

RESEARCH

Open Access



Where the pipeline leaks and delays: gendered academic dynamics in anatomy in Türkiye

Buse Naz Çandır Gürses^{1*} , Sabiha Nisa Çandır^{2,3} and İlke Ali Gürses⁴

Abstract

Background This study examines gender representation across the academic anatomy pipeline in Türkiye, from graduate education and thesis authorship to academic faculty ranks, and aims to identify where gender disparities emerge.

Methods Data were obtained from three national open-access sources: annual reports on the numbers of master's and doctoral students in anatomy programs (2015–2025), all anatomy theses published between 1969–2024, and the distribution of academic staff in anatomy departments as of March 2025. Gender was classified using publicly available institutional and academic profiles. These datasets were examined comparatively to map longitudinal patterns from training to senior academic ranks.

Results A total of 1,657 theses were included; women accounted for 57.2% of authors, and their proportion increased from 42.9% in early decades to 64.8% in 2020–2024 ($p < 0.001$). Between 2015–2025, women's representation rose from 58.2% to 69.7% in master's programs and from 40.1% to 54.7% in doctoral programs. Despite strong representation of women at trainee levels, only 31% of professors in 2025 were women, while their representation was markedly higher among research assistants (74.4%) and lecturers (69.6%). Academic rank and gender were significantly associated ($p < 0.001$), indicating progressive attrition of women along the academic pathway.

Conclusions Although women enter the anatomy field in Türkiye in strong numbers and successfully complete graduate training, this increasing representation does not translate into senior academic positions. These findings show that women's strong early-stage presence fails to reach senior ranks, exposing both clear leakage and suggesting marked delayed advancement in the academic pipeline.

Keywords Gender equity, Gender disparity, Women in academia, Women in anatomy, Leaky pipeline

*Correspondence:

Buse Naz Çandır Gürses
busenazcandir@gmail.com

¹Department of Anatomy, Faculty of Medicine, İstanbul Yeni Yüzyıl University, Maltepe Mah., Yılanlı Ayazma Yolu, No.26, İstanbul 34010, Türkiye

²Department of Clinical Sciences, Faculty of Dentistry, Kapadokya University, Nevşehir, Türkiye

³Department of Anatomy, Faculty of Medicine, Erciyes University, Kayseri, Türkiye

⁴Department of Anatomy, School of Medicine, Koç University, İstanbul, Türkiye



© The Author(s) 2026. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Introduction

Throughout the historical development of knowledge aimed at understanding the human body, women's access to medical education remained systematically restricted for a long time [1–3]. Over time, however, this situation has changed considerably with the expansion of women's access to higher education [3, 4], the strengthening of gender-equality policies [5], and the broader transformation of academic structures [6]. Parallel to these developments, in recent years the visibility and academic contributions of women researchers have markedly increased in medicine, as in many other professional fields [7–9]. Nevertheless, women's representation in senior academic positions remains lower than that of men worldwide [7, 8, 10, 11].

In Türkiye, anatomy education and research are carried out by Departments of Anatomy within medical faculties. Historically, following the enactment of the Higher Education Law No. 2547 in 1981 [12], Anatomy departments were merged under the broader Department of Morphology together with Histology–Embryology [13, 14]. However, in 1993, a decision by the Turkish Council of Higher Education (YÖK) abolished the Morphology departments, and Anatomy and Histology–Embryology were re-established as independent departments [13, 14]. Graduate education in human anatomy is conducted through MSc and PhD programs. In Türkiye, these programs are offered within Faculties of Medicine and Dentistry. These programs commonly accept graduates from health sciences (e.g., dentistry, physiotherapy) or biological sciences, while medical graduates may pursue a PhD or medical residency (MD-Residency) in anatomy. MSc and PhD programs begin with application and admission through graduate education institutes and are carried out under these institutes. The medical residency in Anatomy is assigned through the national Medical Specialization Examination (TUS) and carried out under the Ministry of Health.

Academic advancement in Türkiye is regulated by YÖK criteria, and academic staff in medical faculties may hold the titles of research assistant, instructor, assistant professor, associate professor, and professor: In Türkiye, research assistants are early-career researchers (under the age of 35) enrolled in graduate education and required to remain actively registered throughout their appointment. Their primary responsibilities include assisting with research, analysis, and experimental work. Upon completion of graduate education, research assistants may continue in their positions—subject to institutional agreement—until the age limit is reached. Instructors, by contrast, are academic staff members responsible for delivering lectures and conducting practical teaching activities in higher education institutions. Appointment to an instructor position requires at least

a master's degree with a thesis; however, this role does not require continued enrollment in graduate education, and individuals may hold the position indefinitely without pursuing a doctoral degree. Individuals in both positions who wish to pursue an academic career beyond these roles may apply for faculty positions after completing graduate education. In Türkiye, faculty ranks consist of assistant professor, associate professor, and professor. Appointments to assistant professor and professor positions are made according to criteria determined by the hiring universities, whereas the title of associate professor is conferred based on nationally defined criteria established by the Interuniversity Council (UAK) under the YÖK. Unlike other academic ranks, appointment to the position of professor requires a minimum of five years of service as an associate professor [12].

This historical and institutional background makes it essential to examine the representation of women academics in the field of anatomy. Although global reports indicate an increase in the proportion of women in higher education, a substantial gender gap persists in senior academic positions [15–17]. For instance, in European Union countries, while women represented approximately 40% of academics in 2018, their share at the professor level dropped to 26% [15]. Similarly, a study covering 16 countries reported that women represented only about 12% of full professors [16]. A global report evaluating leadership in higher education showed that women constituted only 19.5% of rectors and deans [17]. In Türkiye, women account for roughly 40% of academics nationwide [18] and in medical faculties [7]. However, studies specifically focusing on anatomy have shown that women are underrepresented in academic positions [19], authorship roles [20, 21], and editorial boards [8]. These gendered patterns in academia may reflect dynamics described as the “leaky pipeline,” in which women exit the system at various stages [22], or “delayed advancement,” referring to slower progression compared with men [23].

Extensive research has shown that gender inequities in scientific and academic careers shape long-term leadership trajectories and influence participation and advancement across the academic workforce [11, 24]. Although similarly comprehensive analyses are limited within the anatomical sciences, the studies that do exist point to comparable structural dynamics [8, 25]. Revealing the stages at which these inequities emerge will guide the development of more equitable hiring, promotion, and mentorship approaches within higher education institutions. Therefore, this study aims to characterise gender representation along the academic anatomy pipeline in Türkiye—from graduate training and thesis authorship to faculty ranks—and to identify potential points of leakage and delayed advancement.

Materials and methods

In this study, two different national open access databases were used to examine representation of women in the field of anatomy (in terms of graduate student distribution, graduate thesis authorship, and faculty positions): (1) YÖK Information Management System and (2) YÖK National Thesis Center. In the YÖK Information Management System, gender is reported only in binary categories (women/men), and our analyses of graduate students and academic staff therefore follow this reporting structure. In contrast, the YÖK National Thesis Center does not include gender information for thesis authors; for this reason gender was identified by the researchers using publicly available information, as described in detail in the relevant section below.

Since all data were obtained from publicly accessible databases, ethical committee approval was not required.

