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PhD Theses Defended in Croatia (1992-2023): A Retrospective Analysis of Trends, Institutional Contributions, and Data Collection Challenges

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Abstract

Objective. This study analyzed PhD theses defended in Croatia between 1992 and 2023, with the aim of examining national trends, institutional contributions, disciplinary patterns, and data-related challenges. **Methods.** This retrospective time-trend study utilized the administrative data obtained from the Croatian Bureau of Statistics. Data on the number of defended PhD theses were collected by year, university, and school/department. Linear regression models were applied to assess temporal trends at both the national and institutional levels. **Results.** A total of 17,578 PhD theses were defended in Croatia between 1992 and 2023. The national output increased substantially, reaching a peak of 1,338 theses in 2012, followed by a subsequent decline and a gradual recovery. The University of Zagreb accounted for 74.8% of all defended theses, followed by the Universities of Osijek, Rijeka, and Split. Across institutions, the medical, economic, and engineering faculties were the most productive. Linear regression analyses demonstrated statistically significant upward trends at both the national level and across all major public universities. Collectively, medical schools produced 18% of all theses, with newer institutions, particularly those in Split and Osijek, exhibiting later but consistent growth. However, notable data inconsistencies were observed, including non-standardized institutional nomenclature, variable data granularity, and discrepancies among official reports. **Conclusion.** Croatia's PhD output expanded markedly after 2000, reflecting the maturation and expansion of its higher education system. Regional universities and medical schools substantially increased their contributions, indicating national academic growth. Sustained institutional support will be essential to sustain progress and foster disciplinary development.

Key Words: Academic Dissertations as Topic ▪ Higher Education ▪ Universities ▪ Croatia.

Introduction

PhD (doctoral) education plays a pivotal role in advancing a nation's research capacity, innovation potential, and overall socio-economic development (1, 2). Croatia gained independence in 1991, and in the decades since, its investment in research and development has steadily increased – reaching 1.1 billion euros in 2023. This corresponded to 1.39% of GDP, with higher education institutions accounting for 28% of this expenditure (3). Despite this progress, limited research has examined the structure and outcomes of PhD programs in Croatia.

In 2023, Vrdoljak published an analysis of trends in PhD graduations in Croatia and other European Union (EU) member states (4). Using data from the Statistical Database of the European Commission (Eurostat) for 35 European countries during the period 2013–2019, the study found that the highest numbers of doctoral graduates per 1,000 inhabitants were recorded in the most economically and socially developed Western European nations. For Croatia, this analysis revealed regional disparities and gender differences in PhD attainment, emphasizing the need for detailed studies to inform equitable educational policies and lifelong learning strategies (4).

Comprehensive longitudinal analyses of doctoral output in Croatia remain scarce, particularly

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those addressing institutional contributions, disciplinary patterns, and data quality issues. Addressing these gaps is crucial to improving doctoral education and strengthening the national research ecosystem. The scarcity of studies on this topic is likely due to difficulties in obtaining data on PhD studies and their outputs in Croatia. In 2024, we reported a case study describing our attempt to compile a complete list and full texts of PhD theses defended at Croatian medical schools between 1992 and 2021 (5). Despite extensive communication with national institutions, universities, and libraries, no single, complete database was available. By consolidating data from four different sources, we identified 2,955 theses, although the availability of full texts online was limited. Only 22% of the PhD theses in the sample were accessible through the national repository, while Zagreb and Split had only partial institutional access to the full text of the theses. The National and University Library held 90% of the targeted PhD theses in print form. This case study underscored substantial barriers to thesis accessibility and highlighted the need for greater transparency to support scientometric research and evidence-based science policy (5).

This study aimed to address this knowledge gap by providing a comprehensive analysis of PhD theses defended in Croatia between 1992 and 2023, focusing on national trends and institution-level contributions.

Methods

Study Design and Setting

This retrospective time-trend analysis utilized national administrative data to examine PhD theses defended across all academic disciplines in Croatia between January 1, 1992, and December 31, 2023. The starting year for the data collection was chosen because Croatia declared its independence on June 25, 1991, when the Croatian Parliament adopted the *Constitutional Decision on the Establishment of the Sovereign and Independent Republic of Croatia* (6).

