

# Temporal Trends and Demographic Characteristics in Body Donation Applications: A Single University Experience

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## ABSTRACT

**Objective:** Body donation remains essential for anatomy education and surgical skills training. Despite advances in simulation and virtual/augmented/mixed reality, donated human bodies provide unmatched tissue realism and anatomical variation. However, many institutions still face cadaver shortages. Understanding temporal fluctuations in donation applications and their demographic correlations may inform targeted outreach and support the sustainability of body donation programs. This study aims to evaluate the effectiveness and outcome of ongoing National Body Donation Programs at our institution.

**Methods:** Retrospective body donation forms submitted to Hacettepe University between 1990 and 2025 were reviewed, including both completed donations and registered applicants. Demographic variables, including application year and sex, were analyzed alongside temporal trends.

**Results:** Between 2003 and 2025, a total of 267 body donation applications were submitted, of which 20 donors were accepted by our institution. The annual number of applications ranged from 0 to 29. A modest upward trend in the annual number of applications was observed beginning in 2012, the year in which the National Body Donation Program was initiated ( $\beta=1.48$ ,  $p=0.052$ ). The applicant population comprised 61.8% males and 38.2% females, with female applicants submitting their applications at a significantly younger age than males ( $p=0.046$ ). Applicants aged  $\leq 30$  years represented 13.5% of the population, while those aged  $\geq 65$  years comprised 31.5%.

**Conclusion:** These findings provide valuable mid-term institutional data that may inform the planning and sustainability of body donation programs in medical education. Continuous monitoring of program outcomes is essential, enabling a proactive management approach and the development of strategies to enhance program effectiveness.

**Keywords:** anatomy education, body donation, cadaver and ethics, cadaver donation trends

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## INTRODUCTION

Body donation remains a crucial resource for both anatomy education and surgical skills training [1,2]. Cadavers remain irreplaceable for understanding variations, tissue fidelity and spatial relationships despite advances in simulation and virtual/augmented reality, a view consistently supported by medical students [3-6]. Sustaining body donation programs is critical due to persistent shortage of cadavers in many institutions [7-9]. This issue has gained increasing importance in recent decades with the rising number of medical schools.

In Türkiye, body donation is legally permitted, yet maintaining sustainable cadaver supply remains challenging [10,11]. Body procurement is regulated by Act 2238 and subsequent amendments, permitting both body donation and the use of unclaimed or imported cadavers [12-14]. Donation may occur through written consent during life (with witnesses and physician approval) or family authorizations after death [13]. Unclaimed bodies may be transferred to anatomy departments with hospitals and prosecutor office, can be used after forensic autopsy under specified conditions [15]. In recent years, the transfer of unclaimed bodies to anatomy departments has been disrupted and remains an ongoing issue [7,16].

Applicant demographics can influence willingness and engagement with donation programs [17,18]. Understanding how these factors change over time is important for predicting donor supply, guiding ethical outreach, improving counseling, and optimizing donation programs. Examining fluctuations in registrations and the factors behind them can inform policies

### Main Points

- Cadaver availability remains limited due to continued reliance on unclaimed bodies and legal or institutional barriers.
- Body donation requests have steadily increased, particularly following the implementation of the National Body Donation Program
- Following the donation program, an increase in body donation applications among younger individuals was observed.
- Continuous monitoring and proactive long-term strategies are essential to ensure a sustainable cadaver supply.

and program design. This study aimed to examine temporal trends in body donation applications and to explore patterns that potentially associated with the implementation of the of the National Body Donation Program (NBDP) in 2012 by the Turkish Society of Anatomy and Clinical Anatomy (TSACA) [16].

## MATERIALS AND METHODS

This retrospective, single-center observational study was conducted using records from Hacettepe University body donation program, and was approved by Ethics Committee of Hacettepe University (Approval Number: SBA 26/035, Date: 2026-01-06). For this study, an applicant is an individual who completes a donation form during life, and a donor is the same individual after death whose body.