Graduate students

The first dataset was obtained from the reports titled “Number of Students by Level of Education and Unit” [26] on the YÖK Information Management System. From the first report for the 2015–2016 academic year to the most recent report for 2024–2025, the numbers of women and men enrolled in MSc and PhD anatomy programs were identified and organised by year to enable gender-based comparisons. These figures represent the total number of students registered in each academic year and do not track individuals across years; therefore, students may appear in more than one year if they remained enrolled.

Graduate thesis authors

Using the YÖK National Thesis Center website [27], theses were identified through the Department filter for ‘Anatomy’ and ‘Morphology’. No additional filters (e.g., thesis type, year range, keywords, abstract search, topic) were applied, ensuring that all theses associated with these academic units were captured. Accordingly, all MSc, PhD, and MD (medical specialty) theses published from 1969—the year of the first anatomy thesis in Türkiye—through 2024 were included. Since 2025 was not yet complete, theses from this year were excluded from the analysis.

All thesis types (MSc, PhD, and MD) conducted within academic units responsible for human anatomy education and research—specifically the Anatomy or Morphology Departments of Faculties of Medicine or Dentistry—were included. The exclusion criteria were as follows: (i) theses conducted within Faculties of Veterinary Medicine, as they do not pertain to human anatomy; and (ii) thesis topics labelled as “anatomy” but carried out in clinical departments (e.g., orthopedics), even when the

research topic related to human anatomy, because the authors’ career pathways are not in anatomy.

The gender of thesis authors was not included in the National Thesis Center database; therefore gender information was identified by the researchers. Gender determination was conducted through systematic online searches using name–surname information. Official university websites, the Academic Data Management System (AVESİS), Google Scholar, DergiPark and other academic platforms were reviewed, and gender classification was performed observationally using academic profiles with photographs, CVs, and personal pronouns (e.g., she/her, he/him). Gender coding was conducted by S.N.Ç. and independently verified in a blinded manner by B.N.Ç.G. and İ.A.G. Although this approach allowed gender classification for the purposes of this study, it is based on externally observable characteristics and may misrepresent individuals whose gender identity does not align with binary categories or perceived gender presentation; therefore, it carries inherent limitations and cannot capture non-binary or gender-diverse identities.

Academic staff

The third dataset was obtained from the “Report on the Number of Academicians by Unit” [28] on the YÖK Information Management System. This report presents the numbers and gender distribution of academic staff (professor, associate professor, assistant professor, instructor, research assistant) working in anatomy departments of universities affiliated with YÖK. Because this dataset reflects only the status as of 27 March 2025, it does not include year-to-year changes related to appointments, promotions, or retirements. Additionally, requests submitted to YÖK to access earlier versions of this report were not answered.

Cross-dataset integration and derived pipeline indicators

Although the three datasets (graduate enrolment, thesis authorship, and academic staff) were obtained from separate sources and do not allow individual-level longitudinal tracking, we conducted a planned cross-dataset integration to derive proxy indicators of progression across stages of the academic pipeline. First, we compared gender proportions in annual MSc and PhD enrolment with gender proportions among MSc and PhD thesis authors within a corresponding outcome window. In defining enrolment periods and outcome windows, national regulations of the YÖK were used as the reference. In Türkiye, MSc programs in anatomy typically span two years and PhD programs four years, with a maximum extension period defined as half of the standard program duration [29]. Based on these timelines, MSc students who entered programs between 2015 and 2022 would be expected to appear among MSc thesis

outcomes between 2015 and 2024, while PhD students who began between 2015 and 2020 would be expected to appear among PhD thesis outputs during the same period. It should be noted that enrolment figures represent total numbers of registered students per academic year and may therefore include the same individuals across multiple years.

Second, we constructed descriptive “progression” contrasts by comparing gender proportions among thesis authors in earlier periods with gender proportions among senior academic ranks in 2025 to contextualise potential delayed advancement. According to typical academic career timelines in Türkiye, researchers who complete a PhD or MD thesis generally progress through approximately five years each at the assistant professor, associate professor, and professor stages, reaching the professor level within roughly 15–20 years. Accordingly, individuals who authored theses between 2005 and 2009 would be expected to contribute substantially to the professor-level academic workforce in the 2020s.

These integrated indicators were used to support interpretation of leaky and/or delayed pipeline dynamics, while explicitly acknowledging that they represent numerical proxies rather than direct person-level transitions.

Statistical analysis

Normality of distributions was assessed using the Shapiro–Wilk test. Categorical variables were summarised using frequencies and percentages, and relationships between groups were analysed using the Pearson chi-square test. When the chi-square test indicated significance, post-hoc two-proportion z-tests were applied for subgroup analyses. Yearly changes and trends were evaluated through linear regression. Annual differences in MSc and PhD student numbers were compared using paired samples t-tests. Nonlinear relationships were analysed using Spearman correlation. All statistical analyses were performed using SPSS (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0, Armonk, NY: IBM Corp.), and a p -value < 0.05 was considered statistically significant.

Results

Graduate students

Data from the 2015–2016 period—the first dataset on MSc and PhD students shared by YÖK—to the most recent period of 2024–2025 were evaluated, covering a 10-year span. Within this scope, the numbers and proportions of women and men at the MSc and PhD levels were calculated.

Student numbers changed significantly over the years; at the MSc level, the number of students decreased by an average of 17 students per year ($p < 0.001$; $\beta = -16.81$),

whereas at the PhD level, the number increased by an average of 8 students per year ($p = 0.005$; $\beta = +8.18$). Additionally, a temporary decrease in student numbers was observed in both levels during the 2019–2020 period; after this period, the decreasing trend continued at the MSc level, while the increasing trend became more pronounced at the PhD level (Fig. 1).

Gender-based analyses showed that the number of women MSc students was significantly higher than that of men (women: 252 ± 22 , men: 144 ± 45 , $p < 0.001$) (Fig. 1). At the PhD level, however, no significant difference was found between the numbers of women and men (women: 179 ± 34 , men: 195 ± 13 , $p = 0.247$). Examination of annual trends revealed a decrease in the number of men enrolled in MSc programs ($p < 0.001$; $\beta = -13.88$) and an increase in the number of women enrolled in PhD programs ($p < 0.001$; $\beta = +10.74$).

Comparison of educational levels revealed no difference in total student numbers between MSc and PhD programs (MSc: 396 ± 57 , PhD: 374 ± 31 , $p = 0.394$). However, the number of women at the MSc level was higher than at the PhD level (MSc: 252 ± 22 , PhD: 179 ± 34 , $p < 0.001$), whereas the number of men was higher at the PhD level compared with the MSc level (MSc: 144 ± 45 , PhD: 195 ± 13 , $p = 0.002$). Analysis of the distribution of gender ratios across years showed that the proportion of women at the MSc level consistently remained above 50% throughout the entire period (Fig. 1). The proportion of women at the MSc level increased from 58% in 2015–2016 to 72% in 2023–2024, while the proportion of men decreased from 42% to 28% during the same period. At the PhD level, the proportion of women, which was initially around 40%, steadily increased and reached 55% in 2024–2025. During this period, the proportion of men declined from 60% in 2016 to 45% in 2025. Women PhD students first surpassed men in 2022–2023, and this trend continued in the following two years. Examination of gender-based changes over time showed that the proportion of women increased significantly at both MSc and PhD levels (MSc: $p < 0.001$; PhD: $p < 0.001$), while proportions of men decreased significantly in parallel (MSc: $p < 0.001$; PhD: $p < 0.001$).

