

Article

Future Physicians in Orthopedics and Trauma Surgery: Their Expectations and Factors for Recruiting New Talent

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Abstract

Introduction: The potential aggravation of the shortage of skilled professionals in surgical specialties presents challenges. The lack of work–life balance and the pressure of training may deter aspiring surgeons. Surgical disciplines still remain predominantly male so that feminization combined with factors such as part-time work and pregnancy-related absence may aggravate workforce shortages. Studies show that the next generation of physicians places more value on work–life balance and seeks a pleasant work environment. This raises the question of whether these developments pose a threat to the future of surgical disciplines or whether generational change may also offer new opportunities. **Methodology:** This prospective observational study was conducted among a cohort of third-year medical students at a medical university in Germany. A non-validated, self-administered questionnaire was used for data collection. Responses on the Likert scale were dichotomized and the results were statistically analysed using chi-square test and logistic regression. **Results:** Job expectations differed only marginally across specialties. Students generally rated work–life balance and a pleasant work environment significantly higher than career, income or prestige. Students interested in surgery place significantly less emphasis on work–life balance than non-surgical peers, particularly in orthopedics and trauma surgery (77% vs. 90%, $p = 0.025$). There was a significant association between interest in surgical specialties and leadership ambitions. Male students were significantly more likely than females to aspire to leadership roles (58.1% vs. 32.7%, $p = 0.001$) and to choose surgical specialties (46.0% vs. 28.3%, $p = 0.018$). Female students were not significantly less interested in trauma surgery. **Conclusions:** Although our data interpretation should be drawn with caution, the increasing feminization of medicine does not appear to exacerbate the shortage of physicians in trauma surgery. In our cohort, we made the indicative suggestion that aspiring surgeons might be willing to trade leisure for career advancement. Specialized curricula could promote identification with the field and develop leadership skills, so that an initial attachment to a specific specialty endures throughout medical studies and results in a corresponding choice of specialty.



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Keywords: students; choice of discipline; trauma surgery; work–life balance; gender

1. Introduction

The increasing shortage of skilled professionals presents an escalating challenge. Alongside increasingly clear career expectations among the emerging generation of physicians, the medical profession is undergoing a demographic shift characterized by a growing proportion of female physicians. While surgical disciplines remain predominantly male, there is concern that feminization combined with structural factors such as part-time work and pregnancy-related absence may aggravate workforce shortages if working conditions are not adapted appropriately [1]. Research suggests that this is partly due to the lack of prominent female role models in these fields [2]. The main cause, however, is the insufficient compatibility of family and career planning [3]. Students worry that as aspiring surgeons, they will struggle to maintain a fulfilling private life alongside their professional activities [4]. The demanding training exacerbates these concerns. Whether the pressure in surgical specialties is actually greater than in other areas is secondary, as many students are already deterred in advance [5]. As a result, a worrying future for the field of trauma surgery is emerging.

1.1. Societal Changes

Contemporary society is undergoing rapid change. Therefore, it is crucial to address this topic now in order to consider possible consequences, such as adjustments to admission requirements for medical studies and early optimization of educational offerings. The main focus of this paper is to investigate the factors considered by the upcoming generation of physicians when making career decisions. Are there differences in expectations for the future professional life, not only between generations but also within different specialties? If so, what characteristics are specific to aspiring surgeons? In the course of this investigation, the results of the 2015 study by Kasch et al. will be validated [6]. In their comprehensive nationwide online survey of medical students across all semesters, they found that the new generation is highly motivated but also places great importance on work–life balance. A pleasant working environment is essential for the engagement of young physicians. The lack of these conditions can lead to the next generation potentially turning away from a clinical career.

1.2. Gender-Specific Aspects

Other sources link the shortage of skilled professionals with the issue of gender roles [5,7,8]. They have found that women, more than their male colleagues, focus on achieving a balance between work and private life [9]. They often prioritize family aspects over their professional careers. As a result, the option of self-employment appears particularly unattractive for women, as the workload is often higher and may not be manageable without an exceptionally supportive environment [8]. However, assuming a supportive family structure, women might benefit from a less competitive situation, especially in underrepresented specialties, should they pursue a career in private practice. Another relevant detail that comes into consideration is that the importance of work–life balance decreases over the course of the medical studies [6].

