

Impact of the COVID-19 pandemic on the trends in corneal donor mortality data from Eye Bank records in India

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Purpose: To describe the causes and trends of corneal donor mortality from eye bank data in India during the coronavirus disease 2019 (COVID-19) pandemic. **Methods:** This retrospective eye bank-based study included 13,529 donors who donated their cornea between January 2018 and December 2021. Donors in whom the cause of mortality was documented were included as cases. The data were collected from the eye bank records. **Results:** Overall, 13,529 corneal donors were included in the study. Most of the donors were males (69.71%). The mean age of the donors was 51.55 ± 20.54 years, whereas the median age was 51 (inter-quartile range: 35–68) years. The mean age of males (49.3 ± 19.47 years) was lesser than the mean age of females (56.72 ± 21.94 years) at the time of donation. The most common age group at the time of donation was during the sixth decade of life with 2,139 (15.81%) donors. The mean age of the donors decreased by a decade from 54.95 ± 20.51 years in 2018 to 44.35 ± 18.88 years in 2021. The most common cause of donor mortality was cardio-respiratory arrest in 5,190 (38.36%) donors and trauma in 3,469 (25.64%) donors, followed by suicide in 2,790 (20.62%) donors. The trend of cardio-respiratory arrest decreased from 53.01% to 9.5% ($p < 0.00001$), whereas the trends of trauma increased from 21.93% to 36% ($p < 0.00001$) and suicide increased from 12.71% to 36.41% ($p < 0.00001$) between 2018 and 2021. **Conclusion:** Corneal donors are more commonly males in their sixth decade of life. The most common cause of donor mortality was related to cardio-respiratory arrest with a concerning rising trend in suicide cases over the years seen significantly during the pandemic.

Key words: COVID-19 pandemic, donor mortality, eye bank, India, mental health, suicide

The coronavirus disease 2019 (COVID-19) pandemic that hit in the year 2020 and changes that it brought in the lives of people will remain etched in the memory lanes of humanity in the times to come. The magnanimity of the pandemic claimed countless lives and completely changed the world order we were living in.^[1] The pandemic brought in the concept of social distancing and resulted in mass isolation of individuals and communities. The fear of contacting the air-borne severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) led to a breakdown of the social fabric at both the physical and mental levels.^[2] Furthermore, the unprecedented nature of the pandemic resulted in several challenges in the access to health care services at a global scale and changes in the medical practice patterns.^[3]

Corneal blindness is estimated to be the second-most prevalent cause of blindness in developing countries, and an estimated 4.9 million bilaterally corneal blind persons could potentially have their sight restored through corneal transplantation globally.^[4] The global survey on eye banking and corneal transplantation had revealed that there is considerable shortage with only one cornea available for 70 needed because

of several cultural barriers and challenges in raising awareness in the population to donate corneal tissues.^[5] The shortage of donor corneas was exaggerated during the pandemic.

In the initial phase of the pandemic, there was a significant decrease in the collection of corneal tissues.^[6] The uncertainties about transmission of the COVID-19 illness via the donor cornea led to the formulation of a newer framework on the suitability criteria for retrieval of donor corneas. Acute COVID-19 illness was added as an additional contra-indication for donor cornea retrieval and utilization. The All-India Ophthalmological Society-Eye Bank Association of India released guidelines regarding corneal donation and eye banking early on during the COVID-19 pandemic to cope with the ever-changing scenarios at the ground level.^[7] The COVID-19 illness in the donor was an important criterion that needed to be ruled out in the algorithm that guided the collection of donor cornea tissues during the pandemic that was evolving globally.

In the context of the pandemic, the study was performed to analyze the changing trends of corneal donor mortality over a period of 4 years (2018–2021) at an eye bank affiliated to a tertiary care center in India.

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Methods

Study Design, Period, Location, and Approval: This retrospective eye bank-based study included all corneal donor data between January 2018 and December 2021 at the Ramayamma International Eye Bank, affiliated to a tertiary eye care center.^[8,9] The relatives of the deceased donor filled out a standard consent form for donating the cornea/eyeball before the procurement. None of the identifiable parameters of the patient were used for analysis of the data. The demographic parameters and the cause of mortality of each donor were entered into a browser-based eye bank software program by uniformly trained eye bank personnel and supervised by an ophthalmologist. The study adhered to the Declaration of Helsinki and was approved by the Institutional Ethics Committee.