Graduate thesis authorship

A total of 1,657 theses that met the inclusion criteria were analysed out of 1,668 theses listed in the National Thesis Center. Of the authors, 57.2% were women ($n = 947$) and 42.8% were men ($n = 710$). Additionally, 50.8% of the theses ($n = 842$) were MSc theses, 34.4% ($n = 570$) were PhD theses, and 14.8% ($n = 245$) were MD theses.

Analysis of 10-year periods (1969–1979, 1980–1989, 1990–1999, 2000–2009, 2010–2019, 2020–2024) showed that the gender distribution of thesis authors varied significantly across decades ($p < 0.001$) (Fig. 2). Authorship

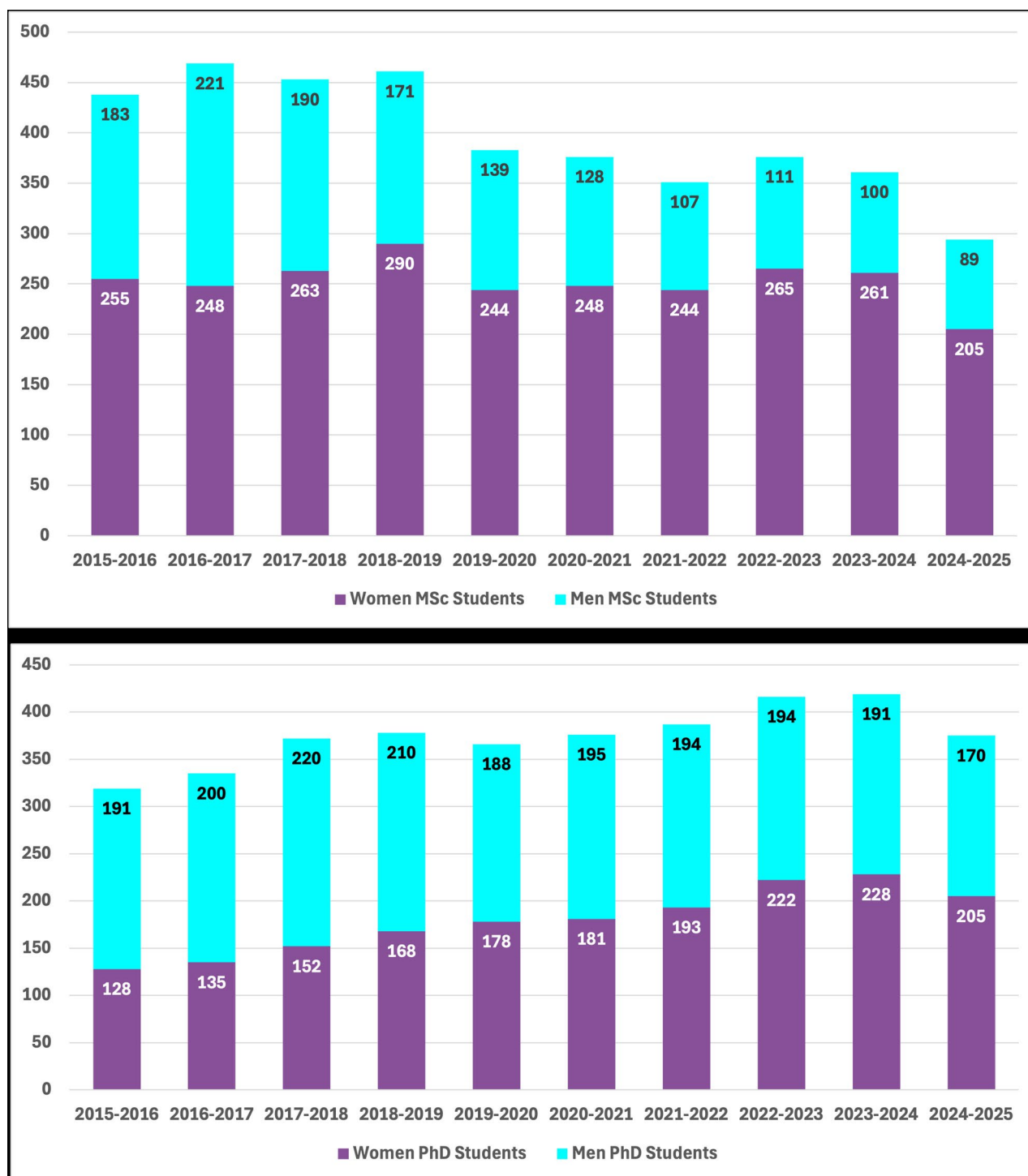


Fig. 1 Gender distribution of graduate students in anatomy

by men was higher than women in the 1969–1979 and 1980–1989 periods, although these differences were not statistically significant ($p=0.27$ and $p=0.16$, respectively). In contrast, authorship by men was significantly higher during the 1990–1999 and 2000–2009 periods ($p<0.001$). The 2010–2019 period was characterised by a

higher proportion of women authors ($p=0.046$), and this increase became even more pronounced in the 2020–2024 period ($p<0.001$).

Thesis types also showed significant changes across the 10-year periods ($p<0.001$) (Fig. 3). PhD theses predominated in the earlier decades, MD theses increased

