Journal of Comprehensive Surgery

Original Article

DOI: 10.51271/JOCS-0078

# What do the numbers say and what do surgeons choose? A national analysis of general surgery subspecialty placements in Turkiye

Şükran Çavdar*[1], Muhammed Salih Süer[2], Faruk Yazıcı[3], Deniz Kütük[2], Bahattin Bayar[2], Serkan Demir[4], Şener Balas[2]

[1]Department of General Surgery, Payas State Hospital, Hatay, Turkiye
[2]Department of General Surgery, Ankara Etlik City Hospital, Ankara, Turkiye
[3]Department of General Surgery, Etimesgut Şehit Sait Ertürk State Hospital, Ankara, Turkiye
[4]Department of General Surgery, Yerköy Şehit Korgeneral Osman Erbaş State Hospital, Yozgat, Turkiye

**Cite this article as:** Çavdar Ş, Süer MS, Faruk Yazıcı F, et al. What do the numbers say and what do surgeons choose? A national analysis of general surgery subspecialty placements in Turkiye. *J Compr Surg.* 2025;4(3):61-67. doi:10.51271/JOCS-0078

**Received:** 14.06.2026 ◆ **Accepted**: 29.06.2026 ◆ **Published**: 25.08.2026

## ABSTRACT

**Aims:** General surgery subspecialty training is influenced not only by individual career preferences but also by institutional capacity, regional inequalities, and changing professional expectations. Despite increasing quotas in recent years, declining occupancy rates suggest that subspecialty preferences may reflect broader professional and structural factors. This study aimed to evaluate temporal trends, occupancy rates, and regional/institutional distribution patterns of general surgery subspecialty placements in Turkiye.

**Methods:** Placement data from general surgery subspecialty programs between 2015 and 2025 were retrospectively analyzed. Examination year, placement type, subspecialty branch, hospital category, geographic region, quotas, vacant positions, and occupancy rates were evaluated using descriptive statistics.

**Results:** A total of 503 placement records comprising 757 quotas were analyzed, of which 68.4% were filled. Occupancy rates declined from 82.8% in 2015-2019 to 58.0% in 2020-2025 despite increasing quotas. Surgical oncology (80.6%) and gastrointestinal surgery (75.5%) had the highest occupancy rates, whereas intensive care (45.8%) and hand surgery (34.8%) showed substantially lower occupancy. Most quotas were concentrated in university hospitals and metropolitan cities. Additional placement quotas demonstrated markedly lower occupancy rates (34.9%) and accounted for a considerable proportion of vacant positions.

**Conclusion:** Although general surgery subspecialty training in Turkiye has expanded quantitatively over the last decade, occupancy rates have declined significantly, particularly after 2020. These findings suggest that subspecialty preferences are shaped not only by numerical quota increases but also by factors such as workload, training environment, burnout, career sustainability, and quality of life. A more comprehensive workforce planning strategy considering surgeons' professional expectations may therefore be necessary.

**Keywords:** Workforce planning, surgical workforce, fellowship selection, regional disparities, career sustainability, physician burnout

## INTRODUCTION

Subspecialty training in general surgery represents one of the most critical stages in the development of the surgical workforce, shaping not only individual career trajectories but also the long-term sustainability and organizational structure of healthcare systems. In many countries, increasing subspecialization has become an inevitable consequence of technological advancement, expanding multidisciplinary care, growing oncological complexity, and rising expectations regarding surgical outcomes and expertise. However, the expansion of subspecialty training opportunities does not necessarily translate into proportional trainee demand, and the relationship between workforce planning and physician preferences has become increasingly complex over the last decade.[1,2]

In Turkiye, the Subspecialty Education Examination (YDUS) constitutes the primary mechanism for placement into general surgery subspecialty programs, including surgical oncology, gastrointestinal surgery, critical care, and hand surgery. Although the number of training positions has increased considerably in recent years, concerns regarding vacant quotas, uneven institutional distribution, and declining occupancy rates have become more prominent. These changes appear to reflect not only numerical imbalances between supply and demand but also broader transformations in the professional expectations of surgeons. Contemporary surgical career decisions are increasingly influenced by factors such as workload intensity, burnout, work-life balance, medicolegal pressure, academic opportunities, institutional support, and

***Corresponding Author:** Şükran Çavdar, avdarkran@yandex.com

long-term career sustainability. Consequently, subspecialty preference patterns may provide indirect yet valuable insight into the evolving professional dynamics of the surgical workforce.