1.3. Research Gap and Study Aim

Despite growing evidence on changing career expectations among medical students, there remains a lack of specialty-specific analyses that simultaneously consider generational change, gender-related aspects, and attitudes toward work–life balance—particularly in

surgical disciplines such as orthopedics and trauma surgery. Existing studies often address these factors in isolation or focus on the medical profession as a whole, limiting their applicability to targeted workforce planning within surgical specialties.

The aim of this study is therefore to examine career expectations and value structures among medical students with a particular focus on aspiring surgeons. By comparing students interested in surgical and non-surgical specialties, this study seeks to identify specialty-specific patterns regarding work–life balance, career priorities, and professional commitment, and to assess whether commonly expressed concerns about feminization and declining engagement in surgery are supported by empirical data.

2. Material and Methods

This study is a survey-based prospective observational study, conducted in accordance with the ethical standards of the 1964 Declaration of Helsinki, and was registered in the German Clinical Trials Register (DRKS00022798) after approval by the local ethics committee (BB 127/19). All participants provided written informed consent for the analysis and publication of the data. Data were collected over a period of 3 months by surveying third-year medical students at the University of Greifswald. Students undergo an examination course at the start of clinical teaching, after the first state examination, where practical skills are first integrated with theoretical knowledge. The trauma surgery examination course was supervised by five alternating physicians in small groups of no more than six students. The survey was conducted immediately after the course. The questionnaire used included sociodemographic factors, an evaluation of the examination course based on a Likert scale, and some open-ended questions. Additionally, the students' future plans were evaluated, covering aspects such as teaching quality, prior experiences, weighting of career opportunities, professional challenges, prestige, income, work–life balance, and a good working environment. Information on future specialization preferences was also gathered. In the final part of the questionnaire, students were asked to assess suggestively worded statements to investigate the prevalence of certain dichotomous stereotypes. The questionnaire is not formally validated. The item selection followed the study's conceptual basis and was in alignment with the study objectives. The items were chosen by review of the existing literature and commonly reported determinants of specialty choice were implemented.

Study inclusion criteria were full participation in the trauma surgery examination course and sufficient German language skills to complete the questionnaire. By including 177 participants from the course, nearly the entire cohort was covered. The survey was not able to include the entire semester due to occasional absences. The exploratory nature of the study as a single-center observational study justifies the lack of unnecessary randomization and blinding.

2.1. Statistical Analysis

Statistical analysis was performed using SPSS software (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY, USA: IBM Corp.). To test our hypotheses, the correlation between two variables was calculated using Pearson's Chi-square test. For expected cell values under $n = 5$, the exact Fisher's test was used, such as when only a few students agreed with a negative statement. Most data were collected using the Likert scale, which allowed for a differentiated evaluation of statements from 1 and 2 ("does not apply at all or mostly does not apply") through 3 ("neutral") to 4 and 5 ("mostly applies or fully applies"). Depending on the type of statement, the cut-off for grouping was set between ≥ 4 and ≤ 3 , or for negating statements between ≤ 2 and ≥ 3 . This resulted in a dichotomization of the data.

2.2. Regression Models

To investigate which sociodemographic backgrounds, thought patterns, and beliefs influence the likelihood of staying in surgical specialties, several regression models were calculated for four different target parameters: the intention to work in a surgical field, the intention to gain further practical experience in trauma surgery, the idea of specializing in orthopedics and traumatology, and agreement with the statement “My decision to specialize in trauma surgery was positively influenced by the examination course.” Random Forest models were implemented to select the most appropriate regressions, with the AUROC value reaching 0.85. The relevant coefficients of the equations were subsequently tested for their univariate significance using Fisher’s Exact Test. No adjustment for multiple testing was performed. Additionally, descriptive statistical methods were used to present the results.

3. Results

3.1. Expectations for Future Professional Life: Comparison of Specialties and Overview

To introduce the topic, we analyse the diverse expectations for future professional life across different specialties. The questionnaire included a free-text field where participants could indicate their preferred specialties. Based on this information, we calculated the corresponding average ratings for factors such as career and income, prestige and professional challenges, as well as work environment and work–life balance. The following representations show these factors and a summary of all parameters specifically for those interested in surgical specialties.

The diagrams (Figure 1) illustrate that only minor differences can be identified between the different specialties. A closer look at the entire cohort reveals that our survey results align with those of Kasch [6]: within this cohort, as previously noted, students place more emphasis on work–life balance (4.27; average rating based on the Likert scale) and a pleasant work environment (4.79) compared to career (3.53), income (3.47), or prestige (2.54). Professional challenges and standards (4.18) also play an important role for the upcoming generation of physicians. As very few students chose the specialties paediatrics, psychiatrics, urology, radiology, forensics and otorhinolaryngology, we decided to combine those into one group “others” when illustrating the findings.

