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Analysis of blood donors' characteristics and deferrals related to COVID-19 in Iran

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ABSTRACT

Background: With the outbreak of the coronavirus disease in 2019, called COVID-19, Iranian Blood Transfusion Organization (IBTO) implemented the new deferrals. This study analyzed the COVID-19 deferrals of blood volunteers and compared the demographics, deferrals, and the donor status during the COVID-19 outbreak in 2019.

Study design and methods: Data were collected from the integrated blood donor database between Feb-Apr 2019 and 2020. Deferral reasons of COVID-19 were categorized as: those who have symptoms or live with a symptomatic family member, have direct exposure with a confirmed case, have travelled from the outbreak affected areas, and have fully recovered from confirmed COVID-19. The z-test analysis was used, and 95 % confidence intervals were calculated to compare the sample proportions.

Results: The blood donations dropped to 26.09 % in 2020. The percent change of first-time blood donors, female donors, and donors within the age group of 45−54 years old was significantly greater in 2020 than the same time frame in 2019 ($p < 0.05$). The results showed that 0.58 % of volunteers were deferred from blood donation to avoid transmission of SARS-CoV-2. The rate of COVID-19 deferrals in all types except travelling to affected areas has increased in the second 30-day of the study ($p < 0.05$).

Conclusion: The blood shortage that occurred during the COVID-19 outbreak was not due to increased deferral for COVID-19, but it was mostly due to a decrease in the number of volunteers who referred to BTCs.

1. Introduction

Coronavirus disease 2019, called COVID-19, is caused by SARS-CoV2 that was firstly reported in Wuhan, China in December 31, 2019 [1]. SARS-CoV-2 has a non-segmented, single-stranded RNA of animal origin and is closely related genetically to the Severe Acute Respiratory Syndrome Coronavirus-1 (SARS-CoV-1) virus and more distantly related to Middle East Respiratory Syndrome Coronavirus (MERS-CoV) [2]. The disease has affected 213 countries and territories around the world which has an estimated average of 2138 laboratory-confirmed patients and 84 deaths per one million populations [3]. The incubation period for COVID-19 is estimated to be within 14 days from exposure to the symptomatic onset [4]. Symptoms of COVID-19 differ in severity from having no symptoms at all to the fever, cough, and shortness of breath, Anosmia/Hyposmia, Dysgeusia and in more severe cases, pneumonia, severe acute respiratory syndrome, kidney and liver failure, and even death [1,2,4]. The coronavirus outbreak was declared as a "Global Pandemic" by WHO on March 11, 2020 [5].

There has been no evidence of transmission of respiratory viruses through blood transfusions and blood components [6,7], and a study has shown that the transfusion of blood components from donors who were diagnosed as COVID-19 after the donation do not cause disease in blood recipients [8]. However, limited data have shown that viral RNA can be detected in plasma or serum of COVID-19 patients [2]. Therefore, due to the necessity of blood safety, especially in the face of unknown viruses, WHO [9], AABB [7], U.S FDA [10] and Chinese Society of Blood Transfusion (CSBT) [11] recommended a 28-day deferral period for the COVID-19; other official centers like European Center for Disease Prevention and Control (ECDC) [12] and Joint United Kingdom (UK) Blood Transfusion and Tissue Transplantation Services Professional Advisory Committee [13] enforced a 14-day deferral period. The new deferrals include the blood donation volunteers who have fully recovered from confirmed COVID-19, those have become symptomatic for COVID-19 or who have a symptomatic family member, those who have had possible close contact to a person with COVID-19, and those who have travelled from highly prevalent COVID-19 areas in the past month [9–13].

Iranian Blood Transfusion Organization (IBTO), established in May 1974, is the only national organization in Iran that consists of 31 main blood transfusion centers (BTCs), which are located in all 31 provinces of country [14]. IBTO provides the blood components for all of the hospitals throughout the country with a total blood donation rate of about 26 per 1000 population in 2017 and more than two million units of whole blood per year [15]. Regular, repeated, and first-time blood donors were accounted for 53 %, 28 %, and 18 % of the total blood collected, respectively [16].