Recent literature has emphasized that burnout and dissatisfaction among surgeons and surgical trainees are becoming globally significant concerns. Systematic reviews have demonstrated strong associations between burnout, excessive workload, emotional exhaustion, impaired work-life balance, and declining professional satisfaction among surgeons and trainees.[1,2] In parallel, studies conducted in Turkiye have similarly highlighted substantial levels of burnout among general surgeons and have underscored the impact of working conditions and educational environments on professional well-being.[3] Furthermore, national surveys evaluating surgical residency training have demonstrated persistent concerns regarding educational quality, mentorship, operative exposure, and institutional support.[4] Collectively, these findings suggest that modern surgical career preferences are increasingly shaped by lifestyle considerations and training conditions in addition to academic interest alone.

The present study is particularly important because the decline in quota occupancy observed after 2020 coincided with a marked increase in the total number of opened positions. As demonstrated in the current dataset, overall fill rates declined from 82.8% during 2015-2019 to 58.0% during 2020-2025 despite substantial quota expansion. Moreover, this decline was not homogenous across subspecialties; while surgical oncology and gastrointestinal surgery maintained relatively high occupancy, critical care and hand surgery experienced pronounced decreases in fill rates. The distribution of quotas was also heavily concentrated within metropolitan cities and university hospitals, suggesting substantial institutional and geographic centralization in subspecialty training.

Despite ongoing discussions regarding surgical workforce planning and subspecialty training in Turkiye, the existing literature remains limited to institutional experiences, surveys, or specialty-specific observations. To our knowledge, no previous national-scale study has comprehensively evaluated general surgery subspecialty placements over an extended period while simultaneously examining temporal trends, institutional concentration, regional distribution, and quota occupancy dynamics. Therefore, the present study aimed to analyze general surgery subspecialty placement data in Turkiye between 2015 and 2025 in order to characterize temporal changes in quota distribution and occupancy patterns and to evaluate the structural transformation of subspecialty training from both workforce and professional perspectives.

We anticipated that the substantial increase in subspecialty training quotas after 2020 would not be accompanied by proportional increases in occupancy rates and that occupancy patterns would vary according to subspecialty branch and institutional characteristics.

## METHODS

### Ethics

Since this study was conducted exclusively using publicly accessible, anonymized, and non-identifiable administrative data obtained from the official ÖSYM database, formal ethics committee approval and informed consent were waived in accordance with national regulations and the principles of the Declaration of Helsinki. No patient-level or personally identifiable information was accessed, and all data were evaluated in an anonymous manner.[8]

This retrospective, descriptive, nationwide study analyzed placement data from the Turkish Medical Subspecialty Examination (YDUS) for general surgery subspecialties between 2015 and 2025. Publicly accessible placement records published by the Measurement, Selection and Placement Center (ÖSYM) were systematically reviewed and analyzed.[5] The study aimed to evaluate temporal changes in quota distribution, occupancy dynamics, institutional concentration, and regional variation in general surgery subspecialty training across Turkiye.

The unit of analysis was defined as each individual placement record corresponding to a specific examination cycle, subspecialty branch, and training institution combination. Variables extracted from the dataset included examination year, examination period (spring or fall), placement type (initial or additional placement), subspecialty category, hospital type, geographic region, metropolitan municipality status, number of opened quotas, number of vacant quotas, and quota fill rates. Subspecialty branches were categorized as surgical oncology, gastrointestinal surgery, critical care, hand surgery, and other subspecialties. Hospital types were classified as university hospitals, training and research hospitals, and city hospitals. Geographic regions were grouped according to the official geographical regions of Turkiye. Metropolitan status was determined according to the legal metropolitan municipality designation.

The primary outcome variable was defined as a "fully filled quota," indicating that all positions opened within a placement record were occupied during the corresponding placement cycle. Aggregate fill rate was calculated using the formula: (number of filled quotas/total opened quotas)×100. Comparisons between study periods were performed using two predefined temporal intervals: 2015-2019 and 2020-2025. This categorization was established to evaluate structural changes in placement dynamics during the post-2020 period, when a substantial expansion in quota numbers became evident.

### Statistical Analysis

Descriptive statistics were presented as number and percentage for categorical variables and as median with interquartile range (IQR) for continuous variables. Associations between categorical variables and fully filled quota outcomes were analyzed using Pearson's Chi-square test or Fisher's exact test where appropriate. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated for binary comparisons. Univariable and multivariable logistic regression analyses were subsequently performed to identify independent predictors associated with fully filled quotas. Variables included in the multivariable model were subspecialty category, hospital type, geographic region, metropolitan municipality status, placement type, examination period, and study period. Model discrimination was assessed using receiver operating characteristic (ROC) curve analysis and area under the curve (AUC) calculations, while calibration was evaluated with the Hosmer-Lemeshow goodness-of-fit test. Collinearity diagnostics were assessed using variance inflation factor (VIF) analysis. Statistical significance was defined as a two-sided p-value $<0.05$.[6,7]

All statistical analyses were performed using R statistical software (R Foundation for Statistical Computing, Vienna, Austria).