Regarding prestige, our secondary logistic regression analysis highlighted that the perceived image of a specialty plays a notable role for students interested in surgical fields. In several models, prestige consistently emerged as one of the strongest predictors. Specifically, students who valued the prestige or image of their future specialty were significantly more likely to choose surgical pathways, including general surgery, internships, electives, and subsequent specialist training in orthopedics and trauma surgery. Interestingly, placing high importance on prestige was associated with a lower likelihood of reporting that the examination course positively influenced the decision to pursue trauma surgery.

Additionally, Fisher’s Exact Test showed that considering future income an important factor was significantly associated with a preference for general surgery and with interest in further internships in orthopedics and trauma surgery. These results suggest that both prestige and anticipated financial rewards are meaningful drivers in the specialty choices of students considering surgical careers. Detailed regression coefficients are presented in Table 1.

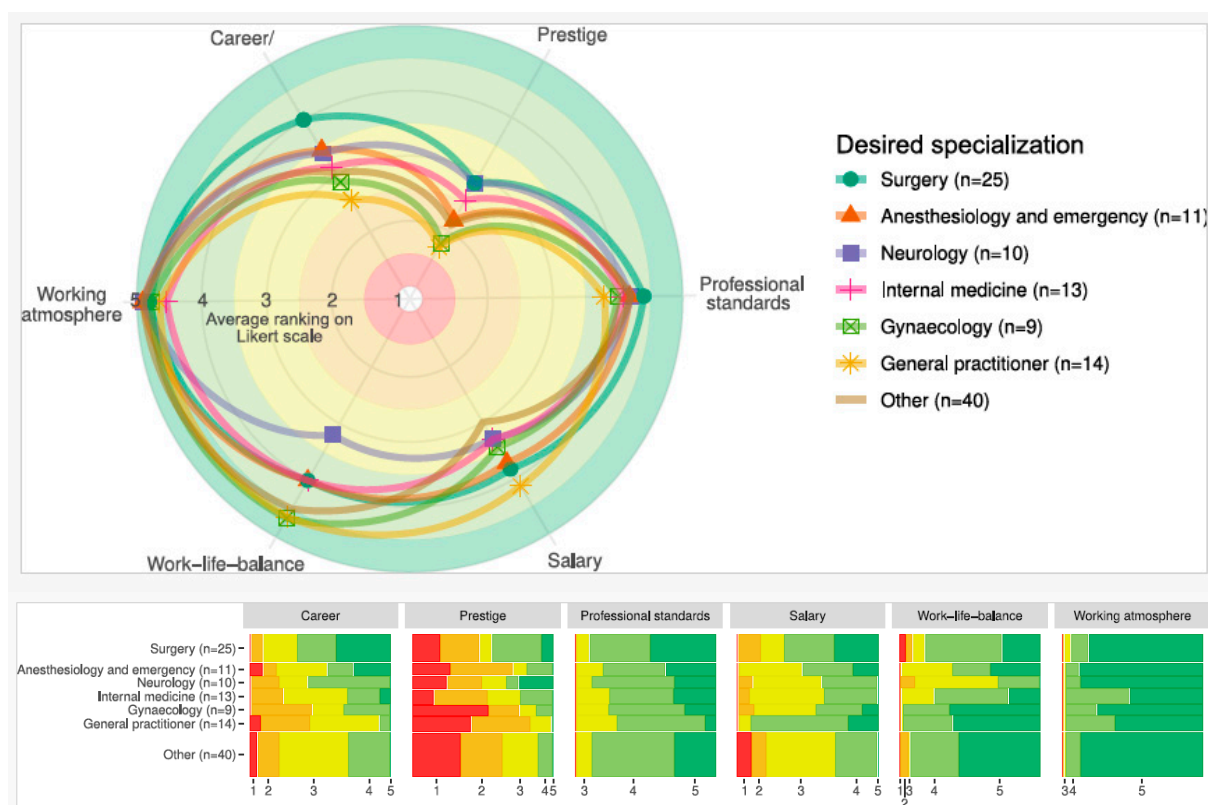


Figure 1. Professional Expectations by Desired Specialization. Both diagrams illustrate the same data. “Other” includes paediatrics, psychiatrics, urology, radiology, forensics, and otorhinolaryngology.