Cases: A total of 13,529 corneal donations were documented at the tertiary center eye bank during the study period, and the demographics and donor mortality data were further analyzed for information.

Data Retrieval and Processing: The data of 13,529 donors included in this study were retrieved from the eye bank software database and segregated into an Excel sheet. The columns included the data on age, gender, year of donation, and cause of donor mortality and were exported for analysis. The Excel sheet with the required data was then used for analysis using the appropriate statistical software.

Statistical Analysis: Descriptive statistics using mean \pm standard deviation and median with inter-quartile range (IQR) were used to elucidate the demographic data. All tables for age, gender, year of donation, and cause of donor mortality categories were drawn by using Microsoft Excel (Microsoft Corporation 2018, Redmond, USA). Chi square test (StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP) was used for univariate analysis to detect significant differences where relevant.

Results

Donors: A total of 13,529 corneal donations were received at the tertiary center eye bank during the study period.

Age: The mean age of the donors was 51.55 ± 20.54 years, whereas the median age was 51 (IQR: 35–68) years. The most

common age group of the donors was distributed between 51 and 60 years ($n = 2,139$; 15.81%), followed by 41 and 50 years ($n = 2,095$; 15.49%). The distribution of donors in each age-decade is presented in Fig. 1.

Sex: There were 9,431 (69.71%) male and 4,098 (30.29%) female donors. Among them, the mean and median age were 49.3 ± 19.47 and 49 (IQR: 34 to 65) years for men and 56.72 ± 21.94 and 60 (IQR: 40 to 75) years for women, respectively. The overall mode was 60 years and was 45 years for men and 65 years in women.

Donor Mortality: Among the 13,529 donors, the most common cause of donor mortality was cardio-respiratory arrest in 5,190 (38.36%) donors and trauma in 3,469 (25.64%) donors, followed by suicide in 2,790 (20.62%) donors. There was a higher proportion of cardio-respiratory arrest (49.68%; $P = <0.00001$), respiratory disease (2.64%; $P = 0.000034$), natural deaths (2.88%; $P = <0.00001$), cancer (1.81%; $P = 0.000023$), and homicide (0.12%; $P = 0.175201$) seen in females and a higher proportion of trauma (31.14%; $P = <0.00001$) and suicide (21.61%; $P = 0.000445$) seen in males. The detailed list of causes of donor mortality is provided in Table 1. Table 2 illustrates the average age of the corneal donors as per the cause of death in years. The trends of donor mortality from 2018 to 2021 are described in Fig. 2.

Cardio-Respiratory Arrest: There were 5,190 (38.36%) donors in whom the donor mortality was because of cardio-respiratory arrest. It was more commonly seen in females in 2,036 (49.68%) donors. The mean age of the patients was 63.5 ± 17.68 years, whereas the median age was 65 (IQR: 52–76) years. The trend of cardio-respiratory arrest decreased from 53.01% in 2018 to 9.5% in 2021 ($p = <0.00001$).

Trauma: There were 3,469 (25.64%) donors in whom the donor mortality was because of trauma. It was more commonly seen in males in 2,937 (31.14%) donors. The mean age of the patients was 40.71 ± 16.21 years, whereas the median age was 40 (IQR: 27–52) years. The trend of trauma increased from 21.93% in 2018 to 36% in 2021 ($p = <0.00001$).