Reporting

The study was reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational research, where applicable, with a focus on aggregated institutional and temporal trends (7).

Data Sources

Data were obtained from the Croatian Bureau of Statistics (Croatian: *Državni zavod za statistiku*, DZS). For the period 2004-2023, data were retrieved from the annual reports published on the DZS website. These reports, available in PDF format, contain both textual and tabular information. Data were extracted from these files.

As of May 2025, detailed information on the number of PhD theses defended at individual institutions in 2024 had not yet been published. For the period 1993-2003, the DZS did not have publicly available reports. These data were collected by visiting the DZS office in Zagreb, where the first author (LP) was granted access to printed statistical yearbooks. Tables containing data on the number of defended PhD theses were photographed and subsequently transcribed manually into a spreadsheet for analysis.

Data Extracted

The extracted variables included: the number of PhD theses defended annually from 1992 to 2023, the name of the university, and the name of the corresponding school or faculty.

Variables Analyzed

The primary outcome was the annual number of defended PhD theses, analyzed at the national, university, and school/department levels. Temporal trends in doctoral production between 1992 and 2023 were examined, and a subgroup analysis was performed for medical schools. Additionally, challenges encountered in accessing and analyzing the data were documented.

Ethics

This study utilized fully anonymized, aggregate administrative data that contained no personal identifiers. Therefore, ethical approval was not applicable.

Statistical Analysis

Descriptive statistics were presented as frequencies and percentages. The analyses were based on annual counts of defended doctoral theses and were not adjusted for the number of active doctoral programs. Namely, longitudinal program-level data by institution were not available in the national reports used as the data source. Consequently, the findings should be interpreted as absolute output measures rather than productivity per program. Temporal trends in the number of defended PhD theses were assessed using a series of linear regression analyses. Ordinary least squares (OLS) regression was applied to model annual changes in thesis counts. This analysis was conducted for descriptive purposes only; no Poisson, negative binomial, or other count models were fitted and no sensitivity analyses comparing model families were performed. Accordingly, the estimated coefficients (and any reported P-values) should be interpreted as descriptive trend indicators rather than confirmatory evidence.

The dependent variable was the annual number of defended PhD theses, and the independent variable was the calendar year (1992–2023). A separate linear regression model was developed for each institution to estimate the direction and magnitude of trends over time. Institutions with fewer than ten annual data points were excluded from regression analyses to ensure adequate statistical power and model stability.

The slope coefficient of each regression line indicated the estimated average annual change in the number of defenses. The statistical significance of each slope was evaluated using a t-test, with a significance threshold of $P<0.05$. Model fit was assessed using the coefficient of determination (R^2), indicating the proportion of variance in thesis counts explained by year. Trends were categorized as "increasing," "decreasing," or "stagnating" based on the direction and statistical significance of the slope – significantly positive slopes indicated increasing trends, significantly negative slopes indicated decreasing trends, and non-significant slopes were classified as stagnating. All statistical analyses were conducted using Microsoft Excel 2021 (Microsoft Corporation, Redmond, WA, USA).

Raw Data Availability

The raw data collected for this study are publicly available on the Open Science Framework at https://osf.io/y5wu8/.

Results

A total of 17,578 PhD theses were defended in Croatia between 1992 and 2023. The annual number of theses defended increased substantially from 234 in 1992 to a peak of 1338 in 2012, followed by a sharp decline and a substantial period of gradual recovery (Figure 1A, Supplementary Table 1).

PhD Output per University

Comparative analysis per university revealed that the majority of theses (74.8%) were defended at the University of Zagreb, followed by the University of Osijek (8.0%), the University of Rijeka (7.5%), and the University of Split (6.6%). Other higher education institutions contributed smaller proportions, each accounting for less than 3% of the total number of defended theses (Table 1).