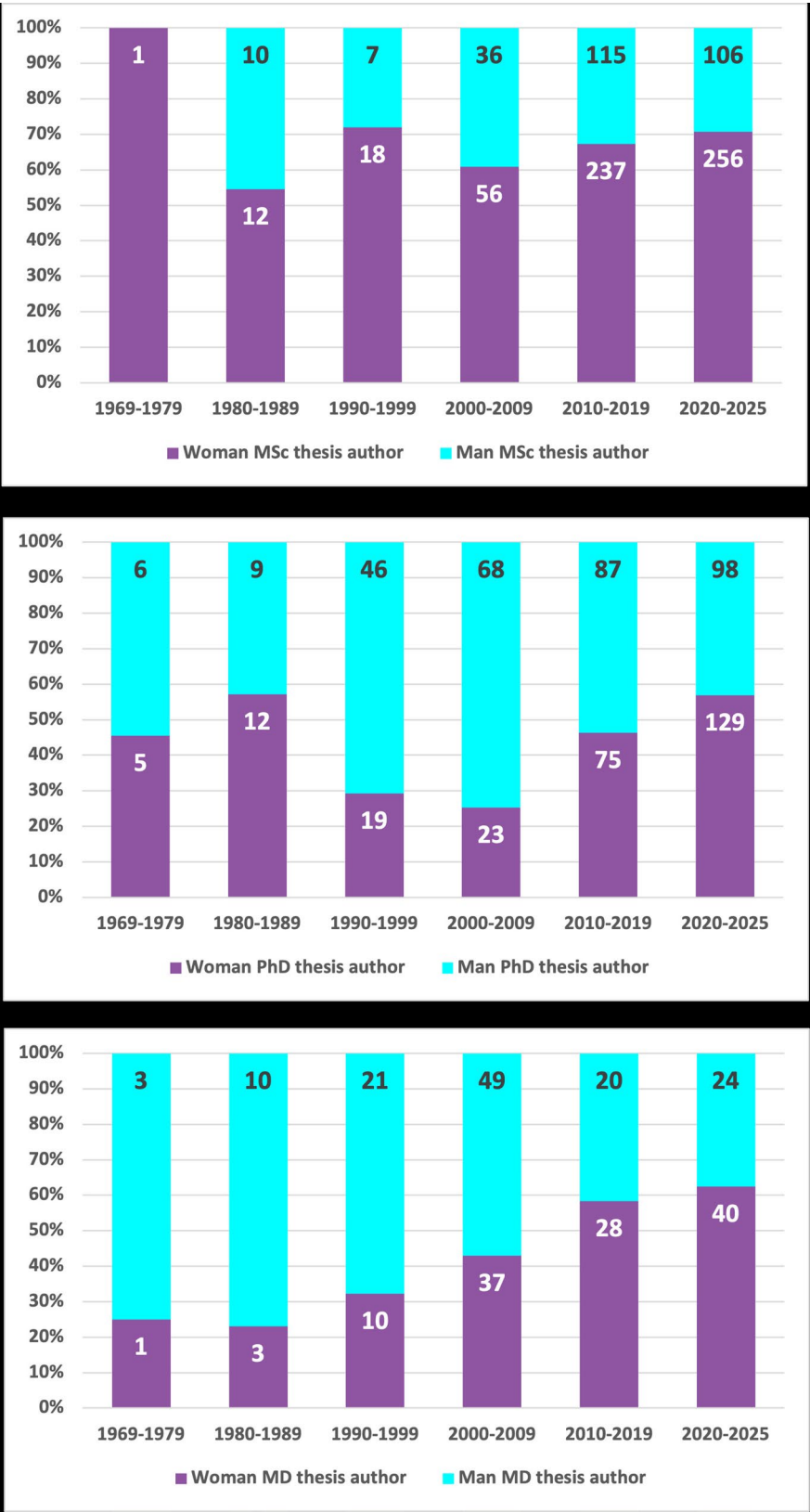


Fig. 2 Gender distribution of thesis authors

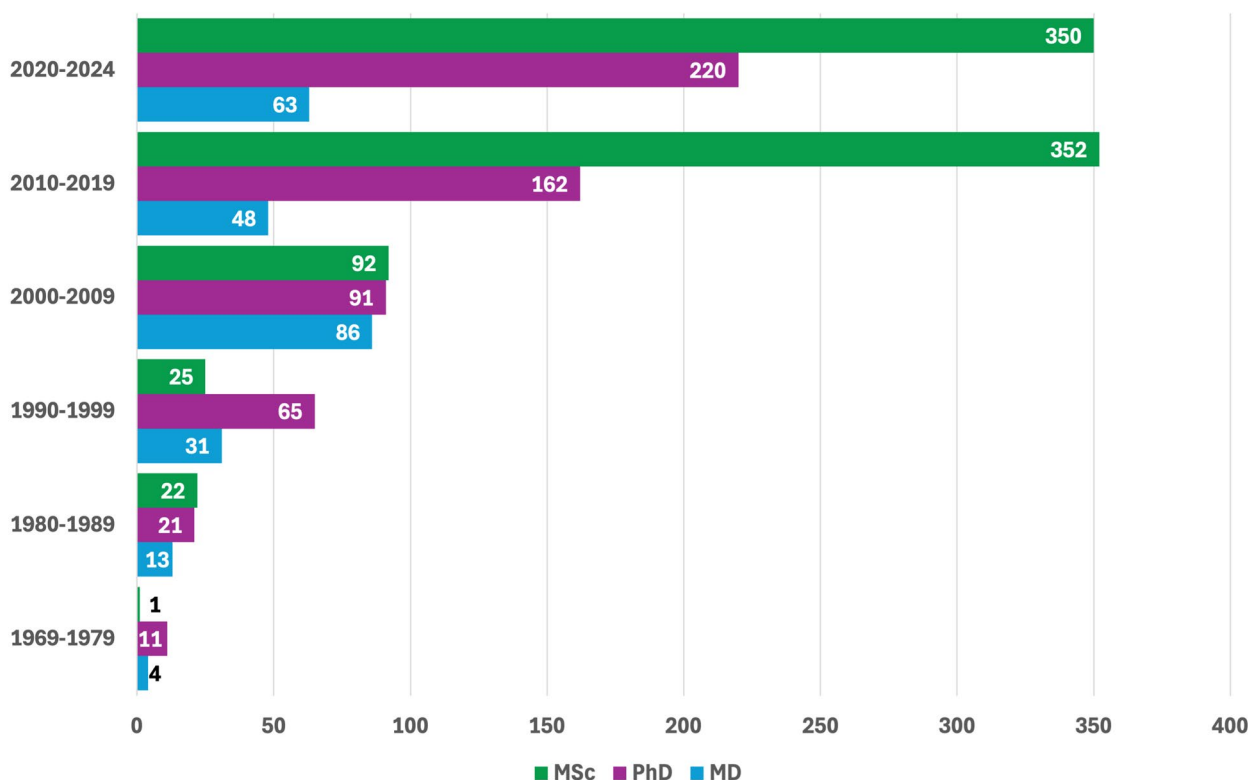


Fig. 3 Distribution of graduate thesis types across decades

markedly during the 2000–2009 period ($p < 0.001$), and MSc theses became substantially more common after 2010 ($p < 0.001$).

Academic staff

A total of 589 academic staff members were identified; 283 (48%) were men and 306 (52%) were women. Analysis by academic rank showed that men outnumbered women at the professor level, whereas women outnumbered men at all other ranks (Fig. 4). The proportion of women was 74% among research assistants, gradually decreased with higher ranks, and dropped to 31% at the professor level (Fig. 4).

A statistically significant association was found between academic rank and gender ($p < 0.001$). The number of men was higher at the professor level, while women were more numerous at the research assistant level. In addition, the proportion of women professors was significantly lower than that of women in the associate professor, assistant professor, instructor, and research assistant groups ($p < 0.001$).

Across institution types, total academic staff numbers were substantially higher in state universities compared with foundation universities (Fig. 4). The proportion of women was higher in foundation universities at the professor, instructor, and research assistant levels, whereas

men were more represented in the associate professor and assistant professor ranks in state universities. Overall, women were more highly represented in foundation universities than in state universities ($p = 0.038$). However, within the same academic ranks, no significant differences were observed between state and foundation universities ($p > 0.05$).

Integrated cross-dataset pipeline indicators

When gender proportions in annual MSc and PhD enrolment were projected to gender proportions among MSc and PhD thesis authorship within the defined outcome windows, women represented 61.1% of MSc enrolment but 67.4% of MSc thesis authors, and 43.0% of PhD enrolment but 55.3% of PhD thesis authors. These findings indicate that women's representation increased from enrolment to thesis completion in both MSc and PhD training.