Table 1. Regression models, target parameters as indicated in the respective readings. The estimate refers to the coefficients of the logistic regression (log odds ratio) and indicates the probability-increasing (≥ 0) or -decreasing (≤ 0) effect. Z-value = Estimate/Std. Error.

Coefficient	Estimate	Std. Error	Z-Value	Pr (> z)
I would like to work in a surgical department.				
Regarding your future professional life, a good working atmosphere is important to you.	1.69	0.60	2.82	0.005
Regarding your future professional life, the prestige/image of your specialty is important to you.	1.63	0.50	3.29	0.001
age above 25 years	1.13	0.56	2.02	0.043
female gender	−1.16	0.46	−2.53	0.012
Regarding your future professional life, the work–life-balance is important to you.	−1.22	0.55	−2.23	0.026
Your parent’s education was mixed academic and non-academic.	−2.10	0.86	−2.45	0.014
You grew up urban or mixed.	−2.46	0.94	−2.61	0.009
My decision to specialize in trauma surgery was positively influenced by the course.				
Your parents are currently living urban or mixed.	2.32	1.10	2.11	0.035
I would like to work in a surgical department.	1.02	0.50	2.03	0.042
Regarding your future professional life, the prestige/image of your specialty is important to you.	−1.33	0.50	−2.68	0.007

Table 1. Cont.

Coefficient	Estimate	Std. Error	Z-Value	Pr (> z)
I could imagine traumatology as future career.				
Regarding your future professional life, the prestige/image of your specialty is important to you.	1.60	0.47	3.41	0.001
age above 25 years	1.32	0.63	2.10	0.036
I am planning to undergo further practical education in the subject of traumatology.				
Regarding your future professional life, the prestige/image of your specialty is important to you.	1.3	0.43	2.30	0.003

3.2. An Analysis of the Weighting of Work–Life Balance and Career

When dividing the cohort into students interested in surgical specialties and those who could not envision such a specialty, an interesting comparison emerges. By contrasting the obtained values for work–life balance, career, a good work environment, and income, only a subtle discrepancy in preferences is revealed. The intra-group differences regarding the different weighting of these factors are more pronounced. Among students interested in surgery, work–life balance is only 0.28 points more important than career, while for the others, there is a 0.99-point difference in favour of work–life balance. Regarding a pleasant work environment, there is also a clear preference among those interested in surgery: the difference compared to the importance of a good income is 1.08 points, while it is 1.45 points in the control group. Figure 2 further illustrates the differences in career expectations between surgical and non-surgical interests. In line with this, the logistic regression showed that a positive commitment to work–life balance reduces the likelihood of general surgical interest. Work–life balance had no impact on the remaining parameters (planned practical experience, specialization in orthopedics and trauma surgery, and the influence of the examination course on the decision to specialize).

Differences in Career Expectations Between Surgical and Non-Surgical Interests

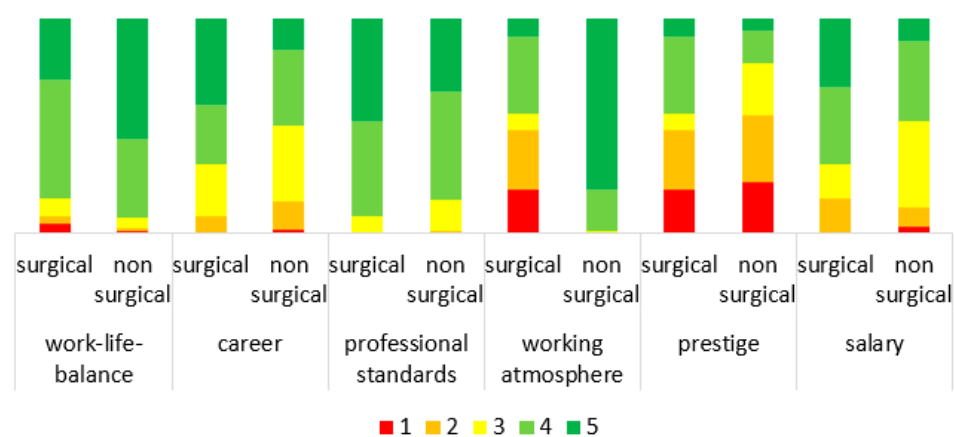


Figure 2. Ranking of Career Expectations on the Likert Scale. Surgical group: $n = 25$, non-surgical group: $n = 159$.