Suicide: There were 2,790 (20.62%) donors in whom the donor mortality was because of suicide. It was more commonly seen in males in 2,038 (21.61%) donors. The mean age of the patients was 35.9 ± 14.32 years, whereas the median age was

Table 1: Causes of donor mortality in corneal donors

Cause of Death	Male	%	Female	%	n	%	P
Cardio-respiratory Arrest	3154	60.77%	2036	39.23%	5190	38.36%	<0.00001
Trauma	2937	84.66%	532	15.34%	3469	25.64%	<0.00001
Suicide	2038	73.05%	752	26.95%	2790	20.62%	<0.00001
Cerebro-Vascular Accident	654	66.40%	331	33.60%	985	7.28%	<0.00001
Other Causes	195	66.55%	98	33.45%	293	2.17%	<0.00001
Respiratory Disease	147	57.65%	108	42.35%	255	1.88%	0.045
Natural death	132	52.80%	118	47.20%	250	1.85%	0.469
Cancer	88	54.32%	74	45.68%	162	1.20%	0.368
Chronic Kidney Disease	54	63.53%	31	36.47%	85	0.63%	0.04
Septic Shock	27	67.50%	13	32.50%	40	0.30%	0.068
Homicide	5	50.00%	5	50.00%	10	0.07%	1
Grand Total	9431	69.71%	4098	30.29%	13529	100.00%	

