease in the number of stillbirths and infant deaths. These situations illustrate the critical importance of not interrupting the delivery of health care. According to the 2018 Prenatal and Postnatal Care and Management Guidelines of the Turkish Ministry of Health, it is recommended that all pregnant women should undergo comprehensive follow-up at least four times during the pregnancy period, all births must take place in the hospital, and the patients must be referred to a higher-level facility, if required [21]. According to the Ministry of Health guide [21], during the

Table 3. Newborn, maternal, and pregnancy variables in stillbirths.

	Stillbirths			<i>p</i>
	March 2018– February 2019, <i>n</i> (%)	March 2019– February 2020, <i>n</i> (%)	March 2020– February 2021 (The period of COVID-19 pandemic), <i>n</i> (%)	
Gender				0.339*
Male	43(27.2)	59(37.3)	56(35.4)	
Female	48(35.1)	43(32.1)	44(32.8)	
Type of pregnancy				0.714*
Single	86(32.0)	89(33.1)	94(34.9)	
Multiple	4(23.5)	7(41.2)	6(35.3)	
Birthweight (g)				0.330*
0–1499	41(26.3)	61(39.1)	54(34.6)	
1500–2499	21(31.8)	19(28.8)	26(39.4)	
2500–4499	25(37.9)	21(31.8)	20(30.3)	
≥4500	2(66.7)	1(33.3)	0(0.0)	
Gestational age				0.087*
<28 weeks	25(22.9)	46(42.2)	38(34.9)	
28–37 weeks	41(33.3)	37(30.1)	45(36.6)	
≥37 weeks	25(41.0)	19(31.1)	17(27.9)	
Maternal age (years)				0.646*
<18	0(0.0)	0(0.0)	1(10.0)	
18–34	70(31.2)	76(33.9)	78(34.8)	
≥35	20(29.9)	26(38.8)	21(31.3)	
Mothers' educational Status				0.672*
No education	2(40.0)	2(40.0)	1(20.0)	
Primary	57(33.1)	59(34.3)	56(32.6)	
Secondary and above	29(26.1)	39(35.1)	43(38.7)	
The time interval between the last childbirth and the index pregnancy				0.018*
First birth	41(35.3)	41(35.3)	34(29.3)	
<2 years	22(40.0)	21(38.2)	12(21.8)	
≥2 years	28(23.0)	40(32.8)	54(44.3)	
Consanguinity between parents				0.118*
Yes	2(12.5)	5(31.2)	9(56.2)	
No	87(32.0)	95(34.9)	90(33.1)	
Blood incompatibility between parents				0.042*
Yes	3(21.4)	2(14.3)	9(64.3)	
No	86(31.3)	98(35.6)	91(33.1)	
Unemployment among persons who contribute to family income				0.012*
Yes	85(29.9)	99(34.9)	100(35.2)	
No	3(75.0)	1(25.0)	0(0.0)	
Presence of health insurance				0.001*
Yes	81(30.5)	86(32.3%)	99(37.2)	
No	7(33.3)	14(66.7)	0(0.0)	
Gestational age(week) (mean ± SD)	31.58 ± 5.89	29.93 ± 5.96	30.01 ± 5.93	0.098**
Birth weight (g) (mean ± SD) ^a	1867.24 ± 1308.99	1491.04 ± 1053.18	1523.26 ± 1028.58	0.045**
Maternal age (years) (mean ± SD)	29.62 ± 6.16	30.56 ± 6.07	29.84 ± 5.81	0.515**
The time interval between the last child birth and the index pregnancy (month) (mean ± SD) ^b	19.66 ± 23.48	42.04 ± 50.17	55.44 ± 46.90	<0.001**

*Ki-kare test, **Mann-Whitney *U* test. Mann-Whitney *U* test with Bonferroni's correction, a; Birth weight Grup 1-Grup 2, *p* = 0.060; Grup 1-Grup 3, *p* = 0.094; Grup 2-Grup3, *p* = 0.980. b; The time interval between the last child birth and the index pregnancy Grup 1-Grup2, *p* = 0.005; Grup 1-Grup 3, *p* < 0.001; Grup 2-Grup 3, *p* = 0.011.

follow-up period, physical examination, drug support, immunization services and treatments are offered to the pregnant woman. In addition, information and counseling services are provided throughout pregnancy. Difficulties that may occur in the mother's access to these services are, for example, transportation difficulties due to her being in the countryside, or the

fact that the patients who need to be referred cannot be referred due to problems. In this period, pregnancy follow-ups in primary health-care centers, public hospitals and private hospitals continued without any interruption. For this reason, difficulties in accessing health services are not caused by the inability to provide health services. The present study found

Table 4. Neonatal, maternal, and pregnancy variables in infant mortality.