The calculations using the Chi-square test also confirm this trend. Students who were positively influenced by the examination course and were interested in specializing in orthopedics and trauma surgery placed significantly less importance on work–life balance compared to the control group (77% vs. 90%, p -value 0.025). A pleasant work environment

remains the most highly valued career factor across all specialties. In contrast, age, gender, and rural vs. urban origin had no significant influence. Notably, the importance of work–life balance was higher among students under 25 compared to older students. This age-related influence was also significant in the logistic regression for the target variables of general surgical interest and specialty training in orthopedics and trauma surgery, with individuals over 25 being more inclined toward surgery.

3.3. Contrasting Results in the Investigation of Leadership Characteristics in Surgery

The analysis of the prevalence of leadership characteristics in surgery yielded contrasting results. Asking the students with surgical interest about their interest in leadership, 54% ($n = 33/61$) percent give ratings ≥ 4 on the Likert scale, indicating interest. A statistically significant correlation was found between interest in surgical specialties and leadership characteristics (p -value 0.010 in the Chi-square test), as well as between leadership characteristics and career (p -value 0.001). However, participants who aspire to future leadership positions did not agree with the statement “Family and friends are more important to you than your career.”

Our results also contradict other associations, such as the assumption that surgeons place more value on prestige and income, while the work environment is of lesser importance to them. Additionally, a positive correlation was found between agreeing with the statement “I would like to work in a surgical specialty later” and “Family and friends are more important to you than your career.” Interestingly, those who felt positively influenced by the examination course in trauma surgery with regard to possible specialization showed little difference compared to the control group in their expectations for future professional life. It was notable that a steep career path was overall less important to them than to other students in the same cohort.

3.4. Limited Significance of Logistic Regressions Regarding Target Group Selection for Orthopedics and Trauma Surgery

Despite the identification of some significant predictive parameters in the logistic regressions, as shown in the table, the original purpose of these analyses—to identify meaningful epidemiological–social factors that could narrow down a potential target group for orthopedics and trauma surgery—was not satisfactorily achieved within the context of this publication. However, some interesting results emerged regarding gender differences. Table 2 illustrates differences between professional expectations.

Table 2. Gender comparison of professional expectations, values are shown in mean and standard deviation.

	Work–Life-Balance	Career	Professional Standards	Working Atmosphere	Prestige	Salary
Sex: female	4.40 ± 0.70	3.39 ± 0.75	4.09 ± 0.54	4.81 ± 0.44	2.34 ± 1.04	3.36 ± 0.83
Sex: male	4.03 ± 0.77	3.91 ± 0.76	4.25 ± 0.50	4.75 ± 0.50	2.89 ± 1.04	3.64 ± 0.69

The statistical analysis of the gender ratio in the field reveals further stereotypical patterns: Male students are more likely to aspire to leadership positions than female students (p -value 0.001), and students choosing a surgical specialty are predominantly male (p -value 0.018), compare Table 3.

Table 3. Gender comparison of leadership ambitions and interest in surgery.

	“I Would Like to Take on a Management Position in My Professional Future.”			Significance in Chi ² Test	“I Would Like to Work in a Surgical Department.”			Significance in Chi ² Test
	Yes	No	Percentage of Students Who Agree		Yes	No	Percentage of Students Who Agree	
Sex: female	37	76	32.7%	<0.001	32	81	28.3%	0.018
Sex: male	36	26	58.1%		29	34	46.0%	

However, it should be noted that, regardless of their choice of specialty, female students from the same generation express the desire for independence in their own practice just as frequently as their male counterparts. The logistic regression revealed that gender only plays a role in the general intention to work in surgery. Female gender decreases the likelihood, while male gender is correlated with increased interest in surgery in Fisher’s Exact Test. Gender had no influence on the other three target parameters specifically related to orthopedics and trauma surgery.

When we restrict the analysis to those interested in trauma surgery, 27% of male students and 20% of female students express a strong interest in this field. The gender difference is not statistically significant, as visualized by Figure 3.

I could imagine traumatology as future career.