Temporal Trends and Linear Regression Analysis

Table 2 summarizes the temporal trends in the number of defended PhD theses in Croatia from 1992 to 2023, based on linear regression analyses conducted for the national dataset and for selected public universities with more than ten annual data points. The five universities included in this analysis were the University of Osijek, the University

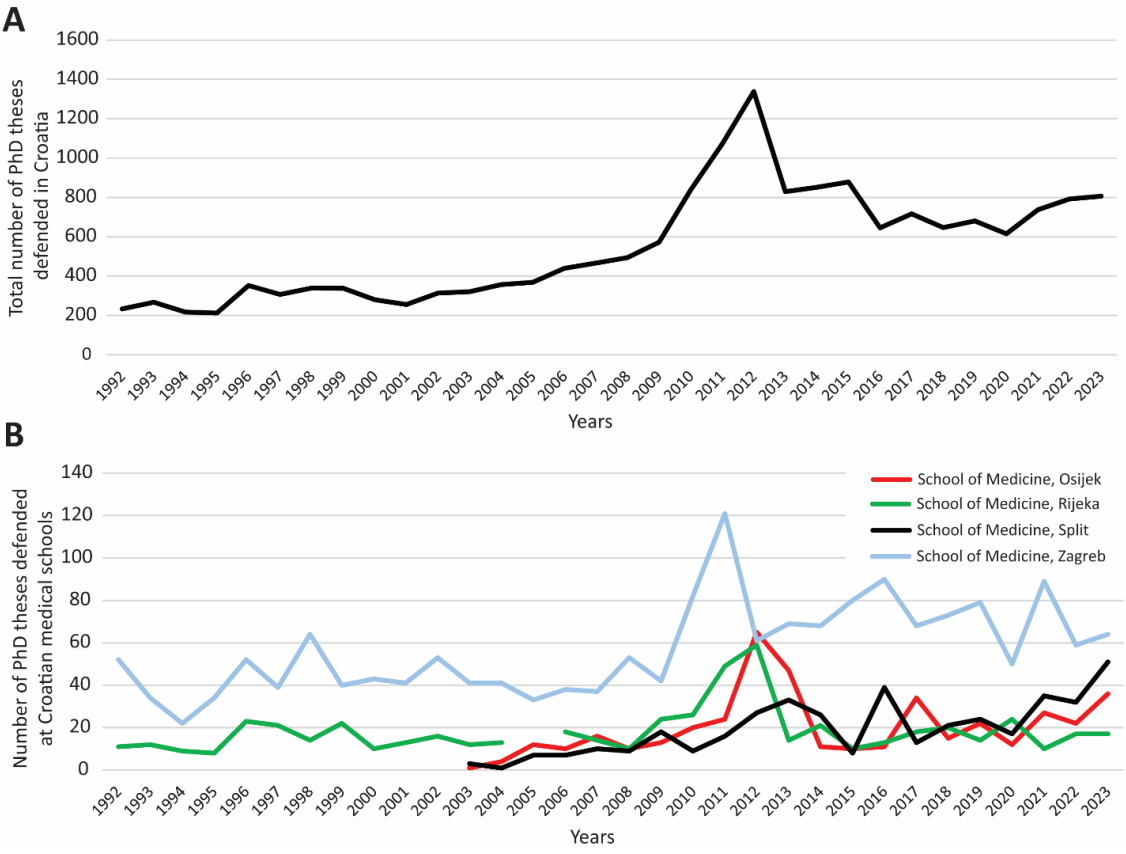

Figure 1. Temporal trends in the number of defended PhD theses in Croatia (1992–2023).
Figure 1A shows the total number of PhD theses defended annually across all Croatian higher education institutions over the 32 analyzed years. Figure 1B presents the cumulative number of defended PhD theses in medical schools in Osijek, Rijeka, Split and Zagreb during the same time frame.