To contextualise potential delayed advancement or attrition beyond graduate training, thesis authorship periods were compared with the academic rank distribution observed in 2025. Women constituted approximately 45% of thesis authors during the 2005–2009 period; however, they represented only 31% of professors in 2025. This cross-dataset discrepancy, together with the progressive decline in women's representation from

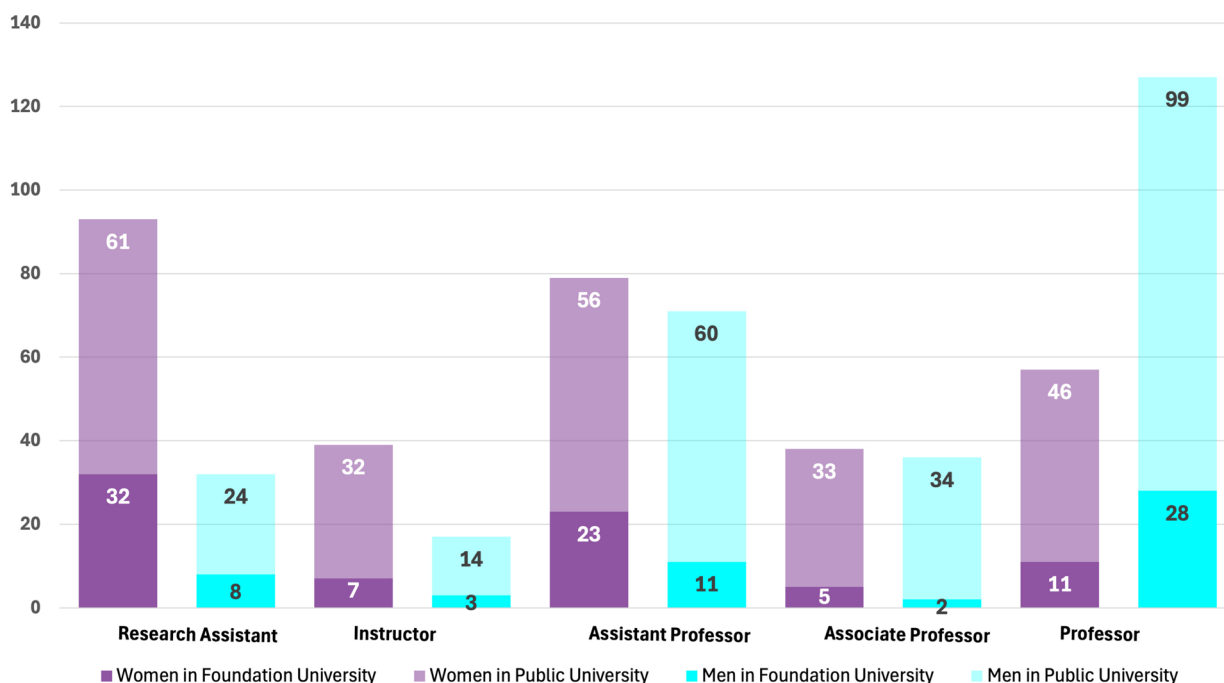


Fig. 4 Gender distribution of academic staff based on 2025 data

early-career ranks (research assistant and instructor) to the professor level, is compatible with numerical patterns consistent with leakage and/or delayed advancement in the transition to senior academic positions.

Discussion

The findings of this study reveal a striking dual pattern regarding women's representation in the field of anatomy in Türkiye: although women's visibility at the entry stages of academia has increased markedly, this rise does not translate proportionally into senior academic positions. The proportion of women among thesis authors increasing from 42.9% to 64.8% between 1969 and 2024, and the fact that women constitute approximately 70% of the MSc and 55% of the PhD student pool in the last decade, demonstrate a substantial strengthening of women's presence at the point of entry into the field. However, as of March 2025, women represent only 31% of professors, indicating a sharp decline in representation as the academic hierarchy ascends. This pattern aligns with the structural inequality dynamics widely described as the “leaky pipeline,” yet the strong representation of women in earlier stages also suggests the possibility of delayed advancement along the promotion pathway [22, 24].

Graduate student distributions

Although comprehensive studies reporting gender distributions among graduate students in anatomy are limited, the existing literature indicates a marked rise in women's representation in graduate programs in recent

years. Large-scale analyses of MD–PhD programs in the United States have shown that the proportion of women increased from 38% to 46% between 2009 and 2018 [30], and more recent data demonstrate that this upward trend continued, with women comprising 51% of the 2023 entering cohort [31].

The graduate student data analysed in the present study for the 2015–2025 period display a similar pattern. In MSc programs, the proportion of women never dropped below 50%, remaining between 52% and 72% across all years, with a generally increasing trajectory. In PhD programs, the initial proportion of women was approximately 40% in 2015–2016, followed by a steady rise in the subsequent years; the proportion surpassed the 50% threshold for the first time in 2022–2023 and reached 54.7% in 2024–2025. Considering these two levels together, women constitute roughly 60–70% of MSc students but only 45–55% of PhD students, suggesting that the transition from MSc to PhD is less common for women than for men. Notably, the lower proportional representation of women at the PhD level compared with MSc—observed both in graduate student distributions (Fig. 1) and in PhD thesis authorship (Fig. 2)—likely reflects barriers at the MSc–PhD transition, rather than lower academic performance, as women who enter PhD programs demonstrate high thesis completion success.

Pipeline indicators suggest that women had a higher likelihood than men of completing MSc programs and reaching the thesis stage. Similarly, despite lower initial representation at enrolment, women who entered PhD

programs demonstrated higher completion success than men. Evaluated collectively, these transitions indicate that although women's overall representation declines at later stages of graduate education, women who remain in the programs are proportionally more likely than men to progress to thesis completion.

Importantly, this pattern indicates that women's underrepresentation at senior academic ranks cannot be attributed to lower academic performance or persistence during graduate training. Instead, the disconnect between higher completion success and later career outcomes suggests that barriers to women's professional advancement in anatomy emerge primarily after formal training, during postdoctoral, early faculty, and promotion stages.

Graduate thesis authorship

The 56-year dataset (1969–2024) on thesis authorship in anatomy in Türkiye reveals a clear shift in women's representation. Although gender distribution was relatively balanced in the early decades, men were significantly dominant as authors between 1990 and 2009 (Fig. 2). From the 2010s onward, however, the proportion of women authors approached parity with that of men, with women becoming slightly more represented after 2020. This pattern may be interpreted in the context of two major expansion waves in Türkiye's higher education system [32]. The first occurred in 1992, during which 24 new universities were established. Considering that the total number of universities prior to this expansion was 29, this represented a near doubling of institutional capacity and inevitably generated substantial demand for academic staff. The second expansion wave occurred in 2006, with the establishment of 16 additional universities, followed by the founding of 37 foundation universities within the subsequent five years. These expansion phases may not have affected women and men symmetrically. In the early 1990s, access to and progression within doctoral training may have remained more readily available to men, potentially contributing to the male-dominated pattern of PhD thesis authorship observed during this period (Fig. 2). In contrast, the second expansion wave may have coincided with relatively more equalized opportunities for women's participation in doctoral training, consistent with the increasing proportion of women among PhD thesis authors after 2010. This interpretation may also be relevant to understanding institutional differences between state and foundation universities (Fig. 4). The vast majority of universities established during the first expansion wave were state institutions, whereas the second wave was characterized by a substantial growth of foundation universities. Given the gender distribution of doctoral thesis authors across these periods, these structurally distinct expansion phases may have contributed

to the observed gender imbalance between state and foundation universities, without implying direct causality. Accordingly, the higher representation of women in foundation universities may reflect the timing and structural characteristics of the second expansion wave, which coincided with relatively more gender-balanced participation in doctoral training. Finally, the expansion of Türkiye's higher education system in the 1990s may also have influenced MD thesis production. In the subsequent period, a marked increase in MD theses is observed, particularly during 2000–2009 (Fig. 3). This trend may be associated with the expansion of academic capacity in medical faculties and the strengthening of specialization-oriented academic career pathways.