IBTO has an integrated structure across the country in all BTCs and the information of deferred donors is shared in a common database. Approximately 20 % of Iranian blood donors are temporarily or permanently deferred from blood donation. The average deferral rates vary slightly in different years in Iran [15], but the difference in the deferrals varies widely in the different seasons. For example, in summer usually the deferral rate is higher, which is due to some parameters including the hemoglobin related deferral, compared to the other seasons [17]. The reported pattern for Iran reveals the most of deferrals (88.6 %) as temporary with more frequency in first-time donors (43 %) [15].

The first two cases of COVID-19 were reported in Iran on February 19, 2020 [18] consequently all 31 provinces were infected by March 5, 2020. With rapid spread of the virus, Iran became one of the COVID-19 affected countries in the world especially in the Eastern Mediterranean Region. The total number of confirmed cases announced in Iran was 293,606 with 255,144 recoveries, and 15,912 deaths by July 28, 2020 [3].

One of the main steps taken by IBTO in the field of blood and blood components safety during the COVID-19 outbreak was to revise the standard operating procedure (SOP) of donor selection on January 28, 2020. The deferral criteria for COVID-19 were revised again in accordance with the new temporary deferral criteria of COVID-19 recommended by CSBT [11] on February 20, 2020, and were implemented by IBTO. Considering the role of donor selection in blood safety, and the shortage of blood donation during the coronavirus outbreak, the importance of donor deferral is vital. Given that no information of donor temporary deferrals from COVID-19 has been reported so far, this study aims to analyze the data of all volunteers who were deferred from blood donation due to COVID-19 outbreak in IBTO between Feb-Apr 2020. The time-line was two initial months at COVID-19 outbreak to investigate the deferral pattern and studying the changes in blood volunteers' status at the beginning of the pandemic to draw a conclusion for the future of COVID-19 outbreak, and perhaps the other pandemic conditions in future. This study also compares the blood donor's demographic characteristics, deferral reasons, and the status of blood donors during the defined period of COVID-19 outbreak with a similar time frame in 2019 (the baseline period). The results will be helpful in establishing donor selection and retention programs.

2. Materials & methods

2.1. Population under study and deferrals

The retrospective study was conducted at IBTO in which we included all volunteers that referred to the BTCs for whole blood donation between Feb-Apr 2019 and 2020. Main focus was on the volunteers who have been temporarily deferred by the trained physician, due to the reasons related to COVID-19 disease. The blood volunteers were evaluated on the basis of questionnaire-based interview, physical examination, Hb estimation, blood pressure, and temperature by a trained physician according to Iranian National Standards for Blood Transfusion.

At first, on January 28, 2020, IBTO implemented the deferral criteria for COVID-19 including (i) the blood volunteers who have travelled from the epidemic areas with the new coronavirus (nCoV-2019) and who have close contact with suspected cases (deferral term of 21 days) and (ii) the blood volunteers who have been diagnosed with new

coronavirus disease or who have been suspected for new coronavirus disease (deferral term of 28 days after completion of treatment and complete resolution).

Following the report of the first confirmed case of COVID-19 in Iran, the deferral criteria for COVID-19 were revised again by the National Committee on Management of COVID-19 outbreak at IBTO, on February 20, 2020 and the deferral criteria of COVID-19 recommended by the CSBT [11] were considered. A 28-day deferral period was implemented for the following cases (The data reported in this study is only based on five donor deferrals):

   I Having a fever and symptoms of a respiratory illness in the past 28 days; whether or not symptoms were associated with COVID-19 disease;
  II Having a family member in the house with a fever and respiratory symptoms in the past 28 days;
 III Having a close contact with someone who is diagnosed with confirmed COVID-19 in the past 28 days;
 IV Having a travel record to highly prevalent COVID-19 areas in the past 28 days;
  V The volunteers who have been diagnosed with COVID-19 (after recovery and the resolution of symptoms)