## RESULTS

A total of 503 placement records comprising 757 opened quotas were analyzed during the study period. Overall, 518 quotas were filled, whereas 239 remained vacant, corresponding to an aggregate fill rate of 68.4%. Most placement records were from spring examination periods (95.0%) and initial placements (67.4%). Surgical oncology constituted the largest proportion of subspecialty placements (41.4%), followed by critical care (24.3%) and gastrointestinal surgery (23.3%). The majority of quotas were concentrated in university hospitals (70.6%), metropolitan municipalities (90.3%), and the Central Anatolia region (36.6%). Baseline characteristics of the placement records are summarized in Table 1.

**Table 1. Baseline characteristics of placement records (n=503)**

| Variable | n (%) |
|---|---|
| **Examination period** | |
| Spring | 478 (95.0) |
| Fall | 25 (5.0) |
| **Placement type** | |
| Initial placement | 339 (67.4) |
| Additional placement | 164 (32.6) |
| **Subspecialty** | |
| Surgical oncology | 208 (41.4) |
| Gastrointestinal surgery | 117 (23.3) |
| Critical care | 122 (24.3) |
| Hand surgery | 46 (9.1) |
| Other | 10 (2.0) |
| **Hospital type** | |
| University hospital | 355 (70.6) |
| Training and research hospital | 79 (15.7) |
| City hospital | 69 (13.7) |
| **Geographic region** | |
| Marmara | 99 (19.7) |
| Central Anatolia | 184 (36.6) |
| Mediterranean | 76 (15.1) |
| Aegean | 65 (12.9) |
| Eastern Anatolia | 58 (11.5) |
| Black Sea | 11 (2.2) |
| Southeastern Anatolia | 10 (2.0) |
| **Metropolitan municipality** | |
| Yes | 454 (90.3) |
| No | 49 (9.7) |
| **Study period** | |
| 2015-2019 | 193 (38.4) |
| 2020-2025 | 310 (61.6) |
| **Quota outcome** | |
| Fully filled | 333 (66.2) |
| Not fully filled | 170 (33.8) |
| **Continuous variables** | **Median (IQR)** |
| Quotas opened per record | 1 (1-1) |
| Empty quotas per record | 0 (0-1) |
| Fill rate per record (%) | 100 (0-100) |
| **Aggregate totals (2015-2025)** | |
| Total quotas opened | 757 |
| Total quotas filled | 518 |
| Total empty quotas | 239 |
| Overall fill rate (%) | 68.4 |

Each record represents one quota allocation in a single examination-subspecialty-hospital combination. IQR: Interquartile range

Marked temporal variation in quota distribution and occupancy rates was observed throughout the study period. Between 2015 and 2019, 319 quotas were opened, with an aggregate fill rate of 82.8%. In contrast, during the 2020-2025 period, the number of opened quotas increased substantially to 438; however, the fill rate declined markedly to 58.0%. This expansion coincided with one of the sharpest declines in occupancy observed during the study period; in 2020, 187 positions were opened across 92 centers, accompanied by a fill rate of only 47.6%. Similarly, 2022 demonstrated persistently low occupancy despite high quota numbers, with a fill rate of 43.0%. Record-level analysis demonstrated that fully filled quota rates decreased significantly from 81.9% in 2015-2019 to 56.5% in 2020-2025 ($\chi^2$=34.33, p<0.001), corresponding to an odds ratio of 3.48 (95% CI: 2.27-5.35) favoring the earlier period. Annual quota distributions and fill rates are presented in Table 2 and Figure 1.

**Table 2. Annual placement quotas and fill rates over the study period (2015-2025)**

| Year | Centers (n) | Quotas opened (n) | Empty quotas (n) | Fill rate (%) |
|---|---|---|---|---|
| 2015 | 33 | 72 | 3 | 95.8 |
| 2016 | 32 | 44 | 6 | 86.4 |
| 2017 | 35 | 52 | 10 | 80.8 |
| 2018 | 43 | 60 | 3 | 95.0 |
| 2019 | 50 | 91 | 33 | 63.7 |
| 2020 | 92 | 187 | 98 | 47.6 |
| 2021 | 37 | 45 | 9 | 80.0 |
| 2022 | 82 | 93 | 53 | 43.0 |
| 2023 | 30 | 39 | 0 | 100.0 |
| 2024 | 25 | 27 | 11 | 59.3 |
| 2025 | 44 | 47 | 13 | 72.3 |
| 2015-2019 | 193 | 319 | 55 | 82.8 |
| 2020-2025 | 310 | 438 | 184 | 58.0 |
| Total | 503 | 757 | 239 | 68.4 |

Comparison of fully filled quota rates between study periods (record-level): 81.9% (158/193) in 2015-2019 vs. 56.5% (175/310) in 2020-2025; $\chi^2$=34.33, df=1, p<0.001; odds ratio for full quota fill in 2015-2019 vs. 2020-2025=3.48 (95% CI: 2.27-5.35). Aggregate fill rate calculated as (opened-empty)/opened×100. CI: Confidence interval

