

Influence factors for successful corneal donation among Chinese adults: data from Nanjing between 2001 and 2012

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Abstract

• **AIM:** To investigate the factors that may influence the successful corneal donation among adults in China.

• **METHODS:** This retrospective study was conducted in 2012. The eligible participants were all the adults registered in Nanjing Red Cross Eye Bank to donate their corneas after death during the period of 2001 and 2012. Multivariate logistic regression models were applied to investigate the influence factors for successful donation, the outcome events.

• **RESULTS:** Totally, 210 of 328 (64.0%) registered potential donors successfully donated their corneas after death. The mean (SD) age at registration was 64.7 (12.5) for all participants, with 65.5 (10.1) and 63.2 (15.8) for successful and unsuccessful donors, respectively. With multivariate logistic regression analysis, five factors, the willingness of donation, age, education level, residence area, and cause of death were identified to be associated with successful corneal donation.

• **CONCLUSION:** The willingness of donation and some socio-demographic factors might substantially affect their successful donation after death for people who registered to donate corneas.

• **KEYWORDS:** cornea donation; influence factors; China

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INTRODUCTION

Corneal blindness is one of the main eye diseases leading to blindness in China. It was estimated that

approximately 4 million people become blind as a result of corneal diseases in 2006^[1,2]. Keratoplasty is an important method for treating corneal blindness. However, its clinical application is restrained by the short supply of qualified corneas. There were only 4000 or so keratoplasty operated annually in China and this figure is much smaller than that in developed countries or even some other developing countries^[3-5]. The giant gap between corneal supply and demand strongly suggests an urgent need to expand the corneal supply. Volunteer donation is the right way to solve this problem. Nanjing Red Cross Eye Bank, the official eye bank, established in Nanjing First Hospital of Nanjing Medical University in April 2001, is responsible for providing corneal materials to hospitals throughout Nanjing area. Up to December 2012, totally 328 volunteers registered to donate their corneas have died. It is of great significance and implications to investigate the factors that may affect registrants to successfully donate their corneas. We conducted this study aiming at identifying influence factors for successful corneal donation using data retrospectively collected from Nanjing Red Cross Eye Bank.

SUBJECTS AND METHODS

Subjects All the participants were selected from the dataset of Nanjing Red Cross Eye Bank in late 2012. Each person who would like to donate his or her corneas is required to register his or her personal socio-demographic, contact (*e.g.* phone number) and other medical information by filling in a structured questionnaire *via* the donation registration system, which makes it easy for us to follow up and collect related data on each potential donor. Firstly, we followed up all registrants to ensure their current survival status (alive or dead). Then, we selected all those died registrants as eligible participants. Since the establishment of Nanjing Red Cross Eye Bank in 2001, there were totally 328 died registrants, of whom 210 successfully donated their eye corneas and 118 did not. Next, we retrospectively gathered those 328 participants' socio-demographic and other related data from our Eye Bank.

Written informed consent was obtained from each participant. The Academic and Ethical Committee of Nanjing First Hospital of Nanjing Medical University reviewed and approved this study in accordance with the internationally agreed ethical principles for medical research involving human subjects.

Study Variables

Outcome variable It was defined as positive outcome

events if registrants' corneas were successfully donated after death, otherwise as negative outcome events if not donated.

Influence factors There were eight selected socio-demographic and other related potential factors in this study. They were categorized into subgroups: 1) Gender: women and men; 2) Age-group: <45, 45-64 and 65+ years old; 3) Residence area: rural and urban; 4) Educational attainment: <9, 9-11 and 12+ years; 5) Occupation: manual and office workers; 6) Marital status: never-married, married with spouse and widower/widow; 7) Cause of death: accident injuries, cardio-/cerebrovascular diseases or tumors, and natural death (no clearly definite direct death cause); and 8) Willingness of donation: registered by children/spouses and registered by donors selves.

Statistical Analysis We calculated descriptive statistics, and compared demographic and clinical characteristics of participants who did, and did not, successfully complete the donation. Then, we investigated the influence of each selected factors on the likelihood of successful donation by computing the odds ratio (OR) and the 95% confidence interval (95%CI) using univariate and multivariate logistic regression models. Data were double entered and cleaned with EpiData 3.0 (The Epidata Association, Odense, Denmark), and managed and analyzed using SPSS 13.0 (SPSS, Chicago, Illinois, USA). $P < 0.05$ was used to assess the two-side statistical significance.

RESULTS

Table 1 presents the numbers of participants who did and did not complete donation by registration year since 2001. There were more participants registered to donate their corneas and actually completed the donation in the recent past years than that in the starting years after establishment of our Eye Bank.