All body donation application forms, cadaver records, and archival documents between 1990 to 2025 were reviewed. Family-authorized donations, unclaimed bodies, and imported cadavers were excluded. The dataset included forms completed by individuals who applied to donate their bodies, as well as records of donations that were realized following registrations. For each applicant, year of application, age at application, and sex (as recorded in official identification documents) were documented, along with any stated special request. Names and identification numbers were excluded from the dataset, and all analyses were conducted on an anonymized list.

### Policy Intervention

This study employed an interrupted time series (ITS) analysis, a quasi-experimental approach used to evaluate whether a defined intervention is associated with a significant change in an outcome over time. By analyzing observations before and after the intervention, the method determines whether any observed change exceeds what would be expected based on the pre-intervention pattern [19]. In this study ITS analysis was applied to evaluate the outcomes of the NBDP in 2012 [16], using with nine pre-intervention and fourteen post-intervention time points, exceeding the minimum of eight required for adequate statistical analysis [20].

### Statistical Analysis

ITS analysis perform temporal trends in body donation applications and the NBDP impact, with autocorrelation assessed using the Durbin–Watson statistic. Group comparisons for age were performed using independent samples t-test or

Mann–Whitney U test as appropriate, and sex distribution differences were analyzed using the chi-square test. A p value of less than 0.05 was considered statistically significant. All statistical analysis were performed using IBM SPSS Statistics, version 23 (IBM Corp., Armonk, NY, USA).

## RESULTS

Archival review revealed that the earliest documented body donation application at our institution was received in 2003. Between 1990 and 2002, cadaveric needs were met through bodies provided by hospital and the Public Prosecutor’s Office, including autopsied and unclaimed individuals. Since 2003, cadaver procurement has been sourced from body donations and imported cadavers. While applicants did not specify requests regarding the use of particular body regions, one donor requested cremation after educational and scientific use.

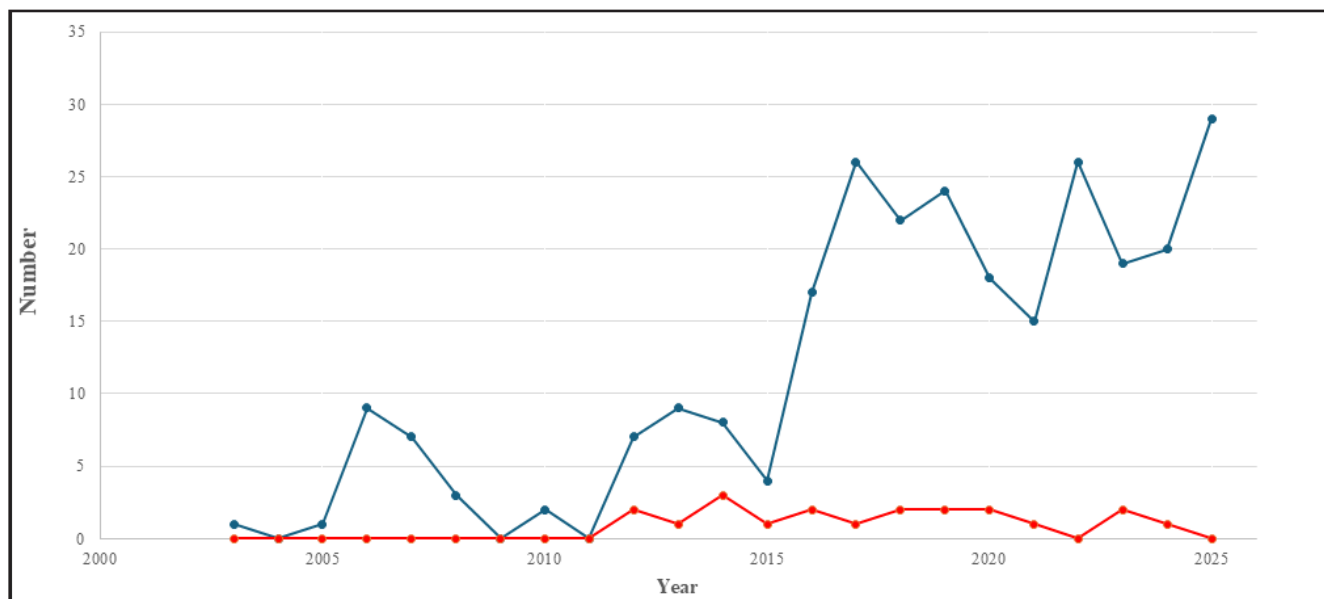
During the study period, 267 body donation application forms were completed, of which 20 preregistered donors were accepted. The annual number of applications ranged from 0 and 29, while the number of cadavers accepted ranged from 0 to 3 (Figure 1). The institution received mean of 11.6 body donation applicants annually during the study period. The annual mean number of body donation applications was 2.55 before 2012, whereas it increased to 17.4 in the period after 2012. ITS analysis showed no significant pre-intervention trend ( $\beta=0.10$ ,  $p=0.877$ ). Although an immediate increase in body donation applications was observed after 2012, this change was not statistically significant ( $\beta=6.40$ ,  $p=0.159$ ). However, the post-