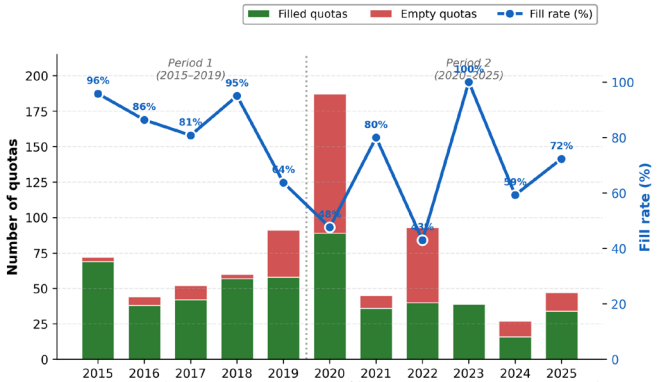


**Figure 1.** Annual placement quotas and fill rates over the study period (2015-2025)

Stacked bars show the absolute number of filled (green) and empty (red) quotas in each YDUS examination cycle. The blue line and right-hand axis show the aggregate fill rate for each year, calculated as filled quotas divided by total opened quotas. The dotted vertical line separates period 1 (2015-2019) from period 2 (2020-2025), the periods used for the primary comparison. Note the marked expansion of opened quotas in 2020 and 2022 with concomitant decline in fill rates

YDUS: Subspecialty Education Examination

Subspecialty-specific analyses demonstrated substantial heterogeneity in occupancy patterns. Surgical oncology and gastrointestinal surgery exhibited the highest overall fill rates at 80.6% and 75.5%, respectively. In contrast, critical care and hand surgery demonstrated considerably lower fill rates of 45.8% and 34.8%, respectively. Temporal comparisons

between study periods revealed relatively stable occupancy in gastrointestinal surgery, whereas critical care and hand surgery experienced dramatic declines after 2020. Critical care fill rates decreased from 80.4% during 2015-2019 to 18.3% during 2020-2025 (OR: 18.29, 95% CI: 7.32-45.73; p<0.001). Similarly, hand surgery fill rates declined from 80.0% to 12.9% (OR: 21.83, 95% CI: 4.64-102.69; p<0.001). Overall heterogeneity among subspecialties was statistically significant ($\chi^2$=85.04, p<0.001). Detailed subspecialty-specific comparisons are shown in Table 3 and Figure 2.

In univariable logistic regression analyses, critical care, hand surgery, additional placement status, and the 2020-2025 study period were significantly associated with lower odds of fully filled quotas. Multivariable logistic regression analysis demonstrated that critical care (adjusted OR: 0.14, 95% CI: 0.07-0.28; p<0.001), hand surgery (adjusted OR: 0.06, 95% CI: 0.02-0.16; p<0.001), Eastern Anatolia region (adjusted OR: 0.32, 95% CI: 0.12-0.82; p=0.018), additional placements (adjusted OR: 0.14, 95% CI: 0.08-0.24; p<0.001), and the 2020-2025 period (adjusted OR: 0.13, 95% CI: 0.07-0.24; p<0.001) independently predicted lower odds of fully filled quotas. In contrast, fall examination periods were associated with higher odds of fully filled quotas after adjustment (adjusted OR: 3.19, 95% CI: 1.05-9.63; p=0.040). The multivariable model demonstrated good discrimination with an AUC of 0.865 (95% CI: 0.834-0.896) and acceptable calibration according to the Hosmer-Lemeshow goodness-of-fit test (p=0.432). Regression model results are summarized in Table 5 and Figure 4.

**Table 3. Subspecialty-specific fill rates and changes between study periods**

| Subspecialty | Total records (n) | Total quotas (n) | Overall fill rate (%) | 2015-2019 fill rate (%) | 2020-2025 fill rate (%) | OR (95% CI) period 1 vs 2 | p period diff |
|---|---|---|---|---|---|---|---|
| Surgical oncology | 208 | 294 | 80.6 | 87.6 | 76.2 | 2.20 (1.01-4.78) | 0.049 |
| Gastrointestinal surgery | 117 | 261 | 75.5 | 83.5 | 69.6 | 0.96 (0.38-2.43) | 1.000 |
| Critical care | 122 | 144 | 45.8 | 80.0 | 17.7 | 18.29 (7.32-45.73) | <0.001 |
| Hand surgery | 46 | 46 | 34.8 | 80.0 | 12.9 | 21.83 (4.64-102.69) | <0.001 |
| Other | 10 | 12 | 16.7 | 0.0 | 28.6 | NA | 1.000 |