The mean (SD) age was 64.7 (12.5) for overall participants, 65.5 (10.1) for successful donors and 63.2 (15.8) for registrants who did not completed donation. Table 2 showed the numbers of participants who did and did not complete donation by selected demographic characteristics. There significant difference in the proportions of successful donation between age-group and rural-urban residence, while there was no difference between marital status and gender.

Table 3 displayed the potential influence factors for successful corneal donation based on 328 donation registrants. Among the 8 selected potential influence factors for successful donation of corneas, 5 (age, rural/urban residence, education, death cause and willingness of donation) were examined having and 3 (gender, occupation and marital status) having not significant association with successful donation, through multivariate logistic regression analysis. Compared with those aged <45 years old, registered participants aged 45-64 (OR=8.85, 95%CI=1.98, 39.49) and 65+ (OR=5.80, 95% CI=1.29, 26.06) were more likely to successfully donate their corneas. Urban participants had 7.49 (95%CI=4.08, 13.76) times likelihood to successfully complete the registered donation relative to their rural

Table 1 Registered participants and successful donation by year in Nanjing

Year	Registrants (n=328)	Completed donation n (%)	Uncompleted n (%)
2001	11	3 (27.3)	8 (72.7)
2002	12	5 (41.7)	7 (58.3)
2003	17	8 (47.1)	9 (52.9)
2004	18	7 (38.9)	11 (61.1)
2005	29	12 (41.4)	17 (58.6)
2006	24	15 (62.5)	9 (37.5)
2007	30	13 (43.3)	17 (56.7)
2008	23	11 (47.8)	12 (52.2)
2009	32	16 (50.0)	16 (50.0)
2010	34	32 (94.1)	2 (5.9)
2011	49	45 (91.8)	4 (8.2)
2012	49	43 (87.8)	6 (12.2)
Total	328	210 (64.0)	118 (36.0)

Table 2 Selected demographic characteristics of registered participants by donation status in Nanjing

Parameters	Donation completed	Uncompleted	P
Age-group (a)			
<45	5 (20.0)	20 (80.0)	
45-64	61 (65.6)	32 (34.4)	<0.01
65+	144 (68.6)	66 (31.4)	
Gender			
Women	114 (68.7)	52 (31.3)	
Men	96 (59.3)	66 (40.7)	0.08
Residence area			
Rural	56 (39.4)	86 (60.6)	
Urban	154 (82.8)	32 (17.2)	<0.01
Marital status			
Never-married	16 (80.0)	4 (20.0)	
Married with spouse	160 (65.8)	83 (34.2)	0.40
Widower or widow	34 (52.3)	31 (47.7)	

counterparts. Interestingly, registrants with college education level were less likely to complete their promised donation (OR=0.24, 95%CI=0.10, 0.53) compared to those with less educational attainment. Another influence factor was the cause of death. Registrants with direct death cause of either cardio-/cerebro-vascular diseases/tumors (OR=0.44, 95%CI=0.23, 0.85) or accident injuries (OR=0.29, 95% CI=0.10, 0.82) were less likely to donate their corneas compared to those died with natural death. The participants whose donation registrations were made by themselves were more likely to complete the final donation relative to those whose registrations were made by their relatives (OR=4.11, 95%CI=2.13, 7.95).

Among the 118 registrants who did not complete the donations, 18 (15.3%) were due to family members asking for economic compensation, 4 (3.4%) due to body cremation, 5 (4.2%) requesting for a reduction of medical expenses, 3 (2.5%) asking for a direct contact with recipient, 23 (19.5%) refusing corneas used for scientific research, and 65 (55.1%) due to family members' conflicting opinions.

Table 3 Identified influence factors for successful corneal donation among adults in Nanjing, China