2.2. Data collection

This study was carried out on data of blood donors collected from IBTO integrated donor database in all BTCs. Data on the COVID-19 new deferrals ranged from the 20th February 2020 until 19th April 2020. Also, additional information during the period of February and April 2020 and the same time frame in 2019, including total registration and blood donation, and total deferrals (temporary and permanent) in all BTCs and demographic characteristics (age and sex) and donor status were collected from the donor database.

2.2.1. Definitions

- First-time donor: is a donor who succeeds in donating blood for the first time.
- Pre-donation laboratory screening (PDLS) donor: is a newly-registered donor after a previous registration and screening at the first visit (pre-donation) and invited again to make the first donation after a defined period.
- Repeat (lapsed) donor: is a donor who has a history of previous donation but with the interval between two donations being more than one year.
- And regular donor: is a donor who donated blood more than once during one year.

2.3. Statistical analysis

Categorical variables were represented as frequencies and percentages. The two-sample z-test analysis was performed for qualitative comparison among the proportions of total registration and blood donation, total deferrals, and demographic characteristics in 2020 with the same period in 2019. The confidence interval 95 % for deferral type related to COVID-19 was separately calculated of total registration in first 30-day and in second 30-day. P-value equal or less than 0.05 was regarded as significant.

The growth rates for deferrals, donor status, and demographics variables in 2020 compared with 2019 were calculated by subtracting the value in 2019 from that in 2020 divided by the 2019 value with the final result multiplied by 100.

The percent change was used to find increase or decrease between two percentage numbers in 2020 compared with those in 2019. The percent change was calculated by the percentage difference of the variable in 2020 and 2019 divided by the 2019 percentage with the final

Table 1

Comparison of data between 2019 and 2020 in a similar time frame (20 Feb- 19 Apr 2020). Total registration and blood donation, total deferrals, demographic characteristics (age and sex) and donor status history were compared.

Variables	2019 N (%)[§]	2020 N (%)[§]	Percent change (%)[¥]	Growth rate (%)[#]	Z-test analysis* between 2020 to 2019	Statistics for COVID-19 deferrals (%)[£]
Total registration	409,231	312,056	–	−23.74	–	–
Total donation	343,163 (83.86)	253,644 (81.28)	−3.08	−26.09	0.0001	–
Donor status						
First-time	39,987 (11.65)	36,450 (14.37)	+ 23.35	−8.84	0.0001	519 (1.42)
PDLS	6918 (2.01)	3277 (1.29)	−35.82	−52.63		10 (0.30)
Repeat	101,539 (29.59)	71,700 (28.27)	−4.46	−29.39	0.0001	540 (0.75)
Regular	194,719 (56.74)	142,217 (56.07)	−1.18	−29.96	0.0001	742 (0.52)
Sex						
Female	13,572 (3.95)	13,472 (5.31)	+ 34.43	−0.74	0.00001	147 (1.09)
Male	329,591 (96.05)	240,172 (94.69)	−1.41	−27.l3	0.00001	1664 (0.69)
Age						
18−24 y	23,296 (6.79)	18,115 (7.14)	+ 5.15	−22.24	0.16152	119 (0.65)
25−34 y	101,515 (29.58)	70,888 (27.95)	−5.51	−30.17	0.0001	524 (0.74)
35−44 y	117,586 (34.26)	87,337 (34.43)	+ 0.50	−25.72	0.4295	629 (0.71)
45−54 y	74,870 (21.82)	58,794 (23.18)	+ 6.23	−21.47	0.00001	404 (0.69)
≥ 55	25,896 (7.55)	18,510 (7.30)	−3.31	−28.52	0.32708	135 (0.73)
Permanent deferral	12,234 (2.99)	7699 (2.47)	−17.39	−37.07	0.02926	–
Temporary deferral	53,834 (13.15)	50,713 (16.25)	+ 23.57	−5.80	0.00001	1811 (3.57)