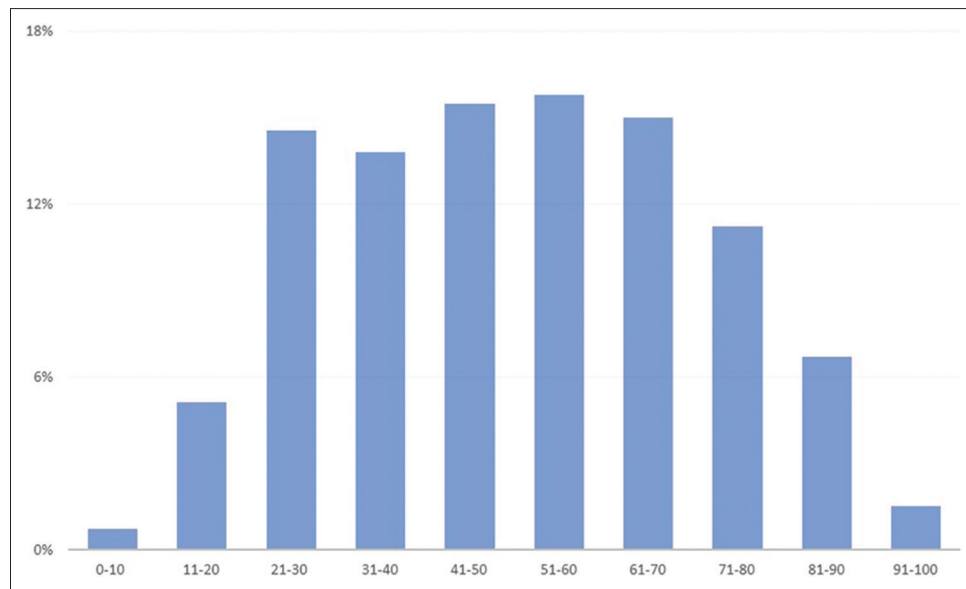


Figure 1: Decade-wise distribution of corneal donors

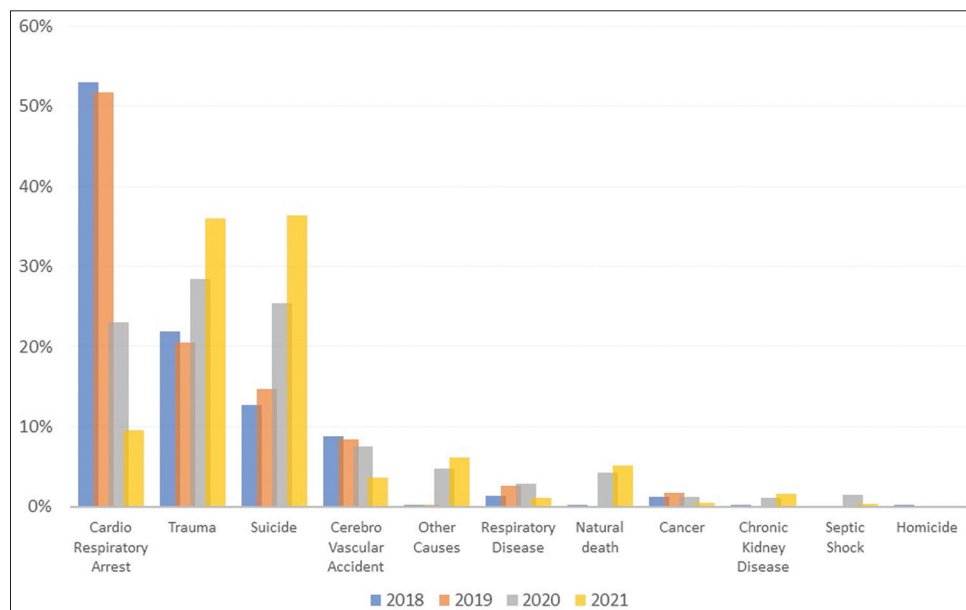


Figure 2: Trends of donor mortality from 2018 to 2021

34 (IQR: 25–45) years. The trend of suicides increased from 12.71% in 2018 to 36.41% in 2021 ($p < 0.00001$).

Discussion

This study sought to describe the causes and trends of corneal donor mortality from eye bank data in India. The study found that the most common profiles of corneal donors are males in their sixth decade of life. Male donors were significantly younger than the female donors. It also found a decreasing trend of donor mortality because of cardio-respiratory arrest and an increasing trend of trauma and suicide, of which suicide showed the highest proportional increase of 286% from 2018 to 2021.

Pantaleão *et al.*^[10] reported their experience of corneal donation, and the most common cause of donor mortality was related to cardio-vascular causes. Their average age

of the donors was 42.74 years. The New Zealand National Eye Bank reported their experience from 1991 to 2003 in 1628 donors.^[11] They found the majority to be males (69.8%) and that the most common cause of donor mortality was cardio-vascular disease (50.5%), followed by trauma (12.5%) and cerebro-vascular accident (11.1%). Our study reported a similar experience as most of our donors were males (69.71%) with cardio-respiratory arrest (38.36%) being the most common cause, followed by trauma (25.64%). Linke *et al.*^[12] shared their experience of 30 years of corneal donation from 5503 donors and found a higher proportion of females dying from cardio-vascular failure (35.8%) and cerebro-vascular accident (17.5%) and a higher proportion of males because of suicide (29%) and trauma (2.5%). Our study also found a similar pattern of distribution of donor mortality among females and males.

Table 2: Average age of the corneal donors as per cause of death in years

Cause of Death	2018	2019	2020	2021	Age (yrs)
Cardio-respiratory Arrest	64.4	63.1	64.8	58.5	63.5
Trauma	40.1	40.4	41.0	41.3	40.7
Suicide	36.2	36.7	35.6	35.5	35.9
Cerebro-Vascular Accident	59.2	59.8	59.8	58.6	59.4
Other Causes	45.9	38.7	52.9	52.6	52.2
Respiratory Disease	62.9	65.1	59.4	63.2	63.2
Natural death	65.3	59.7	74.5	72.1	72.4
Cancer	67.2	64.4	65.8	68.2	65.8
Chronic Kidney Disease	62.6	69.4	53.4	58.0	58.3
Septic Shock	70.0	71.5	61.2	63.1	62.6
Homicide	23.8	38.5	NA	NA	26.7
Age (yrs)	55.0	54.3	49.8	44.4	51.6

The pandemic has brought several challenges in both the harvesting of corneas from the donors and the changing trends of donor mortality. Our study found a decreasing trend from 2018 to 2021 of donor mortality because of cardio-respiratory arrest (53.01% vs 9.5%; $P < 0.00001$). Teoh *et al.*^[13] in a systematic review and meta-analysis on the out-of-hospital cardiac arrest during the COVID-19 pandemic reported a 39.5% increase in the pooled incidence with a nearly doubled odds of mortality among the cases. The social distancing that forced people into their homes, the lack of access to emergency services, and the fear of contacting the virus all contributed to the increased mortality. Although the studies show an increased incidence, our study of the cornea shows a significant decline of cornea retrieval from donors who had mortality because of cardio-respiratory arrest. The reasons can be the limited guidelines issued for the Hospital Corneal Retrieval Program (HCRP) to be resumed only in hospitals declared as non-COVID-19. Fear and panic existed among the population coupled with social distancing, and people were more concerned about the last rites of the deceased than the thought of donating eyes in their time of grief. The hospitals were also overwhelmed with critical cases because of COVID-19, and this also prevented the harvesting of corneas through the HCRP which picked up later based on the weaning of the waves of the COVID-19 pandemic.