Overall heterogeneity test for subspecialty×full-fill outcome: $\chi^2$=85.04, df=4, p<0.001. Odds ratios compare odds of full quota fill in 2015-2019 vs 2020-2025 within each subspecialty; Haldane-Anscombe correction applied for cells with low counts. p-values from Fisher's exact test. NA: Not applicable due to zero cells. OR: Odds ratio, CI: Confidence interval

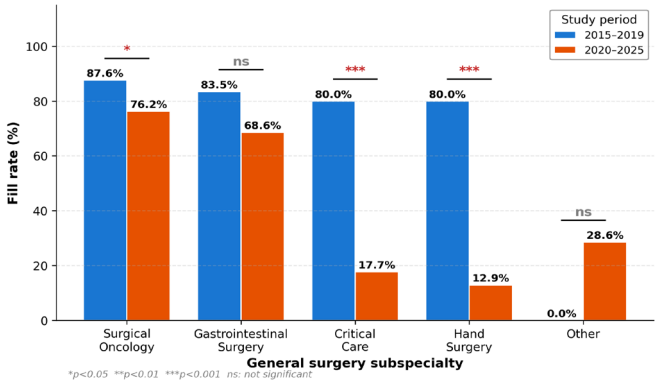


**Figure 2.** Subspecialty-specific fill rates across two study periods (2015-2019 vs. 2020-2025)

Aggregate fill rates (%) are shown for each general surgery subspecialty by study period. Significance markers above each pair indicate the within-subspecialty between-period difference (Fisher's exact test): ns, not significant; *p<0.05; **p<0.01; ***p<0.001. Surgical oncology and gastrointestinal surgery showed minimal change between periods, whereas critical care and hand surgery exhibited a marked decline. The "other" category (n=10 records) showed no significant change

Bivariate analyses demonstrated no significant association between fully filled quota outcomes and hospital type, metropolitan municipality status, geographic region, or examination period. However, placement type was strongly associated with quota occupancy. Initial placements demonstrated a fully filled rate of 80.2%, whereas additional placements demonstrated a markedly lower rate of 37.2% (OR: 0.15, 95% CI: 0.10-0.22; p<0.001). Detailed bivariate associations are presented in Figure 3 and Table 4.

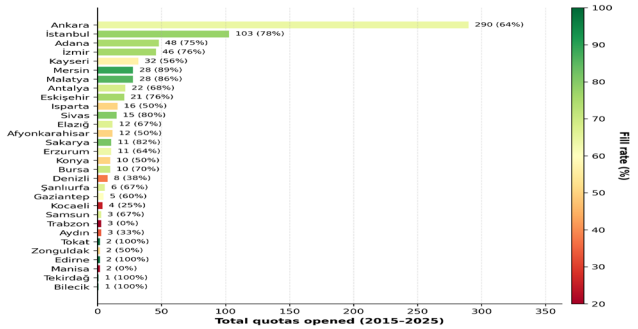


**Figure 3.** Provincial distribution of subspecialty quotas and fill rates, 2015-2025

Horizontal bars represent the total number of subspecialty quotas opened in each province over the study period; bar color encodes the aggregate fill rate (red-yellow-green gradient corresponds to 20-100%). Numerical labels show: total quotas (fill rate%). Quota concentration is heavily skewed toward Ankara (n=290) and İstanbul (n=103), which together account for 51.9% of all opened quotas during the study period. Substantial variability in fill rates is observed across provinces with comparable quota volumes

**Table 4. Bivariate associations between study factors and fully filled quota outcome**

| Factor/level | n (%) | Fully filled n (%) | OR (95% CI) | p |
|---|---|---|---|---|
| **Hospital type** | | | - | 0.684 |
| University hospital | 355 (70.6) | 239 (67.3) | | |
| Training and research hospital | 79 (15.7) | 51 (64.6) | | |
| City hospital | 69 (13.7) | 43 (62.3) | | |
| **Metropolitan municipality (legal status)** | | | 1.40 (0.77-2.55) | 0.274 |
| Yes | 454 (90.3) | 304 (67.0) | | |
| No | 49 (9.7) | 29 (59.2) | | |
| **Geographic region** | | | - | 0.812 |
| Marmara | 99 (19.7) | 69 (69.7) | | |
| Mediterranean | 76 (15.1) | 54 (71.1) | | |
| Central Anatolia | 184 (36.6) | 121 (65.8) | | |
| Aegean | 65 (12.9) | 40 (61.5) | | |
| Eastern Anatolia | 58 (11.5) | 37 (63.8) | | |
| Black Sea | 11 (2.2) | 6 (54.5) | | |
| Southeastern Anatolia | 10 (2.0) | 6 (60.0) | | |
| **Placement type** | | | 0.15 (0.10-0.22) | <0.001 |
| Initial placement | 339 (67.4) | 272 (80.2) | | |
| Additional placement | 164 (32.6) | 61 (37.2) | | |
| **Examination period** | | | 1.58 (0.70-3.55) | 0.269 |
| Spring | 478 (95.0) | 319 (66.7) | | |
| Fall | 25 (5.0) | 14 (56.0) | | |

p-values from Chi-square test or Fisher's exact test where expected cell counts <5. Reference categories: Hospital type-university; Metropolitan-no; Region-Marmara; placement type-Initial; examination period-spring. Outcome 'fully filled' indicates a quota where all positions were filled in that placement event. OR: Odds ratio (computed for 2×2 contingency only), CI: Confidence interval