Beyond reflecting scientific authorship practices, thesis authorship data offer insight into the potential future structure of the academic workforce. In the present study, gender proportions among thesis authors in the 2005–2009 period were not reflected in the professor-level distribution observed in 2025, despite timelines that would predict substantial representation of this cohort at senior ranks. This mismatch, together with the continued predominance of men in professor positions, suggests that women may exit the academic pathway at specific transition points or experience delays in promotion processes within the academic anatomy pipeline in Türkiye.

Importantly, the structural characteristics of professorship in Türkiye should also be considered when interpreting this mismatch. Under the Higher Education Law, professorship is defined as the highest academic rank and is not time-limited [12]. Academic staff in public universities are subject to the general civil service retirement framework, in which the statutory retirement age is typically 65 [33], with extension to 67 for academic staff [12]. Accordingly, once promoted, professors may remain in this rank for extended periods compared to earlier career stages, potentially producing a cumulative effect at the senior level. In addition, retirement does not necessarily imply complete withdrawal from academic life; continued engagement in higher education after formal retirement has been documented in Türkiye [34]. Together with documented structural complexities in academic promotion processes [35], these factors suggest that gender proportions at the professor level may adjust more gradually than at entry or mid-career ranks. Therefore, the observed imbalance may reflect not only possible attrition or delayed advancement within the academic pipeline, but also the demographic inertia associated with extended tenure and relatively limited turnover at the senior rank.

Academic staff

The representation of women in academic anatomy in Türkiye decreases progressively from early-career to

senior ranks. Women constitute 74.4% of research assistants and 69.6% of instructors; however, their proportion declines to 52.7% at the assistant professor level and 51.4% at the associate professor level. At the professor level, women represent only 31%. These findings demonstrate that although women are strongly represented at the entry points of the academic pyramid, their presence decreases sharply as seniority increases.

This vertical stratification aligns closely with international data from medical faculties. According to the Association of American Medical Colleges' report *The State of Women in Academic Medicine 2023–2024*, women comprise 45% of full-time medical school faculty, yet only 29% of full professors, 25% of department chairs, and 27% of medical school deans are women [36]. Longitudinal trends from the same dataset indicate that although women's overall representation in academic medicine has increased, senior ranks remain predominantly occupied by men [37]. A large-scale analysis of basic science faculty in U.S. medical schools reported that between 1998 and 2018, women represented only 24.5–35.3% of basic science faculty, with white male professors consistently comprising the largest group [38]. A systematic review and meta-analysis of academic physicians demonstrated that men were 2.77 times more likely than women to be full professors [16]. At the European level, the *She Figs. 2021* and European Trade Union Committee for Education reports show that although women represent nearly half of doctoral graduates, they hold only around 26% of the highest academic positions [15, 39]. Data from Malta similarly indicate that while women constitute the majority of students in health-related programs, senior academic roles in the same institutions remain predominantly occupied by men [40]. In the United Kingdom, women account for 26.3% of clinical academic staff; their representation increases at the lecturer level but falls to just 15.6% among professors [41]. Collectively, these findings across different countries and institutional settings consistently demonstrate that despite the numerical growth of women in medical education, gender disparities persist at the highest academic ranks.

This international pattern, when considered alongside the graduate student, thesis authorship, and academic staff data presented in this study, indicates a clear “leaky” dynamic within the anatomy academic pipeline in Türkiye. Women's strong majority at the MSc and PhD levels, and in early-career positions such as research assistant and instructor, reflects a broad entry pool of women; however, the narrowing of this representation at the assistant and associate professor stages and its sharp drop to 31% at the professor level suggest substantial losses during the transition to senior ranks. Thus, despite a predominantly female entry into the field, women's representation progressively declines as the academic

hierarchy advances, indicating that the pipeline “leaks” considerably before reaching the professor level. The sustained high representation of women at earlier stages also points to the possibility of delayed advancement in anatomy in Türkiye. Taken together, these findings suggest that, in the Turkish anatomy context, both leakage and delayed advancement dynamics may be operating simultaneously, with women experiencing disadvantages in progressing to senior academic ranks despite their strong initial representation.

Structural mechanisms underlying the leaky and delayed pipeline dynamics

The numerical patterns identified across graduate enrolment, thesis authorship, and academic rank distributions indicate that gender disparities in anatomy in Türkiye are not random fluctuations but reflect systematic processes operating across career stages. The trends observed in the Results can be interpreted through a set of well-documented structural and cultural mechanisms that shape academic careers in medicine and the basic sciences. The following factors provide a conceptual framework for understanding why women's strong representation at entry and training stages does not translate proportionally into senior academic positions.

In academic medicine and the basic sciences, women's underrepresentation in senior positions has been attributed in the literature to multidimensional structural and cultural mechanisms. Key barriers include; (i) work-family balance and caregiving-related career disadvantages are shaped by persistent societal norms and institutional structures that disproportionately assign caregiving and domestic responsibilities to women. These gendered expectations contribute to unequal career interruptions, reduced research time, and slower promotion trajectories for women in academia, particularly during early- and mid-career stages, beyond what can be explained by individual preferences alone [23, 42, 43]. Additionally, (ii) limited access to mentorship and role models restricts women's opportunities for high-quality academic guidance and creates structural disadvantages in accessing academic opportunities [44]. Another major factor is (iii) implicit gender bias within promotion processes; unnoticed biases in committees can adversely influence promotion evaluations and reinforce feelings of not belonging [45]. Furthermore, (iv) gender disparities in access to research funding constitute a critical mechanism that undermines women's publication productivity and promotion trajectories [46, 47]. Finally, (v) psychosocial pressures stemming from gender norms and academic culture intensify feelings of not belonging and increase the likelihood of withdrawal from academic careers among women [48]. Collectively, these mechanisms may contribute either to women exiting the system

(leak) or to slower progression through academic ranks (delay).

These barriers cannot be addressed solely through individual strategies but require long-term, institution-level interventions. The literature highlights that (i) policies supporting work–family balance—such as flexible working models, parental leave, extended tenure/promotion clocks, and childcare support—increase retention of women in academia [48]. Establishing (ii) structured mentorship–sponsorship networks and leadership development programs for women can strengthen promotion outcomes and funding success [44, 46]. To address implicit bias in promotion processes, (iii) evidence-based bias–habit–breaking training, transparent promotion criteria, and gender- and discipline-diverse evaluation committees have been shown to improve departmental climate and promotion equity [45]. Reducing gender disparities in research funding may be supported by (iv) enhancing reviewer training, restructuring evaluation criteria, and partially anonymizing applicant identities during the review stage [45, 47]. Finally, (v) cultivating an inclusive institutional culture, strengthening mechanisms for reporting harassment and discrimination, and adopting gender-responsive institutional policies have been proposed to reduce psychosocial pressures and improve belonging [48].

Although these international barriers and proposed solutions are largely applicable within the Turkish context, current national evidence suggests that such mechanisms remain fragmented and institution-specific, with limited structural transformation in critical areas such as promotion processes, research funding, and access to leadership roles.