	Infant mortality			<i>p</i>
	March 2018– February 2019, <i>n</i> (%)	March 2019– February 2020, <i>n</i> (%)	March 2020– February 2021 (The period of COVID-19 pandemic), <i>n</i> (%)	
Gender				0.019*
Male	57(32.0)	65(36.5)	56(31.5)	
Female	69(47.3)	43(29.5)	34(23.3)	
Type of pregnancy				0.556*
Single	107(37.7)	94(33.1)	83(29.2)	
Multiple	15(44.1)	12(35.3)	7(20.6)	
Birthweight (g)				0.596*
0–1499	66(40.0)	57(34.5)	42(25.5)	
1500–2499	23(35.9)	18(28.1)	23(35.9)	
2500–4499	36(38.3)	33(35.1)	25(26.6)	
≥4500 g				
Gestational age				0.763*
<28 weeks	47(40.2)	39(33.3)	31(26.5)	
28–37 weeks	47(40.5)	38(32.8)	31(26.7)	
≥37 weeks	32(35.2)	31(34.1)	28(30.8)	
Neonatal deaths				0.913*
Pre-neonatal (0–6 days)	55(37.4)	51(34.7)	41(27.9)	
Late-neonatal (7–27 days)	24(36.4)	22(33.3)	20(30.3)	
Post-neonatal (28–365 days)	47(42.3)	35(31.5)	29(26.1)	
Presence of a congenital anomaly				0.006*
Yes	10(34.5)	4(13.8)	15(51.7)	
No	116(39.3)	104(35.3)	75(25.4)	
Jaundice in the infant				0.698*
Physiological jaundice	3(50.0)	2(33.3)	1(16.7)	
No	114(42.1)	68(25.1)	89(32.8)	
Nutritional status of the infant				<0.001*
Not breastfed	56(28.7)	55(28.2)	84(43.1)	
Only breastfed	30(52.6)	23(40.4)	4(7.0)	
Breastfeeding and supplemental feeding	1(50.0)	0(0.0)	1(50.0)	
Vaccination status of the infant				0.122*
Fully vaccinated	24(43.6)	17(30.9)	14(25.5)	
Under-vaccinated	19(42.2)	12(26.7)	14(31.1)	
Non-vaccinated	43(27.7)	50(32.3)	62(40.0)	
Maternal age (years)				0.077*
<18	0(0.0)	1(25.0)	3(75.0)	
18–34	95(38.5)	82(33.2)	70(28.3)	
≥35	29(40.3)	26(36.1)	17(23.8)	
Mothers' educational status				0.034*
No education	7(63.6)	3(27.3)	1(9.1)	
Primary	66(38.4)	59(34.3)	47(27.3)	
Secondary and above	46(35.7)	42(32.6)	41(31.8)	
The time interval between the last childbirth and the index pregnancy				0.032*
First birth	52(39.1)	43(32.3)	38(28.6)	
<2 years	20(38.5)	23(44.2)	9(17.3)	
≥2 years	54(38.8)	42(30.2)	43(30.9)	
Consanguinity between parents				0.061*
Yes	12(35.3)	7(20.6)	15(44.1)	
No	111(38.9)	100(35.1)	74(26.0)	
Blood incompatibility between parents				0.247*

(Continued)

that the difficulties in delivering health-care services for pregnant women have significantly reduced during the COVID-19 pandemic. In the analysis of all deaths, it was found that most pregnancy follow-ups of the mothers were made in the primary

care facilities during the COVID-19 pandemic, similar to the years before the disease outbreak. In addition, most pregnant women suffering a stillbirth or the baby's death had one to three follow-up visits, and none of the patients had missed

Table 4. (Continued).

	Infant mortality			<i>p</i>
	March 2018– February 2019, <i>n</i> (%)	March 2019– February 2020, <i>n</i> (%)	March 2020– February 2021 (The period of COVID-19 pandemic), <i>n</i> (%)	
Yes	2(20.0)	3(30.0)	5(50.0)	0.016*
No	122(39.4)	104(33.5)	84(27.1)	
Unemployment among persons who contribute to family income				0.001*
Yes	113(36.9)	104(34.0)	89(29.1)	
No	5(100.0)	0(0.0)	0(0.0)	
Presence of health insurance				0.674**
Yes	102(36.6)	88(31.5)	89(31.9)	
No	16(50.0)	16(50.0)	0(0.0)	
Gestational age (weeks) (mean ± SD)	30.80 ± 5.96	31.27 ± 5.9	31.51 ± 5.89	0.759**
Birth weight (g) (mean ± SD)	1665.12 ± 1062.48	1762.39 ± 1101.18	1748.18 ± 1043.5	0.187**
Maternal age (years) (mean ± SD)	29.63 ± 5.95	29.16 ± 5.77	28.14 ± 5.96	0.002**
The time interval between the last child birth and the index pregnancy (month) (mean ± SD) ^a	28.54 ± 39.68	37.11 ± 49.36	44.58 ± 32.75	0.597**
Number of follow-ups of the baby (mean ± SD)	2.58 ± 2.11	2.53 ± 2.32	2.93 ± 2.29	

*Kil-kare test, **Mann-Whitney *U* test. Mann-Whitney *U* test with Bonferroni's correction. ^aThe time interval between the last child birth and the index pregnancy: Grup 1-Grup 2, *p* = 0.032; Grup 1-Grup 3, *p* = 0.006; Grup 2-Grup 3, *p* = 0.016.

follow-up visits during the COVID-19 pandemic. A study conducted in Nepal between January 2020 and May 2020 found decreased hospital visits and follow-up visits in pregnant women [22]. A study conducted in Italy found that most pregnant women fear going to the hospitals due to the risk of contracting the disease or vertical transmission [23]. Similar to the literature, the present study found a slight decrease in the mean number of pregnancy follow-up visits during the COVID-19 pandemic. This finding suggests that the mothers may have avoided hospital visits to reduce the risk of COVID-19 transmission.