intervention slope demonstrated a modest upward trend ( $\beta=1.48$ ,  $p=0.052$ ), suggesting that applications may have increased over time, although this trend did not reach statistical significance. The upward trend became more evident from 2016 onward. Year to year trends in the number of body donation applications and donations are summarized in Table 1 and Figure 1.

The mean age of all applicants was 54.2 years, with males averaging 55.8 years (range: 18–88) and females 51.5 years (range: 18–85). Female applicants completed body donation applications at a significantly younger age than male applicants ( $p=0.046$ ). Applicants aged  $\leq 30$  years accounted for 13.5%, and those aged  $\geq 65$  years for 31.5% (Table 1).

Despite some year-to-year exceptions, age of body donation is generally concentrated between 50 and 60 years (Figure 2). Although the mean application age increased from 50.3 years in the pre-intervention period to 54.5 years in the post-intervention period, this difference was not statistically significant ( $p=0.261$ ). Except for one case, all applications from individuals aged  $\leq 30$  years were submitted after 2012.

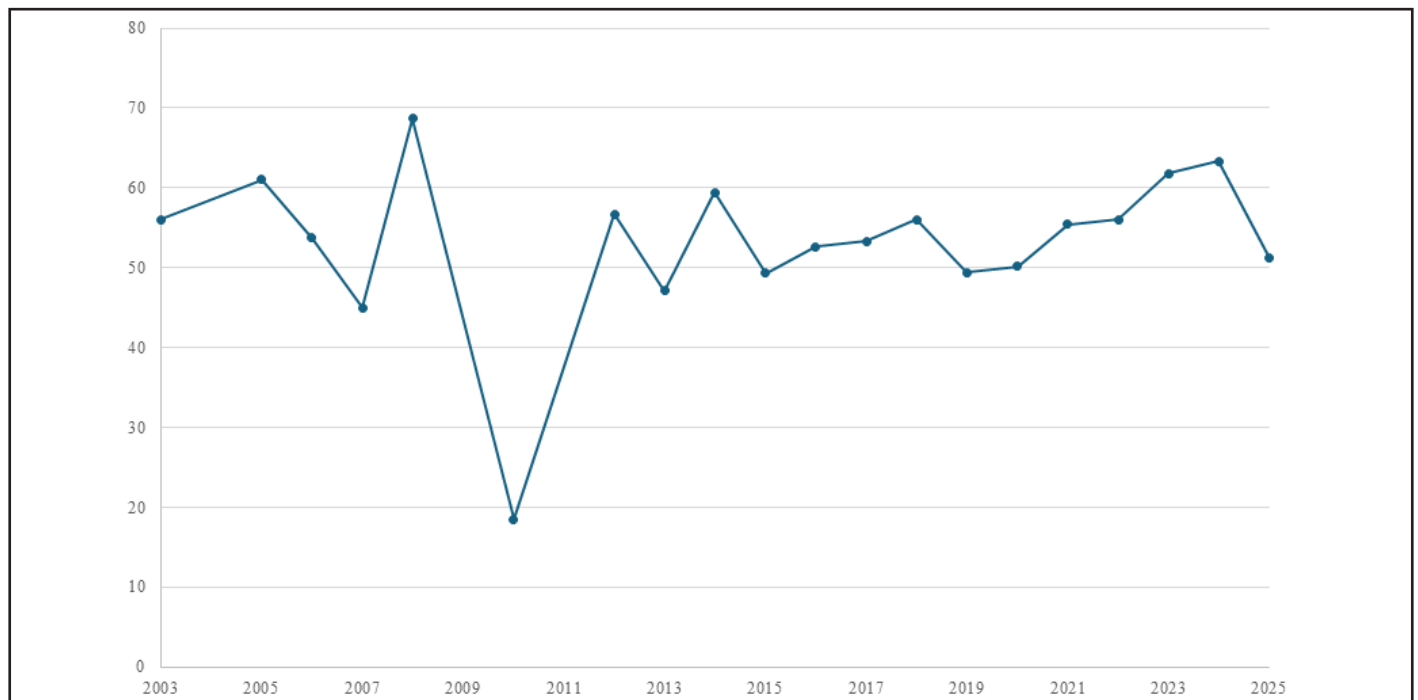
In the pre-intervention period, the proportions of male and female applicants were 82.6% and 17.4%, respectively, whereas in the post-intervention period these proportions were 59.8% and 40.2%. A statistically significant difference in sex was observed between the two periods ( $p=0.032$ ). The distribution by sex and age is presented in Table 1 and Figure 3.