Table 1. PhD Theses Defended in Croatia per University (1992-2023)

University	N (%)
Catholic University of Croatia	9 (0.05)
University North	15 (0.09)
University of Osijek	1405 (8.0)
University of Pula	63 (0.4)
University of Rijeka	1319 (7.5)
University of Slavonski Brod	8 (0.05)
University of Split	1156 (6.6)
University of Zadar	401 (2.3)
University of Zagreb	13152 (74.8)
Scientific legal entities*	50 (0.3)
Total	17578 (100)

*From 1993-1995, this common name was used for doctorates defended at the Institute Ruđer Bošković and the Institute for Medical Research and Occupational Health.

of Rijeka, the University of Split, the University of Zadar, and the University of Zagreb. Institutions excluded from this analysis due to insufficient data were the Catholic University of Croatia, University North, University of Pula, University of Slavonski Brod, and scientific legal entities.

At the national level, there was a statistically significant upward trend in the number of defended PhD theses, with an estimated average annual increase of 22.63 theses per year (R^2=0.574, t=6.36, P<0.001). This result indicates a moderately strong association between time and doctoral output, suggesting a sustained expansion in doctoral education during the study period (Table 2).

At the institutional level, all analyzed universities demonstrated statistically significant positive trends, although with varying slopes and model fits.

Table 2. Temporal Trends in the Number of Defended PhD Theses in Croatia by Institution (1992–2023); Linear Regression Analysis*

University	Slope	Intercept	R2	t-stat; P-value	Trend
Croatia – all PhD theses	+22.63	-44,885.83	0.574	6.36; P<0.001	Increasing
University of Osijek	+3.30	-6577.24	0.537	5.90; P<0.001	Increasing
University of Rijeka	+1.74	-3451.67	0.486	5.33; P<0.001	Increasing
University of Split	+2.94	-5770.12	0.499	5.50; P<0.001	Increasing
University of Zadar	+0.64	-1188.79	0.310	3.54; P<0.010	Increasing
University of Zagreb	+7.29	-14,318.60	0.185	2.75; P=0.010	Increasing

*The analysis made only for universities with more than 10 data points.

The University of Zagreb, the largest Croatian university, showed a statistically significant increase of 7.29 theses per year (t=2.75, P=0.010), albeit with a relatively low explanatory power (R^2=0.185), indicating considerable year-to-year variability not fully explained by time alone (Table 2).

Dominant Schools/Departments within Universities

For some universities, the DZS did not report data disaggregated by school/department. Where such data were available, the most successful schools/departments are shown in Table 3. At the University of Osijek, the schools of medicine, economics, and agriculture/agrobiotechnical sciences collectively accounted for 64% of all defended PhD theses. Similarly, at the University of Rijeka, the School of Medicine, the School of Economics, and the Faculty of Engineering represented 66% of all defended theses. At the University of Split, the School of Medicine, the Faculty of Electrical Engineering, Mechanical Engineering, and Naval Architecture, and the School of Economics, accounted for 67% of all doctorates. At the University of Zagreb, the three highest ranking institutions, based on the number of defended PhD theses, were the Faculty of Science, the Faculty of Humanities and Social

Table 3. Highest Ranking Schools/departments Based on Defended PhD Theses

University/School	N (%)
University of Osijek (N=1405)	
School of Medicine	422 (30)
School of Economics	286 (20)
School of Agriculture/Agrobiotechnical Sciences	190 (14)
University of Rijeka (N=1319)	
School of Medicine	562 (43)
School of Economics	161 (12)
Faculty of Engineering	148 (11)
University of Split (N=1156)	
School of Medicine	406 (35)
Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture	196 (17)
School of Economics	179 (15)
University of Zagreb (N=13152)	
Faculty of Science	2512 (19)
Faculty of Humanities and Social Sciences	2415 (18)
School of Medicine	1812 (14)

Sciences, and the School of Medicine; they accounted for 51% of defended PhD theses at the University of Zagreb (Table 3).

The Role of Medical Schools in PhD Output

Across the analyzed period, four medical schools, those of Zagreb, Rijeka, Split and Osijek, collectively produced 3202 PhD theses, representing 18% of the total national output. The older medical schools in Zagreb and Rijeka awarded doctorates throughout the entire study period, whereas the newer schools in Osijek and Split began awarding doctorates in 2003 (Figure 1B; Supplementary Table 2).