The present study found a higher rate of stillbirths among home births during the pandemic than in previous years; however, the difference was not statistically significant. Many studies have reported increased anxiety due to the COVID-19 threat in pregnant women [23–25]. The anxiety and fear related to hospital visits during the disease outbreak have changed most women's childbirth plans and increased the number of home births [23,25,26]. In the analysis of deaths, the type of health-care facility where the childbirth took place during the pandemic did not differ compared to previous years. The deliveries occurring in the health-care facility are associated with decreased risk of infant mortality [27]. The majority of deliveries in our province having occurred in the health-care facilities during the COVID-19 pandemic might be the cause of a decrease in infant deaths compared to previous years, and that maternal and child care services can be provided in the hospitals during the pandemic as in previous years. Along with an increasing number of stillbirths during the COVID-19 pandemic, a decrease has also been reported in the number of hospital visits before delivery, vaccinations, and childbirth in the hospital [28–30]. Smriti et al. highlighted that disruption has occurred in routine immunization services, and the well-being of the infants was negatively affected due to the risk and fear of contracting COVID-19 during the pandemic [25]. Similar to the literature, the present study found an

increased rate of non-vaccinated infants among the infant deaths during the pandemic compared to previous years, although the difference was not statistically significant. The authors consider that the parents may have postponed vaccinations with the thought that vaccination is not an emergency. The present study found that the presence of high-risk pregnancy, the necessity of referral to a more advanced facility, and the conduction of regular follow-ups in advanced facilities were more common among the deaths occurring during the COVID-19 pandemic than in previous years. It was demonstrated in a study conducted in Nepal that women experiencing no problems during the pregnancy have visited local health-care facilities, while women with complicated or high-risk pregnancies attended follow-up visits with referral to advanced facilities [13]. For this reason, the number of pregnancy follow-ups performed in advanced health-care facilities during the pandemic may have been found higher than the number of follow-ups in primary health-care settings compared to previous years.

The mean maternal age among women suffering a stillbirth or the baby's death was similar between before and during the pandemic. In a study conducted in the UK [31], the mean age was similar between 1,049 women delivering a baby before the pandemic and 316 women delivering a baby during the pandemic, and the mean age in their study (31 years) was higher than the mean maternal age in the present study. This difference may have caused by the fact that the present study investigated only stillbirths and infant deaths. The studies examining infant mortality have stated that the risk of infant mortality increased with decreasing education level of the mother [27,32]. In an ecological study by Williams et al. [33] examining the population health and economic deterioration, unemployment was found to be strongly associated with the rate of under-five deaths. The present study found a significant decrease in the number of illiterate mothers, the rate of unemployed persons contributing to family income,

and the number of persons without social security significantly decreased during the COVID-19 pandemic. The decrease in education level and socioeconomic level of the mothers may complicate access to mothers for counseling purposes and, thus, reduce the sustainability of the services [34]. Because the present study does not cover all infants born between 2018 and 2021 in Samsun Province, we cannot speculate on the factors increasing the risks in stillbirths and infant deaths. Although these findings suggest that higher infant mortality rates in previous years may have resulted from maternal education level and economic differences, there is a need for further analysis of all births that occurred in the specified years for more accurate data.

Strengths, limitations, and future directions

The present study examines all stillbirths and infant deaths between March 2018 and February 2021 in Samsun Province. Due to the retrospective study design, the inability to provide accurate (quantitative) data on the utility of health-care services is an important limitation. Although many studies have provided data on the initial phases of the COVID-19 pandemic, the most remarkable strength of the present study is that it presents the outputs of maternal and child care services by comparing the data during the pandemic with those of previous years.

Conclusion

By analyzing stillbirths and infant deaths occurring in our province during the COVID-19 pandemic, the present study found that maternal and child care services in primary care units and hospitals have continued their usual activities as in previous years. Compared to pre-pandemic periods during the COVID-19 pandemic, it was found that while the number of stillbirths was similar, there was a significant decrease in infant mortality. The continuity of in-hospital childbirth services and maternal and infant follow-ups would contribute to a decrease in maternal mortality ratio and infant mortality rate. In long-lasting crises as the COVID-19 outbreak, particularly in periods of lockdown (stay home) requiring the restriction of population movement for the continuity of public services, approximating maternal and child care services to the public through the use of mobile clinics may be beneficial.

Consent for publication

All participants have agreed for their responses to be anonymized and presented for publication purposes.

Disclosure statement

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Ethical approval

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