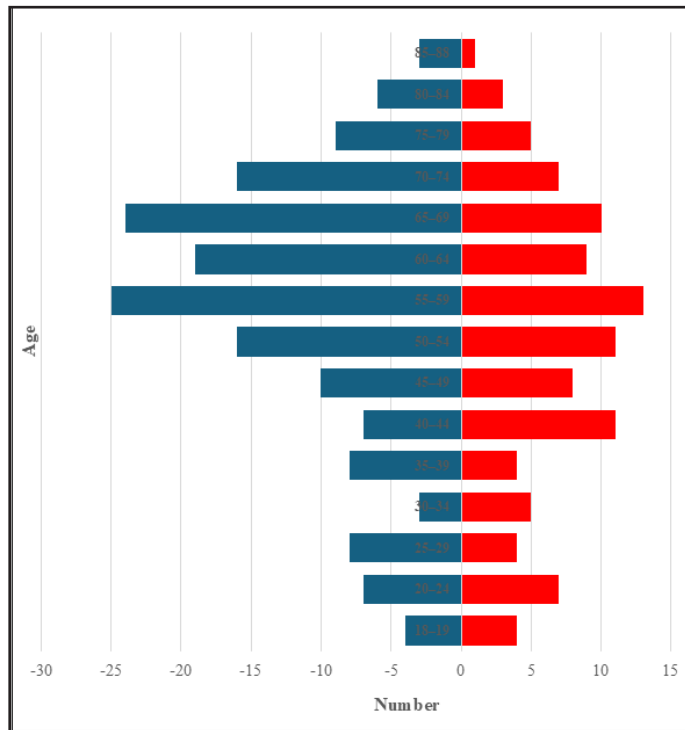
**Figure 1.** Annual numbers of applicants for body donation and accepted donations

**Table 1.** Temporal distribution of body donation registrations by sex, and applicant age

Years	Male		Female		Total	
	Number of application	Application age	Number of Application	Application age	Number of Application	Application age
'03	1	56.0	0	0	1	56.0
'04	0	0	0	0	0	0
'05	0	0	1	61.0	1	61.0
'06	7	53.3	2	55.0	9	53.7
'07	6	45.7	1	41.0	7	45.0
'08	3	68.7	0	0	3	68.7
'09	0	0	0	0	0	0
'10	2	18.5	0	0	2	18.5
'11	0	0	0	0	0	0
'12	5	59.8	2	49.0	7	56.7
'13	7	53.7	2	24.0	9	47.1
'14	7	58.7	1	64.0	8	59.4
'15	2	35.5	2	64.0	4	49.3
'16	12	53.8	5	50.0	17	52.6
'17	17	57.9	9	44.7	26	53.3
'18	12	57.6	10	54.1	22	56.0
'19	11	55.9	13	44.0	24	49.4
'20	9	56.8	9	43.7	18	50.2
'21	10	54.6	5	57.0	15	55.4
'22	11	54.6	15	56.9	26	55.9
'23	12	63.1	7	59.7	19	61.8
'24	11	63.1	8	63.6	20	63.3
'25	19	52.8	10	48.2	29	51.1