**Table 5. Univariable and multivariable logistic regression models for predictors of fully filled quotas**

| Predictor | Univariable OR (95% CI) | p | Adjusted OR (95% CI) | p |
|---|---|---|---|---|
| **Subspecialty (ref. surgical oncology)** | | | | |
| Gastrointestinal surgery | 0.92 (0.52-1.62) | 0.780 | 0.83 (0.42-1.62) | 0.587 |
| Critical care | 0.19 (0.12-0.31) | <0.001 | 0.14 (0.07-0.28) | <0.001 |
| Hand surgery | 0.13 (0.06-0.26) | <0.001 | 0.06 (0.02-0.16) | <0.001 |
| Other | 0.06 (0.01-0.29) | <0.001 | 0.02 (0.00-0.16) | <0.001 |
| **Hospital type (ref. university)** | | | | |
| Training and research hospital | 0.88 (0.53-1.47) | 0.637 | 0.54 (0.26-1.12) | 0.097 |
| City hospital | 0.80 (0.47-1.37) | 0.421 | 0.44 (0.21-0.95) | 0.035 |
| **Geographic region (ref. Marmara)** | | | | |
| Mediterranean | 1.07 (0.55-2.06) | 0.846 | 0.96 (0.40-2.27) | 0.918 |
| Central Anatolia | 0.84 (0.49-1.41) | 0.502 | 0.65 (0.32-1.29) | 0.216 |
| Aegean | 0.70 (0.36-1.34) | 0.280 | 0.63 (0.26-1.55) | 0.317 |
| Eastern Anatolia | 0.77 (0.39-1.52) | 0.446 | 0.32 (0.12-0.82) | 0.018 |
| Black Sea | 0.52 (0.15-1.84) | 0.312 | 0.72 (0.10-4.99) | 0.742 |
| Southeastern Anatolia | 0.65 (0.17-2.48) | 0.531 | 0.26 (0.05-1.38) | 0.113 |
| **Metropolitan municipality (ref. no)** | | | | |
| Yes | 1.40 (0.77-2.55) | 0.276 | 2.22 (0.90-5.48) | 0.082 |
| **Placement type (ref. initial)** | | | | |
| Additional placement | 0.15 (0.10-0.22) | <0.001 | 0.14 (0.08-0.24) | <0.001 |
| **Examination period (ref. spring)** | | | | |
| Fall | 0.63 (0.28-1.43) | 0.272 | 3.19 (1.05-9.63) | 0.040 |
| **Study period (ref. 2015-2019)** | | | | |
| 2020-2025 | 0.29 (0.19-0.44) | <0.001 | 0.13 (0.07-0.24) | <0.001 |

Multivariable model performance: n=503; Nagelkerke $R^2$=0.48; McFadden $R^2$=0.333; AIC=463.5; Hosmer-Lemeshow goodness-of-fit $\chi^2$=8.01, df=8, p=0.432 (good fit); area under the ROC curve=0.865 (95% CI: 0.834-0.896); maximum variance inflation factor=1.89 (no concerning collinearity). Outcome variable: fully filled quota (yes vs no). Reference category for outcome: not fully filled. OR: Odds ratio, CI: Confidence interval, ROC: Receiver operating characteristic

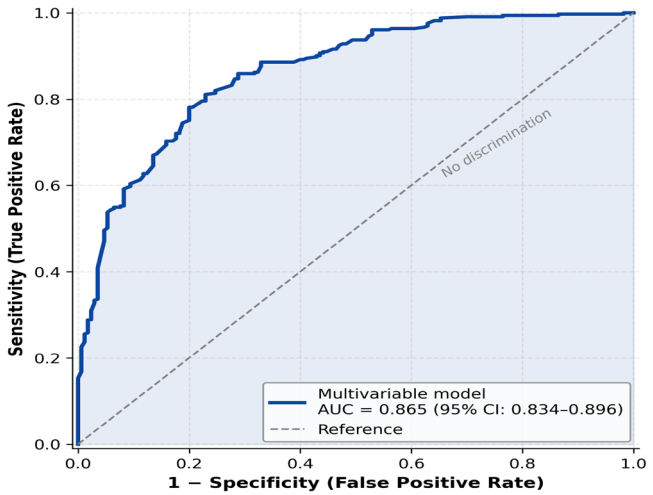


**Figure 4.** ROC curve for the multivariable logistic regression model predicting fully filled quotas

The model included subspecialty, hospital type, geographic region, metropolitan status, placement type, examination period, and study period as predictors. The area under the ROC curve (AUC) was 0.865 (95% CI: 0.834-0.896), indicating good discrimination. The diagonal dashed line represents the no-discrimination reference (AUC=0.5). Model fit was acceptable based on the Hosmer-Lemeshow test ($\chi^2$=8.01, df=8, p=0.432)