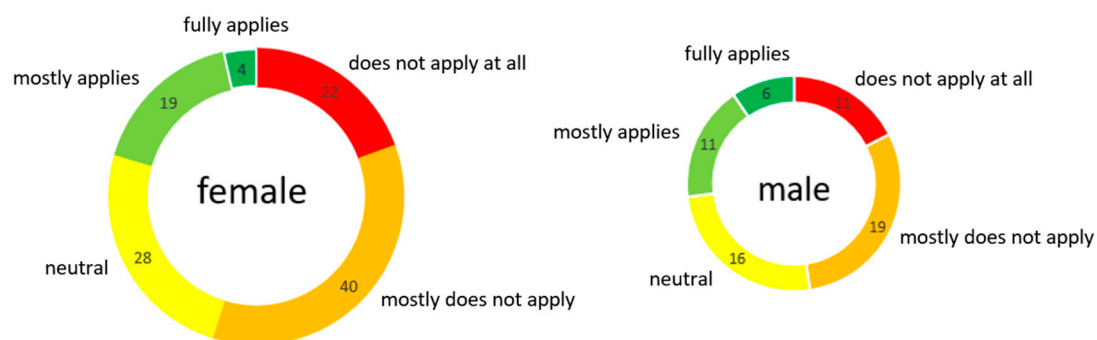


Figure 3. Comparisons of answers on the Likert scale between female ($n = 114$, 1 gave no answer) and male ($n = 63$) students regarding their interest in traumatology.

In direct comparison with the absolute numbers of those generally interested in surgery, the 23 students interested in orthopedics and trauma surgery are opposed by only 32 students generally interested in surgery. This suggests that most of the 32 are specifically interested in orthopedics and trauma surgery.

4. Discussion

4.1. Relevance of Work Environment for Medical Students’ Career Expectations and Initial Implications for Clinics

When it comes to the career expectations of medical students, it is undeniable that a pleasant work environment is of the utmost importance, as highlighted by both our results from the contingency tables and the logistic regression analysis. This finding could serve as a crucial marketing factor for clinics competing for talent. Kasch et al.’s 2015 study already identified work–life balance as a key factor in job satisfaction, with collegial cooperation also playing a prominent role [6]. Current studies further support the trend that work–life

balance is becoming increasingly important to the emerging generation [10]. A positive work environment is often seen as the result of a successful synthesis of collaborative teamwork, a participatory leadership style, and mutual respect. Therefore, our results align with those of Kasch [6].

If employers facing staff shortages wish to increase their presence on social media in the future (as Schmitt-Sausen has been advocating since 2020) [11], they could specifically highlight the pleasant work environment as a central aspect of their marketing strategy or company branding.

4.2. Differentiated Consideration of Career Expectations for Aspiring Surgeons in the Context of Work–Life Balance, Family, and Prestige

A remarkable finding from our study is that aspiring surgeons actually place less importance on their work–life balance compared to students pursuing specialties with more regulated working hours. This observation is in line with the works of Schmedt and Shaikh [12,13]. This result brings a nuanced perspective to the concerning outcome of the logistic regression, which suggests an inverse relationship between a high work–life balance and the likelihood of pursuing a surgical career. It is also noteworthy that work–life balance only plays a significant role in this specific model concerning the expected interest in general surgery, with no impact on decisions regarding orthopedics and trauma surgery.

Another important result is that aspiring surgeons value family planning just as much as students in other specialties. It appears that a steep career, compared to other career prospects, is even less relevant to them (difference: 5%). Agreement with the statement “Family and stable friendships are more important than your career” was significantly correlated in Fisher’s Exact Test with the desire to work in a surgical specialty. This suggests that motivated future healthcare professionals, in the balancing act between work, leisure, and family, might be more likely to sacrifice leisure time.

Another indication of this is the observation that younger students place a higher value on work–life balance, which may indicate a gradual adaptation to the realities of daily life in clinical practice. The introduction of specialized curricula in some faculties, which promote practical experience and early integration into the workforce, could support this adjustment process to professional life. The fact that interest in surgical specialties is stronger among those over 25 is particularly encouraging, given the challenges of gaining practical experience. Here, the option of temporal flexibility is of great importance, despite the recent reform that reduced the numbers in the specialist procedure catalogue.

Regarding prestige, our study shows that it remains relevant for students with an interest in surgical specialties. However, the logistic regression revealed that those who developed a new interest in the specialty through positive teaching experiences place less value on prestige and above-average income. On the other hand, prestige plays a larger role for those who have been contemplating a surgical specialty for a longer period. This underscores the complexity of motivations and decision-making among aspiring surgeons.

4.3. Professional Ambitions in Surgery: The Role of Leadership Qualities

A notable finding from our study is the confirmation of a common stereotype: there is a statistically significant correlation between interest in surgical specialties and the presence of leadership aspirations. This relationship was also observed between leadership characteristics and the pursuit of a successful career. These results raise interesting questions about whether this connection represents a positive drive for aspiring surgeons or whether a certain degree of assertiveness is indeed necessary for a successful career in surgery.