**Figure 2.** Temporal changes in the age of body donation applicants between 2003 and 2025.



**Figure 3.** Population pyramid illustrating the age-specific sex distribution of body donors.

Male donors are shown on the left side (blue bars) and female donors on the right side (red bars). Age groups are presented in 5-year intervals, and values represent the number of donors in each age category.

## DISCUSSION

The shortage of cadavers continues to be a pressing issue in Türkiye, posing ongoing challenges for medical education and research [6,7,9,16,21-28]. This study provides a mid-term overview of body donation applications and donations at a major faculty of medicine in Türkiye. Our institution is located in Ankara, where five state and seven foundation universities have the potential to accept body donations [29].

In Türkiye, 11.5% of anatomy departments have been reported to conduct education without access to cadavers [7], a proportion that may increase as existing cadaver stocks age and gradually lose their suitability for effective teaching. Nationwide survey indicates that unclaimed bodies constitute the primary source of cadavers (84.8%), followed by donated bodies (50%) and imported cadavers (39.1%). Although the use of unclaimed bodies raises ethical concerns due to the absence of prior consent, they have historically constituted a critical educational resource in country where voluntary donation is limited [30-33]. However, evidence suggests that the transfer of unclaimed bodies to institutions has been disrupted, a finding that aligns

with our experience. Despite existing legal provisions, hospital administrators and prosecutors remain reluctant to transfer unclaimed bodies to anatomy departments [7,16]. This hesitation likely reflects administrative barriers, procedural uncertainties, and ethical concerns, indicating that legal authorization alone is insufficient to ensure effective cadaver transfer.

In this context, the limited availability of both donated and unclaimed bodies increasingly challenges the sustainability and quality of anatomy education nationwide. As of May 2013, the mean student-to-cadaver ratio in Türkiye was reported to be 261. To address this shortage, the TSACA, through its NBDP, recommends raising public awareness of body donation, establishing a centralized donation registry, and enhancing cooperation among universities, hospitals, forensic authorities, and governmental bodies. Short-term solution, such as informational visits may help raise awareness among responsible authorities and reinforce knowledge of current regulations [16]. However, the also requires attention to ethical considerations and institutional decision-making, ensuring respect for human dignity and adherence to cadaver-use protocols. The program also advocates revising legislation to facilitate the transfer of unclaimed, non-forensic bodies, implementing a national cadaver-sharing system to reduce regional disparities [11,16]. It is also important to assess whether institutions currently have sufficient infrastructure and administrative capacity to accommodate unclaimed body transfers, should these resume. Our view is that, although major faculties generally have adequate facilities for cadaver storage and preparation, logistical challenges, such as timely transport and staffing, may limit immediate implementation. In addition, cadaveric material remaining in our department from postgraduate hands-on training courses organized by various medical specialty associations continues to serve as a valuable resource for basic anatomy education and research. These recommendations, particularly those concerning cadaver transfers or national cadaver-sharing, should be implemented within a framework that ensures donor consent, legal authorization, and ethical oversight, thereby ensuring transparency, accountability, and adherence to ethical standards.

The present study demonstrates that although the absolute number of cadavers accepted by our institution has remained limited, body donation applications have shown a sustained increase over time, particularly following the implementation of the NBDP with a more pronounced upward trend observed after 2016. It is

important to note that this change cannot be attributed solely to the program. Temporal trends in applications may be influenced by multiple contextual factors, including institutional outreach initiatives, national media coverage, changes in unclaimed body transfer practices, and the increasing number of medical schools in Ankara. These findings indicate a gradual transition toward donation-based cadaver supply, while also highlighting the continued insufficiency of donations to meet educational demands. In the long term, sustainable cadaver procurement may be supported by initiatives aimed at increasing public awareness and establishing social responsibility projects [16,26,31]. These approaches have been demonstrated to be effective across diverse cultural and religious backgrounds [8,17,34].