Data Quality, Consistency, and Reporting Anomalies

The analysis revealed several data-related challenges, including inconsistent reporting of institutional names and structures, variations in the granularity of available data (university-level vs. department-level), and ambiguity regarding the inclusion of doctoral degrees in the arts. Additional issues included nonspecific or duplicative entries and discrepancies between preliminary and finalized datasets. Manual extraction of data from older printed sources, the absence of standardized data organization (e.g., alphabetical ordering before 2019), and occasional typographical or reporting errors further complicated longitudinal comparisons and hindered the accuracy and reproducibility of analyses (Table 4).

Discussion

This comprehensive analysis of doctoral output in Croatia between 1992 and 2023 provides valuable insights into the evolution, growth, and institutional contributions to PhD education over three decades. The observed patterns reflect both the broader structural transformation of Croatia's higher education system and the distinct developmental trajectories of individual institutions.

Following Croatia's declaration of independence in 1991, the national trend reveals a pronounced expansion in doctoral output. In the early 1990s, the number of defended doctoral theses was very low—a finding attributable to

Table 4. Overview of Data Quality Issues in PhD Thesis Records Reported by the Croatian Bureau of Statistics (DZS)

Challenge	Example
Changes in institution names and structures.	The School of Humanities and Social Sciences in Zadar was once part of the University of Split, but later became part of a new university.
Inconsistent naming conventions in published data.	Most data by DZS were categorized by university names, while some were labeled geographically (e.g., "Area Split").
Inconsistencies in the granularity of data.	The Faculty of Humanities and Social Sciences from Zagreb had data displayed sometimes as a whole and other times as individual departments.
Varying levels of aggregation	Some data were reported at the department level, others at the university level, and in some cases, both presentations existed throughout the analyzed period.
Possible inclusion of doctorates in the arts, which may not be distinguished from science doctorates.	Some institutions, such as Music Academy, Academy of Fine Arts, are also on the DZS lists.
Nonspecific entries	Entries such as "University of Osijek" are listed as both a university and a school/department in some years.
Manual data extraction challenges	Data before 2004 was only available in printed monographs and had to be manually photographed and extracted.
Lack of alphabetical sorting in data tables until 2019, reducing standardization.	In data tables until 2019, the institutions were not listed alphabetically.
A discrepancy in reported figures	For the year 2018, one DZS report listed 647 defended PhDs, while another listed 628. Upon contacting DZS, the correct number (647) was confirmed; the lower number was from a preliminary report.

the Croatian War of Independence (1991-1995). The war had a profound adverse impact on the national education system, reducing enrollment in higher education, disrupting academic activities, and mobilizing a portion of the student population into active military service (8-10).

Subsequent years saw a steady increase in doctoral defenses, reflecting the gradual recovery and development of the higher education and research sectors. This growth culminated in a peak of 1,338 defended doctorates in 2012, followed by a marked decline. The 2012 peak likely resulted from a transitional provision in the 2003 *Croatian Act on Scientific Activity and Higher Education*, which abolished the pre-Bologna master of science (Croatian: *magisterij znanosti*) degree. The act allowed holders and enrollees of that degree program to obtain a PhD by defending a dissertation without enrolling in a formal doctoral program until 2011, with the final deadline extended to 2012 (11-13).

Regression analyses confirmed a statistically significant national upward trend, with an estimated average annual increase of 22.63 defended theses (slope = +22.63; $P<0.001$). This finding demonstrates a sustained expansion of doctoral training in Croatia, driven by higher education reforms, and the implementation of the Bologna Process (14, 15).

Reliable and internationally comparable data on the number of newly awarded doctorates remain limited. However, the global trend toward the expansion of doctoral education mirrors the Croatian experience. Among memers states of the Organisation for Economic Co-operation and Development (OECD), available data indicate that the number of doctoral degrees nearly doubled between the mid-1990s and 2017 (16). Furthermore, doctoral attainment in OECD countries increased by 25% between 2014 and 2019 (17), underscoring a worldwide emphasis on the expansion of doctoral training.