The positive correlation between leadership traits and the desire to work in surgical specialties, within the broad spectrum of surgery, is an encouraging outcome. It may be worthwhile to implement mentorship programs or seminars for emerging leaders to

attract and retain talent within the surgical fields. This could help develop a generation of surgeons who are not only clinically proficient but also possess the leadership skills necessary for effective team management and department leadership.

Unfortunately, disparities still exist in the quality of education received by women and men in orthopedics and trauma surgery [14]. However, some studies indicate a growing female presence within the faculty, signaling positive changes [15].

4.4. Gender Perspectives in Trauma Surgery and Orthopedics: Opportunities and Challenges for Career Choice and Specialty Development

The gender-specific aspects regarding interest in trauma surgery and orthopedics raise thought-provoking questions. It is noteworthy that women are just as open to orthopedics and trauma surgery as their male colleagues, and this study found no significant gender differences in this regard. This could be a promising sign that the field is equally attractive to both genders and has the potential to attract female professionals.

The fact that women place a higher value on work–life balance and workplace climate could be seen as a barrier to a career in trauma surgery, as traditional perceptions of this specialty often associate it with demanding working conditions. However, this could also be viewed as a future opportunity for the field. With an increasing proportion of women in the specialty, these values could naturally be integrated more strongly into the daily work environment, potentially leading to a positive shift in the working culture. A recent study by Kalbarczyk et al. found that female leaders not only improve working conditions, but also enhance overall outcomes of medical institutions [16]. A positive work environment and a balanced work–life dynamic could become attractive features, making the specialty more appealing to aspiring physicians, regardless of gender.

Although female students of the same generation express the desire to have their own practice just as often as their male peers, male students tend to be more inclined toward leadership positions [17]. This could be one contributing factor to the low percentage of women (20%) among specialists in orthopedics and trauma surgery, as reported by the most recent physician statistics from the German Federal Chamber of Physicians in 2024 [18]. It is remarkable that the proportion of women has already increased compared to 2018; back then, it was 4% [19]. However, it is unlikely that this situation is solely due to differing leadership ambitions.

This underrepresentation may stem from a complex combination of factors, such as historical biases, career expectations, and workplace dynamics, rather than just a gender-based preference for leadership roles. Addressing these multifaceted challenges could pave the way for greater gender equity in these demanding fields.

The decisions of women who initially express interest in the specialty but later choose alternative career paths might be linked to the conflict between motherhood and professional advancement [3,9]. Young women, on one hand, wish to do everything for the well-being of their families, and on the other hand, they do not want to make any compromises when it comes to their professional skills—skills that are essential in surgery for providing the best possible patient care. Many young women prefer part-time contracts [6]. Notably, Sanfey et al. (2006) found in a U.S. study that men are increasingly concerned with achieving a balance between work and family life as well [9]. Recent studies also show that the challenge of balancing work–life, family, and career for individual satisfaction affects men and women equally by now [20].

Additionally, the stereotype of the male, assertive orthopedic surgeon may deter some women [3]. Literature indicates that surgeons are often attributed with non-charismatic traits, which women generally do not associate with themselves [2]. This again highlights the importance of positive role models to encourage young talent in surgery. Given that the proportion of female students is already 62% [1], there is a risk that the current shortage of

professionals in orthopedic surgery may increase, and the feminization of medicine could become a challenge rather than an opportunity for patient care [2,9,21].

The emerging trend of increasing female representation in orthopedic surgery over the past decade is already measurable. From 14% in 2014 [22], the proportion rose to 20% by 2024 [18]. For comparison: in the USA, the proportion of orthopedic surgeons who graduated from fellowship between 2016 and 2021 was 11% women [23]. However, the numbers are also increasing there: a report from 2009 shows that the female proportion was only 6% back then [24,25].

However, regarding the comparison of absolute female numbers in surgery and specifically in orthopedic and trauma surgery in this study, it must be noted that the data can only have limited statistical validity, as no other surgical subspecialties were included. Nevertheless, our results suggest that orthopedic and trauma surgery is leading in terms of a more balanced gender distribution. Most students interested in surgery seem to be most likely to apply to this surgical subspecialty.

This trend is encouraging and indicates that the field is slowly opening up and becoming more attractive to women. Active efforts to promote a balanced gender distribution in the field could, in the long run, lead to better patient care and a more diverse work culture.