PDLS: pre-donation laboratory screening. [§]Total registration was the bases to calculate the percentages for total donation and deferrals and total donation was the bases to calculate the percentages for donor status, sex, and age-groups. [¥]The percent change between two percentages in 2020 compared to 2019. [#]Growth rate: decrease in 2020 compared to 2019. *p ≤ 0.05 was significant. [£]Total statistics in 2020 column was the bases to calculate the percentages for COVID-19 deferrals.

result multiplied by 100.

/ % of the variable in 2019 multiplied by 100.(% of variable in 2020 − % of variable in 2019)

3. Results

The total registration, blood donation, deferrals, and demographic characteristics of blood donors in 2019 and 2020 are described in Table 1. The number of registered blood volunteers and blood donations dropped to 23.74 % and 26.09 % in 2020 compared to the same time frame in 2019, respectively. Also, this reduction was greater in the repeat and regular donors, male donors, and within the age group of 25−34 years than the other categories (Table 1). However, the percent change in the number of first-time blood donors, female donors, and those within the age group of 45−54 years was significantly greater in 2020 than the same time frame in 2019 (p < 0.05). In addition, despite an overall reduction in the permanent and temporary deferrals in 2020, the percent change in temporary deferrals in 2020 was upper than 2019 (p < 0.05) (Table 1). The percentage of COVID-19 deferral of total temporary deferrals in 2020 was 3.57 %. The COVID-19 deferral rate was higher in the first-time (1.42 %) than in repeat and regular donors. The COVID-19 deferral rates in 18−24 and 45−54 were lower compared to other age-groups (Table 1). The percentage of COVID-19 deferral of total registration in 2020 was 0.58 % (data not shown in Table 1).

Total number of COVID-19 deferral was 1811. The total deferral for COVID-19 in second 30-day (n = 1202) was about twice as high as in first 30-day (n = 609). The deferral type I (i.e. having a history of fever and respiratory symptoms) demonstrated the highest frequency (48.15 %) among the other deferral reasons (Table 2).

Table 3 shows that the rate of COVID-19 deferral in all types except type 4 has increased in the second 30-day of the study compared to the first 30-day (p < 0.05). The confidence interval 95 % for deferral type related to COVID-19 was calculated in each time period (first 30-day and second 30-day).

4. Discussion

The COVID-19 pandemic is creating a blood inventory shortage worldwide [19]. The results of this study showed that in Iran, along with other countries involved in COVID-19 [6,19,20], the blood donation had a decrease about 26 % during the outbreak of COVID-19. Regarding the low rate of COVID-19 deferral (3.57 % of total temporary deferral), it seems that the reduction of blood donation was not due to COVID-19 deferral and it was mostly due to a decrease in the number of volunteers who referred to BTCs. The national policies to manage the outbreak like the social or physical restriction, job closure, and social distance advice were possibly the main reasons for the shortage. However, IBTO considered some measures; such as the use of the social media to inform people, call for the Health Ministry to encourage all of the hospitals to cancel elective surgeries, the use of the enough personal protective equipment for employees and donors and so on to counter this condition [21].

This study revealed that despite the decline in the total number of blood donors, the percent change in the first-time donors increased significantly compared to the same period last year. Regarding the high frequency of first-time donors among the young age donors in Iran [15], it seems that the closure of all educational institutions and universities due to COVID-19 in Iran and the announcement of a relatively low attack rate of COVID-19 in young age-group [22] have probably increased the chances of young blood volunteers referring to BTCs. Also it can be due to a dramatic change in donor recruitment activities during the period including using the social media and patient advocacy groups for encouraging the donors, activation an online blood donation appointment system throughout the country, meeting with members of

Table 2
Demographic characteristics and donor status based on deferrals related to COVID-19 (20 Feb–19 Apr 2020). Deferrals I-V for COVID-19 described in section of materials and methods.