Dominance of the University of Zagreb

The University of Zagreb accounted for 75% of all defended PhD theses during the study period. While this dominance is unsurprising given the university's size, disciplinary breadth, and long-standing tradition of doctoral education, it raises important considerations regarding the concentration of doctoral training and the potential risks associated with over-centralization (18). The University of Zagreb also exhibited a statistically significant, though comparatively less stable, upward trend in doctoral output ($R^2=0.185$). This weaker model fit likely reflects internal institutional diversity and varying research capacities among its faculties.

Other public universities with at least a decade of recorded data, specifically Osijek, Rijeka, Split, and Zadar, also demonstrated statistically significant positive trends, albeit with smaller total outputs. The Universities of Osijek, Rijeka, and Split showed moderate-to-strong model fits (R^2 between 0.49 and 0.54), indicating more consistent year-on-year increases in doctoral production. These results suggest successful institutional consolidation and gradual expansion of doctoral education outside the capital, consistent with the decentralization goals of the European Higher Education Area (EHEA) (18).

Regional Diversification and New Universities

Beyond Zagreb, regional universities, particularly those in Osijek and Split, have shown substantial growth in the number of schools/departments awarding PhD degrees over the analyzed period. This expansion underscores a broader national effort to diversify and strengthen research capacity across Croatia, reflecting both regional development strategies and the increasing maturity of academic institutions.

The emergence of PhD programs in newer universities, including the University of Zadar, the Catholic University of Croatia, University North, and the University of Slavonski Brod, further indicates an ongoing diversification within the Croatian higher education landscape. Although their overall contributions remain modest and relatively recent, these institutions represent important steps toward building research capacity and promoting balanced academic development across different regions of the country.

Disciplinary Concentration in Medicine, Economics, and Engineering

At the Universities of Osijek, Rijeka, and Split, three dominant schools accounted for approximately two-thirds of all defended PhD theses, suggesting a strong concentration of doctoral education within a limited number of disciplines. The consistent prominence of medical, economic, and engineering faculties reflects clear disciplinary trends and institutional priorities. These findings are consistent with prior research showing that STEM and biomedical fields tend to receive greater institutional investment and attract larger numbers of doctoral candidates due to more defined academic and professional career pathways (6).

At the University of Zagreb, by far the largest contributor to the national doctoral output, the highest-ranking three schools collectively accounted for just over half (51%) of all defended theses. This indicates comparatively greater disciplinary diversity. Nevertheless, these results reveal persistent imbalances across fields and may reflect broader structural factors, including disparities in research funding, institutional strategies, and labor market demand. Such disciplinary concentration warrants further investigation into the alignment of national research priorities with doctoral education policy and institutional support for underrepresented academic areas.

Medical Schools as Key Drivers of Doctoral Output in Croatia

Medical schools at the universities of Zagreb, Rijeka, Split, and Osijek were among the most productive institutions in Croatia in terms of doctoral output. The strong performance, particularly of the Universities of Zagreb and Rijeka, can be attributed to their earlier establishment and long-standing academic traditions. The University of Zagreb School of Medicine was founded in 1917 (19), and the University of Rijeka School of Medicine in 1955 (20). Their longer institutional histories have facilitated the development of robust research infrastructure, extensive international collaborations, and close integration with research-intensive hospital systems.

By contrast, the delayed onset of doctoral activity at the newer medical schools in Split and Osijek was expected, given their later founding dates. The University of Split School of Medicine was founded in 1997 (21), and the University of Osijek School of Medicine in 1998 (22). Despite their recent origins, both institutions rapidly implemented doctoral programs, with the first theses defended in 2003. The upward trend in defended PhD theses observed at both schools indicates the successful establishment and progressive development of their doctoral training programs.

Although the overall number of medical doctoral theses in Croatia is relatively high, only a limited number of studies have examined the quality, productivity, and structure of medical PhD education. In 2003, Frković et al. published an analysis of publication output derived from doctoral and master's theses defended at the medical schools in Rijeka and Osijek. They found that only a minority of theses resulted in published scientific articles and emphasized the need for stronger institutional support to facilitate dissemination of doctoral research (23).