4.5. Consideration of Statistical Analysis Using Logistic Regression

The absence of clear predictive effects in the multivariate analysis highlights that current concerns regarding feminization, loss of prestige, or declining commitment in surgical careers do not represent an acute or uniform threat. Rather than pointing to a single at-risk group, the findings underscore the complexity and heterogeneity of career expectations among medical students. This complexity should be understood as an opportunity: it allows clinics to move away from rigid assumptions and toward more flexible, individualized recruitment and retention strategies that better reflect the diverse motivations of future physicians. Based on these results, we formulated key recommendations for clinical decision-makers.

Initial Implications for Clinics and Hospital Administrators:

- No need for crisis-driven recruitment measures: The findings indicate no acute worsening of staffing challenges related to feminization or loss of surgical prestige, allowing clinics to avoid reactive or short-term recruitment strategies.
- Move away from “one-size-fits-all” targeting: There is no clearly defined or predictable target group for surgical careers; recruitment strategies should therefore avoid rigid demographic assumptions.
- Adopt flexible, individualized recruitment approaches: Clinics should design recruitment and retention initiatives that address diverse career motivations, interests, and life plans rather than relying on standardized access criteria.
- Reduce pressure to introduce new formal entry requirements: Instead of tightening selection mechanisms, administrators can focus on optimizing existing training pathways and workplace conditions.
- Use complexity as a strategic advantage: Acknowledging the multifactorial nature of career decision-making enables clinics to develop broader, more appealing career offerings, supporting a diverse and sustainable future workforce.

4.6. Limitations

As this study is based on questionnaire data, the results reflect self-reported attitudes rather than observed behavior and may therefore be subject to contextual influences and social desirability bias. Moreover, the design of our questionnaire was neither validated

nor pre-tested, as our study was a pilot project. Item selection followed the study's research aim as presented in the Section 2.

From a statistical perspective, our single-centre survey, which directly followed a trauma surgery examination course, may have influenced the students' responses. This timing might have influenced their answers either positively or negatively. Furthermore, the *p*-values have not been corrected for multiple testing, and the regressions have not been validated using independent data. This greatly reduces the generalizability of our findings. Dichotomizing Likert scale responses could also have led to a loss of information, and potentially attenuate effect sizes or obscure more nuanced associations. Future analyses should therefore consider retaining the ordinal structure of the data and applying ordered logistic regression or treating the scale as continuous where appropriate to better capture gradations in presented attitudes.

Conclusions regarding the impact of feminization on workforce shortages should be drawn with caution, as the available data do not allow for definitive causal inferences. While the findings suggest that feminization is not associated with an acute worsening of staffing shortages, stronger claims would exceed the evidentiary scope of the study. Similarly, interpretations implying that aspiring surgeons might reduce their leisure time in favor of professional commitments remain speculative. These results should therefore be understood as indicative of differing priority structures rather than as direct predictors of future working behavior.

5. Conclusions

No evidence was found that the increasing feminization of medicine is at risk of exacerbating workforce shortages in orthopedic surgery, contrary to earlier concerns raised in the German literature [26].

Students aspiring to surgical careers place significantly less emphasis on work–life balance than their non-surgical peers, indicating a high level of professional commitment that may help meet future specialist workforce demands despite increasing system pressure. Across generations, doctors share core professional values [11]. But younger cohorts increasingly expect open communication, supportive leadership styles, and improved interpersonal competencies from their supervisors [11,12,27,28]. Poor working conditions remain a major risk for attrition, as evidenced by persistently low completion rates of surgical training and the gradual withdrawal of qualified specialists from curative practice when conditions are unfavorable [6,29–31].

In summary, considering the limitations of this study and the insights derived from the existing literature, our findings suggest a clear practical implication: specialized 'focus curricula' could constitute a promising and actionable strategy for recruitment and retention in orthopedics and trauma surgery. Such tailored educational programs may promote early professional identification, provide realistic exposure to clinical practice, and strengthen sustained motivation independent of gender. Furthermore, the integration of leadership training components may contribute to long-term workforce sustainability while supporting the provision of high-quality patient care [32].

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Gender Disclaimer: This study reports gender-related findings using a binary framework (male/female). We acknowledge that gender is a spectrum and that binary categorizations are socially and politically limited. The binary approach was retained to examine persistent stereotypes and is not intended to reinforce binary gender norms.

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