Deferral type[§]	First 30-day (20 Feb-19 Mar)						Second 30-day (20 Mar-19 Apr)						20 Feb-19 Apr					
	I	II	III	IV	V	Total	I	II	III	IV	V	Total	I	II	III	IV	V	Total
Donor Status																		
First-time	74	3	2	83	0	162	184	23	23	97	30	357	258	26	25	180	30	519 (28.66)
PDLS[*]	2	0	0	1	0	3	2	0	1	3	1	7	4	0	1	4	1	10 (0.55)
Repeat	60	2	1	92	0	155	208	24	25	104	24	385	268	26	26	196	24	540 (29.82)
Regular	118	8	7	154	2	289	224	30	44	132	23	453	342	38	51	286	25	742 (40.97)
Gender																		
Female	17	0	0	20	0	37	59	9	7	27	8	110	76	9	7	47	8	147 (8.12)
Male	237	13	10	310	2	572	559	68	86	309	70	1092	796	81	96	619	72	1664(91.88)
Age																		
18–24 y	15	0	0	28	0	43	41	3	12	17	3	76	56	3	12	45	3	119 (6.57)
25–34 y	76	5	6	99	1	187	169	17	20	114	17	337	245	22	26	213	18	524 (28.93)
35–44 y	91	7	3	120	1	222	202	26	36	125	18	407	293	33	39	245	19	629 (34.73)
45–54 y	52	1	1	58	0	112	163	20	22	58	29	292	215	21	23	116	29	404 (22.30)
≥ 55	20	0	0	25	0	45	43	11	3	22	11	90	63	11	3	47	11	135 (7.45)
Total[#]	254 (41.71)	13 (2.13)	10 (1.64)	330 (54.19)	2 (0.33)	609	618 (51.41)	77 (6.41)	93 (7.74)	336 (27.95)	78 (6.49)	1202	872 (48.15)	90 (4.97)	103 (5.69)	666 (36.77)	80 (4.42)	1811

§ Deferral type: I. Having a fever and symptoms of a respiratory illness in the past 28 days; II. Having a family member in the house with a fever and respiratory symptoms in the past 28 days; III. Having a close contact with someone who is diagnosed with confirmed COVID-19 in the past 28 days IV; Having travel record to a region that has been high risk for COVID-19 (an area with highly prevalent COVID-19 cases) in the past 28 days; V. The volunteers who have been diagnosed with COVID-19 (after recovery and the resolution of symptoms).

* PDLS: pre-donation laboratory screening.

The percentage for deferral type related to COVID-19 was separately calculated of total deferral in each time period (first 30-day and second 30-day).

the Association of Thalassaemia and Haemophilia Patients in order to attract their cooperation in recruiting blood donors, and the establishment of a station for measuring body temperature and mask distribution to protect blood donors in each BTC [23]. However, it should not be overlooked that the number of blood donors (especially first-time donors) usually increases significantly during the disasters [24–26]; therefore, the public ads for donor attraction and recruitment during the outbreak of COVID-19 have had a greater impact on the emotion of people who have not experienced a blood donation.

As in other disasters studied [24–26], an increase in the proportion of female donors was seen during the COVID-19 outbreak. The more impact on women's emotions and feelings in response to donor attraction ads for a shortage of blood reserves could be the reason for this.

Two groups of 18−24 and 45−54-year-old blood donors, at the time of COVID-19 outbreak, showed an increase in the number compared to the same period last year. According to the previous reports, the frequency of regular donors was higher in older age-groups [15], so it was unpredictable to see a higher number of donations in the age-group of 18−24 years during the outbreak and we were expected that the age-groups with the most regular donors would be the most involved. It is likely that the closure of educational centers and Universities in Iran could have increased the presence of this age-group at BTCs.