In 2017, we reported an interventional study aimed at improving completion rates among medical PhD students (24). Conducted at the University of Split School of Medicine, this study demonstrated that implementing stricter admission criteria, regulatory measures, and curriculum reforms in a newly established biomedical PhD program significantly increased completion rates and reduced time to degree, without adversely affecting the number or impact of thesis-related publications (24).

Subsequently, Benzon et al. conducted a retrospective study of the biomedical PhD program *Biology of Neoplasms* at the University of Split School of Medicine, exploring factors associated with the PhD students' completion rates (25). Their findings showed that mentor experience and student employment in academia were significant predictors of successful graduation and higher research output, whereas age, sex, and tuition

support had no measurable impact. Those findings support EU policy recommendations for doctoral program evaluation and reform (25). In 2024, we reported persistent challenges in obtaining the comprehensive list and full texts of PhD theses defended at medical schools in Croatia, highlighting systemic issues in data accessibility and transparency within higher education institutions (5).

Limitations of the Study

Several data inconsistencies and reporting challenges were encountered during the analysis, which may have affected the integrity and interpretability of the dataset. Changes in institutional names and organizational structures complicated longitudinal tracking, making it difficult to ensure consistent institutional identification over time. Inconsistent naming conventions, such as the use of university names versus geographical identifiers, further impeded categorization and limited the potential for automated or programmatic data processing.

Variability in data granularity also posed challenges, as some datasets were reported at the university-wide level while others provided department-level information, complicating fair comparisons across institutions and time periods.

Unclear inclusion criteria for doctorates in the arts further limited disciplinary comparability and undermined international benchmarking. Nonspecific or incomplete entries reduced data granularity and hindered sub-institutional analyses. Additionally, manual data extraction increased the potential for human error, and the absence of standardized formatting, such as alphabetical ordering in earlier datasets, complicated data validation and reduced usability.

A discrepancy identified for the year 2018 underscores the necessity of cross-verifying data from multiple sources and highlights the risks associated with relying on provisional statistics. It also demonstrates the importance of using finalized, validated datasets for accurate analysis. Consequently, researchers should exercise caution when interpreting apparent fluctuations in the number of defended theses, as such variations may result from reporting inconsistencies rather than genuine changes in academic productivity.

Methodologically, this study did not include formal diagnostics for OLS regression assumptions (linearity, homoscedasticity, independence, normality), nor did we employ count-specific models (Poisson, negative binomial, quasi-Poisson) or use standard-error adjustments tailored to counts. As a result, untested data features, such as serial correlation, nonlinearity, or overdispersion, may have affected the precision of estimated standard errors and confidence intervals, potentially leading to over- or under-statement of p-values. Future research could address these limitations by employing count-based or rate-based modeling approaches with robust or quasi-likelihood methods that explicitly account for temporal dependence.

The number of active doctoral programs varies across institutions and over time. This likely influences the total number of theses defended. However, we were unable to adjust for these variations, as consistent, institution-level time series of active programs were not available in the national statistics we analyzed and, to our knowledge, are not publicly traceable for the full period studied. Consequently, the observed trends and between-institution differences reflect both research capacity and institutional availability, rather than productivity per program. Future analyses should incorporate program-level denominators (e.g., number of active programs, enrolled doctoral students, or faculty size) once such data become available.

Future Research

Future research and policy efforts should further investigate the effects of higher education policies and funding mechanisms on doctoral education in Croatia. In particular, analyses should explore how national reforms and the establishment of new doctoral programs have influenced institutional productivity and research quality.

The study period overlaps with two major structural developments. Namely, Croatia accessed the European Union in July 2013. Also, during this period, Croatia adopted the Bologna

Process, which standardized higher education systems across Europe into three academic cycles, including doctoral studies. These milestones likely shaped national research policy, funding priorities and the expansion of doctoral education.