Influence factors	% (n/N)	Successful donation	
		OR (95%CI) ¹	
		Model 1	Model 2
Gender			
F	68.7 (114/166)	1	1
M	59.3 (96/162)	0.66 (0.42, 1.04)	0.67 (0.37, 1.21)
Age group			
<45	20.0 (5/25)	1	1
45-64	65.6 (61/93)	7.63 (2.62, 22.21)	8.85 (1.98, 39.49)
65+	68.6 (144/210)	8.73 (3.14, 24.26)	5.80 (1.29, 26.06)
Residence			
Rural	39.4 (56/142)	1	1
Urban	82.8 (154/186)	7.39 (4.45, 12.29)	7.49 (4.08, 13.76)
Educational attainment (a)			
<9	66.9 (117/175)	1	1
9-11	71.7 (66/92)	1.26 (0.72, 2.19)	1.36 (0.65, 2.84)
12+	44.3 (27/61)	0.39 (0.22, 0.71)	0.24 (0.10, 0.53)
Occupation			
Manual workers	62.0 (127/205)	1	1
Office clerks	67.5 (83/123)	1.27 (0.80, 2.04)	1.63 (0.83, 3.23)
Marital status			
Never-married	80.0 (16/20)	1	1
Married with spouse	65.8 (160/243)	0.48 (0.16, 1.49)	0.94 (0.20, 4.36)
Widower or widow	52.3 (34/65)	0.27 (0.08, 0.91)	0.88 (0.16, 4.76)
Cause of death			
Natural death ²	77.8 (112/144)	1	1
Cardio-/cerebrovascular diseases or tumors	59.3 (80/135)	0.42 (0.25, 0.70)	0.44 (0.23, 0.85)
Accident injuries	36.7 (18/49)	0.17 (0.08, 0.33)	0.29 (0.10, 0.82)
Willingness of donation			
Registered by children or spouses	46.5 (73/157)	1	1
Registered by selves	80.1 (137/171)	4.64 (2.84, 7.56)	4.11 (2.13, 7.95)

¹Odds ratios (95%CI) were estimated using univariate logistic regression approaches in model 1, and multivariate logistic regress methods including gender, age-group, residence area, education, occupation, marital status, cause of death and willingness of donation in model 2; ²No clearly definite cause contributing to the direct death.

DISCUSSION

This study reported that there were 5 identified influence factors for successful corneal donation among 328 adults who previously registered to donate their corneas. Those registrants who were older, from urban areas, with high school or less educational attainment, died from natural causes and made their registration by themselves were more likely to complete their promised corneal donation after death.

It has been estimated that the proportion of corneal blindness was approximately 0.3% among rural population in northern China^[6]. Considering that the total regular population is over 8.1 million in Nanjing and that Nanjing Red Cross Eye Bank has successfully obtained corneal donation from only 210 registered adults since its establishment, there are lots of people being experiencing blindness due to lack of available corneas. Sri Lanka International Eye Bank, the largest eye bank in the world, has provided more than 65 000 corneas to

blind patients worldwide^[7]. In USA, there are 100 eye banks since its first bank established in 1944, and currently there are more than 40 000 eyes collected from dead bodies and 25 000 corneal transplantation surgeries successfully operated^[8]. In China, more and more eye banks have been established in different regions, however almost all of these eye banks are not able to receive from donors and provide for blind patients sufficient corneas. Thus, it is of urgent need to register sufficient corneal donation volunteers and successfully obtain sufficient donated corneas. The findings from present study are of significant implications to meet this urgent need.

Participants donated their corneas unconditionally. Irrespective of registration made by themselves or relatives, the actual donation was completed by their relatives after their death with serious consideration of their true idea of donation. However, when the registrants died, the eye bank discussed registered corneal donation promise with

registrants' relatives and highly respected the relatives' decision on whether to complete the final donation or not^[9-11]. Registrants made the potential donation promise by themselves and died from natural cause were more likely to complete corneal donation by their relatives, which was consistent with existing findings from other countries^[11-13]. It is believed that people with high educational level are relatively easy to accept new ideas such as corneal donation. Most available studies have consistently demonstrated that a positive association between educational attainment and willingness to donate corneas in adults^[14-20]. However, one previous study reported that people with high education level tended to be unwilling to donate corneas^[21]. Worthy to note, people with strong willingness to donate corneas do not exactly mean that they must actually complete the final donation. This scenario may, in part, explain that registrants with high education level were less likely to keep their donation promises in this study.

The majority (55.1%) of those who did not complete the donation were because family members could not get the same opinion on donation and the next major reason was that registrants' family members could not agree donated corneas would be used for scientific research, which suggested that the strong support from all family members was pretty important for successful donation. However, the basic corneal donation rules include double-blind principle for both corneal donors and recipients, totally volunteer donation^[12,13]. Thus, it is urgently necessary to publicize such basic ethics rule and to highly encourage volunteer and humanitarian donation spirits in the context of today's China. Organ transplantation needs not only ethics guidance but also legal support. Compared to that there are relatively perfect legal regulations to help organ transplantation in some Western countries with excellent achievement of human organ donation, there is no well-established legal system to regulate human organ donation. To improve the donation quantity and quality of corneas as well as other human organs, it is needed to modify the current "Regulations on human organ transplantation" issued on May 1, 2007 with sufficient consideration of present China's situation on human organ donation, including social norms, ethics, folk and cultural conventions.

In conclusion, registrants' age, residence area, education level, death cause and donation willingness were investigated to be significantly associated with the successful actual corneal donation. It will be of help to support corneal donation through publicizing the ethics rule and volunteer spirits of human organ donation and legal action.

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