Limitations

Although the graduate student, thesis authorship, and academic staff datasets were interpreted sequentially, it was not possible to conduct a longitudinal analysis following the same individuals over time. As a result, individual-level professional progression from research assistant to senior academic ranks could not be directly observed. Instead, progression was assessed indirectly using cross-sectional academic rank distributions and cross-dataset comparisons, an approach commonly employed in pipeline research to identify patterns of attrition and delayed advancement.

The data were obtained from publicly accessible sources provided by the YÖK and therefore lacked additional individual-level information, such as age. Moreover, earlier versions of the academic staff reports were not available on the current web platform, and requests submitted to the YÖK to access historical data went unanswered. Institutional policies, appointment and promotion procedures, and inter-university differences that

might influence gender distributions across academic ranks could not be incorporated into the analysis.

Because the study focused exclusively on the field of anatomy, large-scale comparisons with other health science disciplines were not feasible. In addition, due to the limited availability of anatomy-specific data internationally, some aspects of the discussion were informed by the wider medical and basic science literature. Finally, the authors acknowledge the limitations of determining thesis authors' gender based on publicly available online profiles and recognize that the binary gender classification used in the YÖK's datasets may not fully reflect individuals' self-identified gender, thereby constraining analyses of gender diversity. The exclusion of non-binary and gender-diverse identities may also limit interpretations of gendered academic trajectories and obscure additional forms of marginalisation within academic progression, underscoring the need for more inclusive data collection practices in higher education systems. These limitations should be considered when interpreting the findings.

Conclusion

This study highlights a clear inflection point in women's representation along the academic career pathway in anatomy in Türkiye. The strong majority of women observed in recent years among graduate students and thesis authors indicates a pronounced presence of women at the entry stages of the field. However, this pattern does not extend to the upper levels of the academic hierarchy. While gender distributions become more balanced at the assistant and associate professor ranks, the professor level remains predominantly male. This discrepancy suggests the presence of structural barriers that lead women to exit the academic pathway or to progress more slowly, despite their numerical strength at earlier stages.

The sequential evaluation of graduate student data, thesis outputs, and academic staff distributions demonstrates that both leaky and delayed pipeline mechanisms operate within the field of anatomy. These dual dynamics reflect the cumulative influence of institutional, cultural, and structural factors rather than individual choices. The findings underscore that gender inequality patterns long documented in academic medicine and the basic sciences are also evident in anatomy in Türkiye, emphasizing the need to address barriers that hinder women's advancement to senior academic positions.

Although this study is situated within the Turkish higher education system, the gendered patterns observed across the academic anatomy pipeline closely mirror those reported internationally in academic medicine and the basic sciences. By providing nationally comprehensive, discipline-specific evidence, this study contributes to the broader understanding of leaky and delayed pipeline dynamics and offers insights that may inform

institutional equity policies, mentorship structures, and promotion practices across diverse academic settings.

Acknowledgements

Not applicable.

Authors' contributions

Conception: BNÇG, İAG - Design: BNÇG, İAG - Supervision: BNÇG, İAG - Materials: BNÇG, SNÇ - Data Collection and/or Processing: SNÇ, BNÇG, İAG - Analysis: BNÇG - Literature: BNÇG- SNÇ - Review: İAG - Writing: BNÇG, SNÇ - Critical Review: BNÇG, SNÇ, İAG.

Funding

No funds, grants, or other support was received.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval was not required for this study, as all data were obtained from publicly accessible open-sources.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 18 November 2025 / Accepted: 12 February 2026