In the event of a blood shortage during non-disaster conditions, the number of regular donors referring to BTCs and responding to their public call for blood donation was more than the repeat or first-time. But it does not seem to be the case during the outbreak of emerging diseases in the community, and the abundance of donors in the young age-group as well as first-time donors is increasing. By studying other pandemic conditions and seeing similar results, not only this group of donors can be a priority in the planning for the recruitment department, but also the training and information of other age-groups can be reviewed and strengthened.

Comparison of the total deferrals rate during the outbreak showed an increase in the overall temporary deferral rate. It was indicated that temporary deferrals related to tattoo, and cupping was also increased in first-time donors (Unpublished data). The higher rate of such deferral in the donor population could be due to lack of knowledge of first-time donors on the donation criteria. It appears that the increase in the referred first-time donors to BTCs during the COVID-19 outbreak to be the reason. The previous report has also shown that the temporary deferral rate was more in first-time blood donors [27] and similarly our study showed that the deferral rate for COVID-19 was higher in the first-time donors than the others.

Analysis of COVID-19 deferral cases during the two months showed that it was accounted for a small fraction of total temporary deferrals during the COVID-19 outbreak. This low rate of deferral has been achieved in a situation where the public notification of blood donation volunteers for COVID-19 outbreak was done before the reporting of first case of COVID-19 in Iran, and it seems that the public announcement has been done well to raise the level of awareness of blood donation volunteers and to prevent the individuals with risk factors related to COVID-19 from appearing in the BTCs. The most common deferral reasons of COVID-19 were No I and IV i.e. having a history of fever and respiratory symptoms in the donor and a history of traveling to epidemic areas in the past month, respectively.

Our study was conducted during the first two months after the first case of COVID-19 was reported in Iran, [6] so it was predictable that the rate of this type of deferrals to be higher than other deferrals due to the increasing trend in prevalence of the disease in the general population (Fig. 1). As well, the rate of COVID-19 deferral in the repeat and regular donors was lower compared to the first-time donors. This finding appears to be the result of the effectiveness of continuing education in the regular donors and it seems that most of those who have thought to be exposed to COVID-19 have refused to go to BTCs.

An interesting point about the COVID-19 deferrals was the 18−24-year age group having had the lower COVID-19 deferral rate than other

Table 3

The comparative analysis of COVID-19 deferrals of the first and second 30-day of the study.

Deferral type[§]	First 30-day (20 Feb-19 Mar)		Second 30-day (20 Mar-19 Apr)		P*
	No of deferrals	Deferral per total registration (CI 95 %)[¥]	No of deferrals	Deferral per total registration (CI 95 %)[¥]	
I	254	2204 (1945−2488)	618	4465 (4123−4828)	P <0.05
II	13	112 (62−188)	77	556 (442−691)	P <0.05
III	10	86 (44−154)	93	671 (545−819)	P <0.05
IV	330	2864 (2567−3186)	336	2428 (2178−2698)	N.S
V	2	17 (3−57)	78	563 (448−699)	P <0.05

[§] Deferral type: I. Having a fever and symptoms of a respiratory illness in the past 28 days; II. Having a family member in the house with a fever and respiratory symptoms in the past 28 days; III. Having a close contact with someone who is diagnosed with confirmed COVID-19 in the past 28 days IV; Having travel record to a region that has been high risk for COVID-19 (an area with highly prevalent COVID-19 cases) in the past 28 days; V. The volunteers who have been diagnosed with COVID-19 (after recovery and the resolution of symptoms).

[¥] The numbers were calculated as deferral number per 10^6 registrations. The confidence interval 95 % for deferral type related to COVID-19 was separately calculated of total registration in first 30-day (n = 115,231) and in second 30-day (n = 138,413).