Further studies should also assess the labor market outcomes of PhD graduates in Croatia to evaluate the alignment between doctoral training and national economic and societal needs. Establishing a better data infrastructure within the Croatian Bureau of Statistics would enhance the ability to monitor and evaluate doctoral education. Such improvements would enable evidence-based policymaking, facilitate cross-institutional comparisons, and provide deeper insights into disciplinary trends and program performance.

Additionally, more granular research on PhD education in Croatia is needed, focusing on curriculum development, quality assurance mechanisms, and internationalization strategies. Developing a comprehensive longitudinal dataset on active doctoral programs and student enrollment would allow for rate-based analyses (e.g., theses per program) and provide a more accurate assessment of institutional productivity and efficiency.

Conclusion

This study presents the first comprehensive national analysis of doctoral education in Croatia, documenting substantial growth in doctoral output from 1992 to 2023 and revealing key institutional and disciplinary patterns. The findings underscore the dominant role of the University of Zagreb, the increasing contributions of regional universities, and the sustained prominence of medical, economic, and engineering fields in shaping Croatia's doctoral landscape. These patterns reflect both the historical evolution and ongoing transformation of Croatia's higher education and research systems. As Croatia continues to integrate with European research and education frameworks, maintaining long-term investment in doctoral programs, promoting disciplinary diversity, and supporting the strategic development of emerging institutions will be crucial for strengthening national research capacity and fostering balanced academic advancement.

What Is Already Known on This Topic:
Comprehensive analyses of national trends in the number of defended PhD theses across all academic institutions in Croatia are lacking. Fragmented reports have highlighted issues such as low completion rates and variations in institutional research output, but temporal patterns and institutional comparisons have not been systematically explored. Additionally, the quality and completeness of publicly available data on PhD theses in Croatia remain uncertain, limiting efforts to monitor and evaluate the effectiveness of doctoral education policies over time.

What This Study Adds:
This study provides the first national-level longitudinal analysis of PhD thesis defense trends in Croatia from 1992 to 2023. It identifies leading institutions by output, reveals temporal patterns in doctoral productivity, and highlights significant gaps in data reporting. Notably, the analysis shows that the medical schools, particularly the University of Zagreb School of Medicine, consistently rank among the top institutions in terms of the number of defended PhD theses. These findings offer a foundation for informed policy decisions and future research on doctoral education in Croatia.

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Data Availability: Raw data collected for this study are available on the Open Science Framework (link: https://osf.io/y5wu8/).

Conflict of Interest: The authors declare that they have no conflict of interest.

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Supplementary Material

Table 1. Number of PhD Theses Defended in Croatia by Year (1992-2023)

Year	Number of PhD theses defended
1992	234
1993	267
1994	217
1995	212
1996	352
1997	307
1998	339
1999	338
2000	280
2001	255
2002	314
2003	321
2004	357
2005	368
2006	439
2007	466
2008	494
2009	572
2010	838
2011	1072
2012	1338
2013	830
2014	851
2015	878
2016	646
2017	716
2018	647
2019	680
2020	615
2021	737
2022	792
2023	806

Table 2. Number of PhD Theses Defended in Schools of Medicine in Croatia by Year (1992-2023)

Year	Osijek	Rijeka	Split	Zagreb
1992	-	11	-	52
1993	-	12	-	34
1994	-	9	-	22
1995	-	8	-	34
1996	-	23	-	52
1997	-	21	-	39
1998	-	14	-	64
1999	-	22	-	40
2000	-	10	-	43
2001	-	13	-	41
2002	-	16	-	53
2003	1	12	3	41
2004	4	13	1	41
2005	12	-	7	33
2006	10	18	7	38
2007	16	14	10	37
2008	10	10	9	53
2009	13	24	18	42
2010	20	26	9	82
2011	24	49	16	121
2012	65	59	27	61
2013	47	14	33	69
2014	11	21	26	68
2015	10	10	8	80
2016	11	13	39	90
2017	34	18	13	68
2018	15	20	21	73
2019	22	14	24	79
2020	12	24	17	50
2021	27	10	35	89
2022	22	17	32	59
2023	36	17	51	64