Published online: 17 February 2026

References

- Green MH. Books as a Source of Medical Education for Women in the Middle Ages. *Dynamis*; 2000.
- Harkness D. A view from the streets: women and medical work in Elizabethan London. *Bull Hist Med*. 2008;82:52–85.
- Morantz-Sanchez RN. Sympathy and science: women physicians in American medicine. New York: Oxford University Press; 1985.
- Attridge M. A history of women in higher education. *BestColleges*. <https://www.bestcolleges.com/news/analysis/2021/03/21/history-women-higher-education/>. Accessed 10 Nov 2025.
- United Nations. Declaration on the elimination of discrimination against women. <https://www.ohchr.org/en/instruments-mechanisms/instruments/declaration-elimination-discrimination-against-women>. Accessed 10 Nov 2025.
- Llorens A, Tzovara A, Bellier L, Bhaya-grossman I, Flinker A, Fonken Y, et al. Gender bias in academia: a lifetime problem that needs solutions. *Neuron*. 2021;109:2047–74. <https://doi.org/10.1016/j.neuron.2021.06.002>. Gender.
- Eroğlu FS, Koyuncu SB, Erkan KY B. Cross-sectional study of women's representation in leadership positions in Turkish medical schools, academic departments, specialty boards, conferences and journals in 2023. *BMJ Open*. 2025;15:e089298. <https://doi.org/10.1136/bmjopen-2024-089298>.
- Çandır Gürses BN, Karaca Bozdağ Z, Macunluoğlu ACGI. Unveiling disparity: A call to action for gender diversity in anatomy journal editorial teams. *Anat Sci Educ*. 2025;18:558–67. <https://doi.org/10.1002/ase.70034>.
- Jenkins MR, Herrmann A, Tashjian A, Ramineni T, Ramakrishnan R, Raef D, et al. Sex and gender in medical education: a National student survey. *Biol Sex Differ*. 2016;7(Suppl 1):45. <https://doi.org/10.1186/s13293-016-0094-6>.
- Penny M, Jeffries R, Grant J, Davies SC, Europe R, Centre W, et al. Women and academic medicine: a review of the evidence on female representation. *J R Soc Med*. 2014;107:259–63. <https://doi.org/10.1177/0141076814528893>.
- Holman L, Stuart-fox D, Hauser CE. The gender gap in science: how long until women are equally represented? *PLoS Biol*. 2018;19:e2004956. <https://doi.org/10.1371/journal.pbio.2004956>.
- Resmî TC, Gazete. (17506). Yükseköğretim Kanunu. 06 Nov 1981. Kanun Numarası: 2547. Ankara, Türkiye: Turkish Government. 142 p. 1981. <https://www.mevzuat.gov.tr/MevzuatMetin/1.5.2547.pdf>. Accessed 11 Feb 2026.
- Ankara Üniversitesi Tıp Fakültesi. Histoloji ve Embriyoloji Anabilim Dalı – Hakkında. <https://histoloji.medicine.ankara.edu.tr/hakkinda/>. Accessed 11 Nov 2025.
- Ege Üniversitesi Tıp Fakültesi. Histoloji ve Embriyoloji Anabilim Dalı – Tarihçe. <https://histo-med.ege.edu.tr/tr-3802/tarihce.html>. Accessed 11 Nov 2025.
- European Commission. Directorate-General for Research and Innovation. She Figs. 2021: gender in research and innovation: statistics and indicators. 2021. <https://data.europa.eu/doi/10.2777/06090>. Accessed 12 Nov 2025.
- Li B, Jacob- J, Dossa F, Salata K, Kishibe T, Greco E, et al. Gender differences in faculty rank among academic physicians: a systematic review and meta-analysis. *BMJ Open*. 2021. <https://doi.org/10.1136/bmjopen-2021-050322>.
- American Council on Education. Women's representation in higher education leadership around the world. 2023. <https://www.acenet.edu/Documents/Womens-Rep-in-Higher-Ed-Leadership-Around-the-World.pdf>. Accessed 12 Nov 2025.
- Yenilmez Mİ. Women in academia in turkey: challenges and opportunities. *J Adm Sci*. 2016;14:289–311.
- Chia TI, Sc M, Oyeniran OI, Sc M. Determining the anatomy of anatomy educators. *J Taibah Univ Med Sci*. 2020;15:102–9. <https://doi.org/10.1016/j.jtutmed.2020.03.001>.
- Singal A, Goyal S. Exploring gender disparities in first authorship in anatomy during last two decades. *Surg Radiol Anat*. 2025;47:1–7. <https://doi.org/10.1007/s00276-025-03597-w>.
- Olivares M, Brown K. Gender bias in authorship in The Anatomical Record and Anatomical Sciences Education journals. https://www.researchgate.net/publication/352588654_Gender_bias_in_authorship_in_the_Anatomical_Record_and_Anatomical_Sciences_Education_journals. Accessed 11 Nov 2025.
- Jackson M. The leaky pipeline in academia. *Mo Med*. 2023;120:185–7.
- Carr PL, Raj A, Kaplan SE, Terrin N, Breeze JL, Freund KM. Gender differences in academic medicine: Retention, rank, and leadership comparisons from the National faculty survey. *Acad Med*. 2018;93:1694–9. <https://doi.org/10.1097/ACM.0000000000002146>.
- Blickenstaff JC. Women and science careers: leaky pipeline or gender filter? *Gend Educ*. 2005;17:369–86. <https://doi.org/10.1080/09540250500145072>.
- Borgno L. Women. Anatomy and the glass ceiling: speech vs reality. *Rev Argentina Anatomía Clínica*. 2023;15:12–4. <https://doi.org/10.31051/1852.8023.v15.n1.40847>.
- Yükseköğretim Bilgi Yönetim Sistemi. Öğretim Düzeyleri ve Birimlere Göre Öğrenci Sayıları. <https://istatistik.yok.gov.tr/>. Accessed 27 Mar 2025.
- Yükseköğretim Kurulu. National Thesis Center. <https://tez.yok.gov.tr/UlusalTezMerkezi/>. Accessed 27 Mar 2025.
- Yükseköğretim Bilgi Yönetim Sistemi. Birim Bazında Akademisyen Sayıları Raporu. <https://istatistik.yok.gov.tr/>. Accessed 27 Mar 2025.
- Yükseköğretim Kurulu. Lisansüstü Eğitim ve Öğretim Yönetmeliği. 2016. <https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=215108&MevzuatTur=7&MevzuatTertip=5>. Accessed 15 Nov 2025.
- Martinez-strengel A, Samuels EA, Cross J, Cramer LD, Desai MM, Gotian R, et al. Trends in U.S. MD–PhD program matriculant diversity by sex and Race/Ethnicity. *Acad Med*. 2022;97. <https://doi.org/10.1097/ACM.00000000000004747>.
- Brass LF, Akabas MH. More women than ever are entering MD-PhD programs. What Lies ahead for them? *JCI Insight*. 2024;9:e184715. <https://doi.org/10.1172/jci.insight.184715>.
- Günay D, Günay A. 1933 'Den Günümüze Türk Yükseköğretiminde Niceliksel Gelişmeler. *Yükseköğretim Ve Bilim Derg*. 2011;1:1–22. <https://doi.org/10.5961/jhes.2011.001>.
- Resmî TC, Gazete. (12056). Devlet Memurları Kanunu. 23 July 1965. Kanun Numarası: 657. Ankara, Türkiye: Turkish Government. 201 p. 1965. <https://www.mevzuat.gov.tr/MevzuatMetin/1.5.657.pdf>. Accessed 11 Feb 2026.
- Özben M, Kanbir F. Those who retired and found a position in higher education. *J Econ Cult Soc*. 2025;71:86–103. <https://doi.org/10.26650/JECS2024-1584427>.
- Demir E, Demir CG, Özdemir MÇ. Faculty members' views on academic promotion and appointment process. *J High Educ Sci*. 2017;7:12–23. <https://zlik.org/JA58N22CY>.
- Association of American Medical Colleges. The State of Women in Academic Medicine: 2023–2024. Progressing Toward Equity. 2024. <https://www.aamc.org/data-reports/data/state-women-academic-medicine-2023-2024-progressing-toward-equity>. Accessed 16 Nov 2025.

37. Association of American Medical Colleges. Medical School Faculty Trends by Rank and Gender (2024 data set). 2024. https://www.aamc.org/data-reports/faculty-institutions/data/us-medical-school-faculty-trends-percentages?utm_. Accessed 16 Nov 2025.
38. Bennett CL, Salinas RY, Locascio JJ, Boyer W. Two decades of little change: an analysis of U. S. medical school basic science faculty by sex, race/ethnicity, and academic rank. *PLoS ONE*. 2020;31:e0235190. <https://doi.org/10.1371/journal.pone.0235190>.
39. European Trade Union Committee for Education. Career development and gender equality in academia and research. 2022. <https://www.csee-etu.org/en/news/etuce/5118-career-development-and-gender-equality-in-academia-and-research?utm>. Accessed 16 Nov 2025.
40. Grech E, Pace A, Mallia TA, Cuschieri S. Gender trends in healthcare and Academia — Where does the university of Malta stand ? *Soc Sci*. 2022;11:463. <https://doi.org/10.3390/socsci11100463>.
41. Ribeiros R, Carroll L. Women in cardiology: between the 'glass ceiling' and the 'sticky floor'. *Rev Port Cardiol*. 2021;40:505–8.
42. Jolly S, Griffith KA, DeCastro R, Stewart A, Ubel PJR. Gender differences in time spent on parenting and domestic responsibilities by high-achieving young physician-researchers. *Ann Intern Med*. 2014;160:344–53. <https://doi.org/10.7326/M13-0974>.
43. Zheng X, Yuan HNC. How parenthood contributes to gender gaps in academia. *Elife*. 2022;13:e78909. <https://doi.org/10.7554/eLife.78909>.
44. Files JA, Blair JE, Mayer AP, Ko MG. Facilitated peer mentorship: A pilot program for academic advancement of female medical faculty. *J Womens Heal*. 2008;17:1009–15. <https://doi.org/10.1089/jwh.2007.0647>.
45. Carnes M, Devine PG, Baier Manwell L, Byars-Winston A, Fine E, Ford CE, et al. The effect of an intervention to break the gender bias habit for faculty at one institution: A cluster randomized, controlled trial. *Acad Med*. 2015;90:221–30. <https://doi.org/10.1097/ACM.0000000000000552>.
46. Ginther DK, Schaffer WT, Schnell J, Masimore B, Liu F, Haak LLKR. Race, ethnicity, and NIH research awards. *Sci* (80-). 2011;333:1015–9. <https://doi.org/10.1126/science.1196783>.
47. van der Lee REN. Gender contributes to personal research funding success in the Netherlands. *Proc Natl Acad Sci U S A*. 2015;112:12349–53. <https://doi.org/10.1073/pnas.1510159112>.
48. Cech EA, Blair-loy M. The changing career trajectories of new parents in STEM. *Proc Natl Acad Sci U S A*. 2019;116:4182–7. <https://doi.org/10.1073/pnas.1810862116>.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.