ROC: Receiver operating characteristic, AUC: Area under the curve, CI: Confidence interval

## DISCUSSION

The present nationwide analysis demonstrates that although general surgery subspecialty training quotas in Turkiye expanded substantially between 2015 and 2025, this quantitative growth was not accompanied by proportional increases in occupancy rates. On the contrary, the post-2020 period was characterized by a marked decline in fill rates despite a considerable rise in available positions. More importantly, this decline was not uniform across subspecialties. Surgical oncology and gastrointestinal surgery maintained relatively stable occupancy patterns, whereas critical care and hand surgery experienced dramatic reductions in fill rates. These findings suggest that contemporary subspecialty preferences among general surgeons are shaped not solely by numerical workforce demands, but also by broader professional, institutional, and workforce-related determinants.

One of the most striking findings of the study was the temporal shift observed after 2020. During the 2015-2019 period, overall fill rates exceeded 80%, whereas this figure declined substantially in the subsequent period despite a marked expansion in quotas. This pattern indicates that increasing the number of available positions alone may not be sufficient to sustain interest in subspecialty training. Workforce planning in surgical disciplines is inherently multidimensional and depends not only on institutional need but also on surgeons' perceptions of professional sustainability, workload, educational quality, and future career expectations.[1,2] Particularly in high-intensity specialties, growing concerns regarding work-life balance, burnout, medicolegal pressure, and declining professional satisfaction may substantially influence career decisions. Therefore, the decline observed in the present study likely reflects a broader transformation in the culture and expectations of modern surgical practice rather than a simple mismatch between supply and demand.

The pronounced heterogeneity among subspecialties further supports this interpretation. Surgical oncology and

gastrointestinal surgery demonstrated persistently high occupancy rates throughout the study period, whereas critical care and hand surgery showed dramatic declines, especially after 2020. These differences are unlikely to be explained solely by quota numbers. Instead, they probably reflect variations in perceived academic prestige, operative exposure, institutional support, lifestyle burden, financial expectations, and long-term professional identity associated with different subspecialties. Previous studies have shown that surgeons increasingly consider lifestyle-related factors and institutional working conditions when making career decisions.[2-4] Critical care, in particular, is known to be associated with high emotional stress, demanding working hours, prolonged exposure to critically ill patients, and elevated burnout risk, all of which may contribute to declining trainee interest.[1,9] Similarly, hand surgery within the general surgery pathway may suffer from limited procedural exposure and comparatively lower institutional visibility, potentially reducing its attractiveness among candidates.

Another important finding was the substantial concentration of quotas within university hospitals and metropolitan municipalities, particularly Ankara and İstanbul. Although metropolitan concentration itself was not independently associated with fully filled quotas in multivariable analysis, the overwhelming centralization of training positions indicates that subspecialty education in Turkiye remains heavily dependent on a limited number of institutional hubs. Such concentration may contribute to regional disparities in both training opportunities and future workforce distribution. Similar concerns have been reported internationally, where academic centralization and uneven distribution of subspecialty training resources have been shown to affect long-term healthcare accessibility and regional workforce balance.[10] The persistence of relatively high vacancy rates in certain geographically limited regions despite low quota numbers further suggests that geographic availability alone does not fully determine candidate preferences.

The markedly lower occupancy observed in additional placement quotas represents another critical observation. Additional placements demonstrated significantly reduced odds of full occupancy both in bivariate and multivariable analyses. This finding may indicate that many additional quotas reflect positions that are already perceived as less desirable by candidates due to institutional, geographic, or specialty-related factors. From a workforce planning perspective, repeated expansion through additional placements without addressing the underlying causes of low demand may contribute to inefficient allocation of educational resources. In this context, the present findings suggest that future subspecialty planning strategies should not rely exclusively on numerical quota expansion but should also incorporate qualitative dimensions of surgical training and professional sustainability.

From a policy perspective, these findings may help guide future subspecialty workforce planning in Turkiye. Rather than relying solely on numerical quota expansion, future planning strategies may benefit from considering specialty-specific demand, regional workforce needs, and the professional expectations of surgeons.