Trauma was the second most common cause of donor mortality in our study. It showed an increasing trend (21.93% vs 36%; $P = < 0.00001$) from 2018 to 2021 and a proportional increase of 164%. Sampaio *et al.*^[14] showed that donor tissues derived from violent deaths had no statistical interference ($p = 0.6$) on the tissue suitability for transplantation. Yasin *et al.*^[15] reported the global trends of the COVID-19 pandemic on road traffic collisions and found an overall reduction on the absolute numbers despite the relative increase of severity of injury and death. The effect of the lockdown (April–May 2020) saw a significant reduction of road traffic accidents in India as reported by Hazra *et al.*^[16] The resumption of the vehicular movement post the lockdown would have contributed to the increasing trend in our study. Empty lanes because of reduced vehicular traffic, an increased speed, harsh acceleration, and usage of mobile phones during driving all contribute to the cause.

Mental health was one of the most severely affected aspects in the population because of the COVID-19 pandemic. Our study found an increasing trend from 2018 to 2021 of donor mortality because of suicide (12.71% vs 36.41%; $P = < 0.00001$) and an alarming proportional rise of 286%. Although this increase is partly explained by the limited retrieval from cardio-respiratory deaths because of COVID-19 restrictions and challenges, there was a striking increase in the absolute number of suicides as a cause of donor mortality in the first year of the pandemic (520 in 2018 vs. 1161 in 2021).

Studies around the world have shown a significant increase in suicidal tendencies among university students (47.9%) in Bangladesh,^[17] an increase in young males who died by suicide in Australia,^[18] an increase in rate among both males (0.26) and females (0.3) in Nepal,^[19] an increased suicidal ideation among youth in South Korea,^[20] and a prevalence of suicide risk of 5.3% in Colombia.^[21] Gimbrone *et al.*^[22] reported strong associations between declining mobility and increasing mental health and suicide-related searches in the US population during the COVID-19 pandemic. The literature from India is limited mostly to online media reports and print media. Balaji *et al.*^[23] reported ten pandemic stressors that included economic hardship, fear of the virus, and isolation being most notable. Sripad *et al.*^[24] found a higher risk among males and in those with positive, suspected COVID infection within the first week. Pathare *et al.*^[25] analyzed 369 cases of suicide from versions of newspapers, magazines, and other digital publications and found a higher risk in older men who were employed and had poor mental and physical health.^[25] The sheer magnitude of the rise of suicide cases of 286% in our cohort reflects the deteriorating mental health of the population during the toughest of times such as the COVID-19 pandemic. One of the limitations of the study is that it might not be representative of the trend across India because of the differences in state laws and policies on tissue and organ donations. As most of the reports are limited from the media, the cornea donor mortality data serve as an indicator to the disturbing rising trend of suicides in India. There is an urgent and essential need for suicide prevention strategies which include raising awareness, promoting discussions about mental health, developing suicide help clinics and helplines, early identification of people at risk, and close monitoring and follow-up of vulnerable individuals. India contributed to more than 25% of the worldwide suicides in 2016 translating to 631 suicides per day, which is an immense burden, and it is a collective responsibility at the government, social, and personal levels to address this issue.^[26] The National Crime Records Bureau (NCRB) report in October 2021 reported a rise of suicides in India from 134 thousand deaths in 2018 to 153 thousand deaths in 2020,^[27] and students who usually make up 7–8% of deaths by suicide every year registered a 21.2% increase in 2020, the highest among different occupations.^[28]

Conclusion

In conclusion, this study aimed to describe the causes and trends of corneal donor mortality from eye bank data in India. The findings show that corneal donors are more commonly males in their sixth decade of life. The most common cause of donor mortality was related to cardio-respiratory arrest with a concerning rising trend in suicide cases over the years seen significantly during the pandemic.

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Conflicts of interest

There are no conflicts of interest.

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