Male applicants constitute a higher overall proportion, while female applicants tended to apply at a significantly younger age. Previous national studies have reported inconsistent sex distributions, some have observed a predominance of female donors [35], whereas others have reported higher proportions of male donors [8,9,21,36,37]. Survey-based studies in Türkiye conducted have yielded mixed results; some indicated greater willingness to donate among women [6,24], while others found no significant sex differences [25]. Notably, although women demonstrated higher willingness in survey, this has not been reflected in the actual proportion donation rates. Collectively, these findings suggest potential behavioral differences in the body donation decision-making process. In addition, the recent increase in donations among younger age groups may be associated with the reach of NBDP, growing awareness, and greater engagement with digital media. Although body donation-specific social media campaigns at national or global levels are currently limited, some universities and purpose-driven organizations have utilized these platforms to share educational content and raise awareness. Alongside traditional media, ethical use of social media could serve as a long-term strategy to address cadaver procurement challenges by improving young people's access to accurate information.

Anatomists may be the primary target group, as their donation may raise public awareness and reduce societal concerns [7,27,38]. Other role models, including medical professionals, educators, and public figures, may also contribute to shaping public attitudes. Physicians occupy a highly visible and trusted position in society and may receive more initial body donation inquiries than anatomy departments; however, they may be insufficiently prepared to adequately inform and direct potential

donors. Strengthening physicians' awareness and engagement could enhance societal trust and participation in body donation programs [22]. This also applies to medical students, who will serve at all levels of the healthcare system after graduation [7,39]. At our institution, a body donation social responsibility project involving medical students has been implemented over the past few years as an educational initiative, conducted in conjunction with organ and tissue donation programs. The primary target group is the general public, with efforts should focus on providing accurate information through a variety of channels, such as websites, seminars, hospital collaboration, social media and brochures [23]. For instance, in Brazil, it has been reported that 26% of donors have at least one family member enrolled in a body donation program [17]. Implementing standardized educational sessions for individuals willing to donate their bodies, regardless of their prior knowledge or whether they raise questions, may further enhance understanding and engagement.

An increase in body donation applications suggests a potential shift in public awareness or attitudes. Monthly analyses of applications indicate that registration peaks often follow National Anatomy Week activities, implying that targeted awareness campaigns may exert measurable effects on donor behavior [9]. Although this study does not aim to establish definitive causal relationships, the observed trends likely reflect broader societal engagement with the program, including media coverage of commemorative events [40] and heightened awareness of unmet educational needs [41]. A study conducted in İstanbul, another major city in Türkiye, reported a significant increase in body donation applications in 2012, which was attributed to the NBDP and related initiatives [7]. A single-university study in South Korea documented an increase from 7 donors in 1992 to over 128 annually in recent years, primarily linked to cultural and religious changes, that enhanced the societal value of body donation [8]. Consistent upward trends have also been reported in Thailand and India [36,37], reflecting growing global awareness and societal acceptance of body donation. These findings underscore the importance of continuously monitoring donation trends and adapting strategies to local cultural, institutional, and societal contexts.

Cultural and religious values significantly influence public perceptions of body donation. Beliefs about the sanctity of the body and limits on individual ownership may contribute to societal hesitation [42-44]. In a survey conducted among religious officials, 38.2% reported that they considered religious

beliefs to be a contributing factor to the inadequacy of organ donation, while 50.6% stated that members of the public asked them questions regarding organ donation [45]. In Türkiye, public awareness of organ donation has reached a level where individuals often seek religious guidance and local approval, a trend that may also apply to body donation [7,45]. Individuals who donate organs and tissues may also be more willing to consider body donation, and a coordination model that enables these processes to be managed in an integrated manner could be developed. Consequently, religious officials are a key audience for efforts to raise awareness of body donation programs.