The increasing emphasis on burnout and physician well-being in the contemporary surgical literature further contextualizes the findings of the present study. Multiple international studies have demonstrated that burnout among surgeons and surgical trainees is associated with reduced job satisfaction, emotional exhaustion, impaired educational engagement, and even attrition from surgical careers.[1,2,9] National studies from Turkiye similarly emphasize the significant psychological and occupational burden experienced by general surgeons.[3] Therefore, declining occupancy rates in certain subspecialties may represent not merely a training issue but also an indirect indicator of broader structural stress within the surgical profession itself. In this regard, subspecialty preference trends may function as an important workforce-sensitive marker reflecting changing perceptions of professional desirability among surgeons.

The present study has several strengths. To our knowledge, this is the first nationwide study evaluating general surgery subspecialty placements in Turkiye over an extended 11-year period while simultaneously analyzing temporal trends, institutional characteristics, geographic distribution, and predictive factors associated with quota occupancy. The inclusion of regression modeling and performance analyses additionally strengthens the analytical depth of the study beyond simple descriptive reporting. Furthermore, the use of publicly accessible nationwide placement data minimizes selection bias and allows a comprehensive overview of the national subspecialty training landscape.

### Limitations

Several limitations should also be acknowledged. First, the study was based on administrative placement data and therefore could not directly evaluate individual-level motivations underlying subspecialty preferences. Variables such as income expectations, academic aspirations, burnout severity, institutional culture, mentorship quality, and work-life balance perceptions were not directly measurable within the dataset. Second, occupancy rates may be influenced by external sociopolitical and healthcare-system-related factors evolving over time, including the COVID-19 pandemic, changes in healthcare policy, and broader economic conditions. Third, although the study identifies important associations, causal inferences cannot be established because of its retrospective observational design.

Despite these limitations, the findings provide important insight into the ongoing structural transformation of surgical subspecialty training in Turkiye. The observed decline in occupancy rates despite substantial quota expansion suggests that future workforce planning policies should move beyond purely quantitative approaches and incorporate the professional expectations, working conditions, and long-term sustainability concerns of surgeons. Understanding why certain subspecialties maintain strong candidate interest whereas others experience progressive decline may become increasingly important for maintaining balanced and sustainable surgical workforce planning in the coming decades. Future workforce policies that fail to account for these evolving professional realities may face increasing difficulty in maintaining a sustainable surgical subspecialty workforce.

## CONCLUSION

The present nationwide analysis demonstrates that although general surgery subspecialty training quotas in Turkiye have

expanded substantially over the last decade, this quantitative growth has not been accompanied by proportional increases in occupancy rates. The marked decline in fill rates observed after 2020, particularly in critical care and hand surgery, suggests that subspecialty preferences are shaped not only by workforce demand and quota availability but also by broader professional and institutional determinants, including workload, burnout, training environment, career sustainability, and quality of life. The considerable concentration of quotas within metropolitan and university-based centers further highlights the ongoing institutional and geographic centralization of subspecialty training. In addition, the persistently low occupancy rates observed in additional placement quotas suggest that numerical expansion alone may be insufficient to address workforce needs when underlying professional expectations and structural concerns remain unresolved. Taken together, these findings indicate that future subspecialty workforce planning strategies in Turkiye should move beyond purely quantitative quota-based approaches and adopt a more comprehensive framework that incorporates educational quality, professional well-being, institutional sustainability, and surgeons' evolving career expectations. Understanding the factors driving differential subspecialty preferences may become increasingly important for maintaining a balanced, sustainable, and resilient surgical workforce in the coming years.

## ETHICAL DECLARATIONS

### Ethics Committee Approval

Since this study was conducted using publicly available, anonymized, and non-identifying administrative data obtained from the official ÖSYM database, ethical committee approval was not required.

### Informed Consent

Since the study was conducted without the participation of any living being, no written consent form was obtained.

### Peer Review Process

This manuscript was subject to external peer review.

### Conflict of Interest

The authors declare no conflicts of interest related to this study.

### Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

### Author Contributions

Concept: ŞÇ, MSS, FY, DK, BB, SD, ŞB; Design: ŞÇ, MSS, FY, DK, BB, SD, ŞB; Control: ŞÇ, MSS, FY, DK, BB, SD, ŞB; Resources: ŞÇ, MSS, FY, DK, BB, SD, ŞB; Materials: ŞÇ, MSS, FY, DK, BB, SD, ŞB; Data Collection and/or Processing: ŞÇ, MSS, FY, DK, BB, SD, ŞB; Analysis and/or Interpretation: ŞÇ, MSS, FY, DK, BB, SD, ŞB; Literature Review: ŞÇ, MSS, FY, DK, BB, SD, ŞB; Writing the Article: ŞÇ, MSS, FY, DK, BB, SD, ŞB; Critical Review: ŞÇ, MSS, FY, DK, BB, SD, ŞB.

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