[*] $p \leq 0.05$ was significant. N.S: non-significant. The total deferral for COVID-19 in the second 30-day (n = 1202) was about twice as high as in the first 30-day (n = 609).
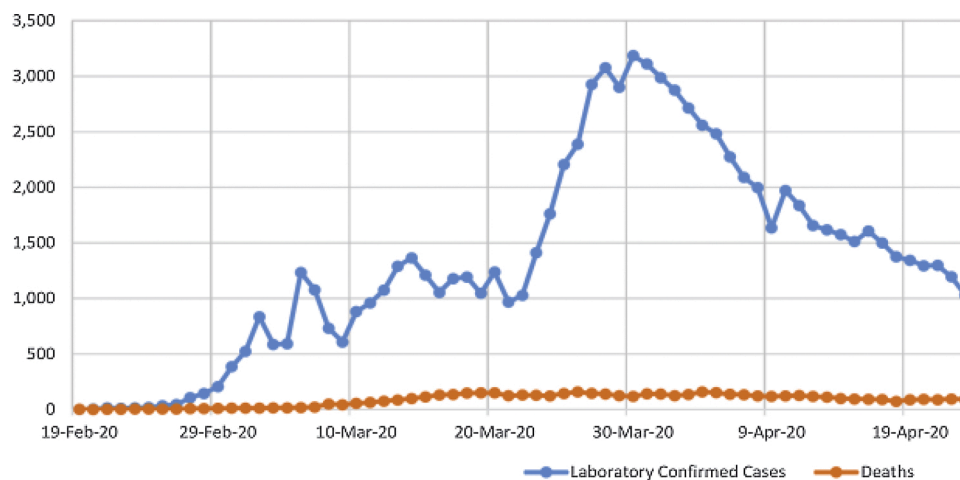

Fig. 1. Trend of COVID-19 Laboratory-Confirmed Cases and Deaths in the general population of Iran. (Adopted from a report update from WHO Regional Director for Eastern Mediterranean, table of confirmed cases in the EMR Countries. 24 July 2020).

age groups. The frequency of temporary deferrals in this age-group was usually reported to be higher [28] and it is unknown at this time if it is an exception during the COVID-19 outbreak or any other reasons are involved.

In addition, the comparative analysis of the first and second 30-day of the study showed a significant increase in the deferral cases in No I-III and V with a near-to-significant decrease in the deferral No IV during the second 30-day. With the spread of COVID-19 across all 31 provinces in the country on March 5, 2020, the number of infected persons in the country has increased, accordingly the chances of referred donors with risk factors have increased. So, it seems that the increasing changes in the deferral for No I-III and V coincided with the prevalence of COVID-19 in the community (Fig. 1). Also, the implementation of more traffic control and new restrictions on intercity travel (Mar 14) [29] could be a reason for decrease in the deferral cases for No IV in the second-30 day.

The strength of this study was the national monitoring of COVID-19 deferrals for all BTCs across the country and it will help in the necessary decisions in the field of reviewing the deferrals and will be effective in establishing donor selection and retention programs. Although the number of temporary deferrals has increased during COVID-19 outbreak, the lack of demographic characteristics on the deferrals made it difficult for us to interpret some of the results.

In summary, the blood shortage that occurred during the COVID-19 outbreak was not due to the deferral for COVID-19, but pertained to a reduction in the number of volunteers who referred to BTCs. In addition, the demographics and donor status pattern of blood donors changed under the influence of COVID-19 outbreak.

CRediT authorship contribution statement

Mohammad Hessam Rafiee: Formal analysis, Investigation, Methodology, Project administration, Software, Writing - original draft. **Sedigheh Amini Kafiabad:** Conceptualization. **Mahtab Maghsudlu:** Supervision, Validation, Visualization.

Declaration of Competing Interest

The authors declare no conflict of interests.

manuscript with support from S.AK. M.M supervised the data analysis and made comments on the manuscript. All authors discussed the results and discussion and contributed to the final manuscript.

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