It is important to assess factors influence willingness to donate, including age, sex, ethnicity and cultural beliefs, religion, education, occupation, and income [18]. While higher education and income increase willingness in some populations [7,46,47], in others, such as Brazil, donors often have lower education and income [17], highlighting that each community's social dynamics must be considered individually. In Türkiye, registered donors are generally well-educated and motivated by usefulness, impermanence, and awareness of the role of body donation in medical education [9]. Survey-based research also shows that attitudes are shaped by sociodemographic factors, religious beliefs, and psychological considerations related to death and postmortem body use [9,25,48].

Coordination with municipal authorities and cemetery departments is essential to ensure that post-use procedures are carried out in accordance with donors' wishes. Although burial after utilization remains the prevailing preference in society, such coordination is particularly important in cases where donors request cremation. As demonstrated by a donor in our institution who requested cremation, establishing the necessary institutional and administrative linkages, through formal communication with relevant public authorities and the activation of a previously inactive cremation facility, enabled the fulfillment of the individual's wishes, thereby removing cremation as a potential barrier to body donation. Furthermore, our experience indicates that advance preparation of financial resources and intercity coordination is particularly beneficial to ensure the timely transfer of the donor's body when death occurs in another city.

Furthermore, openly demonstrating respect and gratitude toward applicants and cadavers within society is valuable for this purpose. In Türkiye and many other countries, universities

have long held commemorative ceremonies on special occasions, presenting plaques or flowers to honor body donors [30,39,49]. Additionally, on designated special days such as World Anatomy Day, donors and their families may receive greeting cards of appreciation. Material representation of respect, such as monuments and sculptures, may also be beneficial. In this context, the "Manifesto of the Cadaver" sculpture competition was organized in recent years in memory of Prof. Dr. Mustafa Fevzi Sargon, former Head of Department of Anatomy at Hacettepe University, through collaboration between the Faculty of Medicine and the Faculty of Fine Arts, under the slogan "Donate Your Body, Let It Live in Medical Education". The selected sculpture is planned to be inaugurated in the near future and permanently displayed at the entrance of the anatomy department, symbolically honoring body donors and representing an innovative, interdisciplinary approach to raising awareness of body donation. [50].

Together with this study, evidence from Türkiye indicate rising public awareness and body donation applications [7,21]; although this has not yet been reflected in the number of officially donations, it serves as a warning for institutions to begin preparing the necessary institutional facilities.

### **Limitations**

Its single-center design may limit the generalizability of the findings to other institutions. In addition, Ankara hosts several medical faculties authorized to accept body donations. In such a multi-institutional environment, donation applications may be influenced by referral pathways, institutional preferences, geographic proximity, and potential interinstitutional competition. This contextual factor should be considered when interpreting results. Moreover, the absence of a routine questionnaire alongside the legally required donation procedure, restricting the availability of detailed information on applicants' motivations and attitudes. Finally, the study provides only mid-term outcomes, and longer follow-up periods are needed to assess long-term trends in body donation practices. The limited number of annual observations may have reduced the statistical power to detect an immediate intervention effect.

### **CONCLUSION**

This retrospective analysis of body donation applications at a major medical institution over a mid-term period. Temporal trends in body donation suggest that the NBDP and associated initiatives may have influenced the increase in applicants,

emphasizing that continuous monitoring of donation trends is essential for institutions to develop proactive strategies and further improve these programs.

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**Informed Consent:** Not applicable

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**Author Contributions:** Conception: BP, HYG Design: BP, MÜ, HYG - Supervision: MDD - Data Collection and/or Processing: BP, MÜ - Analysis and/or Interpretation: BP - Literature: BP, MÜ, HYG - Review: BP, MÜ, HYG - Writing: BP - Critical Review: MÜ, HYG, MDD.

**Data Availability Statement:** The data and materials concerning this study are available, if necessary from the corresponding author.

**Author Statement Regarding the Use of Artificial Intelligence-Enhanced Tools:** AI applications were used for grammar and spell checking, and language editing of the manuscript. The authors have read and approved the final version of the manuscript.

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