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Original Article

Evaluation of the Productivity of Research Leading to Publications at Shiraz University of Medical Sciences

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Abstract

Introduction: Measuring research productivity is essential for improving the efficiency of academic output. This study evaluated the productivity of research projects, resulting in published articles by Shiraz University of Medical Sciences.

Methods: This descriptive cross-sectional study was conducted in 2023 using a census sampling method. A total of 487 research projects completed by the end of 2022, each resulting in at least one published article in a reputable journal, were included. Data were collected using a structured Excel-based form. Descriptive statistics, including frequencies, percentages, mean article score per project, average cost per score, and average cost per project, were calculated using Microsoft Excel 2019.

Results: The university earned 699.42 research scores from the projects. The highest scores were attributed to articles from non-thesis projects (233.6) and medical school projects (196.35). A total of 674,802.40 USD was spent to support these projects. The highest average cost per research score was observed in projects from the School of Paramedical Sciences (9,976.03 USD) and postdoctoral projects (3,736.56 USD). In contrast, the lowest average costs per score were found in projects from the Student Research Committee (501.7 USD) and grant-based projects (510.3 USD).

Conclusion: According to this study, paramedical school and postdoctoral projects incurred the highest costs per research score, indicating a need for improved resource management. In contrast, the Student Research Committee and grant-based projects demonstrated higher productivity. These results underscore the importance of prioritizing funding mechanisms that maximize research output per dollar spent.

Keywords: Productivity, Research Projects, Grant, Cost, Article

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Introduction

A country's scientific progress and development can be primarily evaluated by assessing its researchers' academic activities and outputs. Scientometric indicators—such as the number of publications, citation rates, and journal impact factors—are valuable tools that enable analysis, comparison, and monitoring of researchers' scientific performance (1). Research, particularly in the field of medical sciences, plays a vital role in enhancing social, economic, and public health indicators and serves as a key driver of sustainable development in the long term. Innovations in medical research offer practical solutions to health-related challenges and help enhance quality of life. In recent decades, the increase in human life expectancy has been significantly linked to advancements in medical research (2).

Universities, as centers of education and research, play a significant role in the production of knowledge and in driving a country's economic and social development, ultimately contributing to societal advancement (3). Medical universities focusing on public health and healthcare contribute substantially to generating health-related knowledge. By producing reliable scientific evidence, they can more effectively inform policymaking and decision-making processes within the healthcare system (4). Therefore, the continuous monitoring and evaluation of the research performance of these universities, especially the productivity of studies resulting in scientific publications, is essential and cannot be overlooked (3, 5).

In recent years, research productivity has emerged as a crucial metric for evaluating the effectiveness of research activities within universities and research institutions (6). Research productivity is typically assessed using both quantitative and qualitative indicators. Quantitative measures include the number of publications, completed projects, patents, and postgraduate students supervised. At the same time, qualitative indicators cover citations, h-index, journal impact factor, institutional rankings, and field-weighted citation impact (FWCI). These metrics comprehensively view the research output's scope, quality, and impact (7, 8). In other words, research is only deemed valuable when it results in the creation of new knowledge and its dissemination through scientific articles, books, or other credible documentation. Without proper documentation and publication, research findings do not effectively contribute to scientific advancement (2, 9). Evaluating research productivity improves the quality of research, creates the foundation for optimal resource allocation, and enhances the university's academic standing nationally and internationally (10). In the study by Khanali and colleagues (2023), the research productivity of faculty members at Iran's medical universities was examined from 2016 to 2020. The results indicated a significant upward trend in research productivity among faculty members. Specifically, the average number of published articles per person increased from 4 to 10, the number of citations per article rose from 1.5 to 4.8, and the H-index grew from 1 to 4 during this period (11).

In addition, the number of articles published by faculty members and researchers is considered one of the most important and commonly used indicators for evaluating a university's research productivity, academic credibility, and scientific capacity (12, 13). In a study conducted by Oyeyemi and colleagues (2019), which aimed to evaluate the research productivity of faculty members at a Nigerian medical university, the findings showed that the average number of published articles over three years was 6.8±6.6, while the average number of conference presentations was 4±4.5. Considering a productivity threshold of six articles over three years, many faculty members at that university were not classified as productive (13).

Evaluating research productivity by identifying the strengths and weaknesses of research structures plays a crucial role in optimizing support policies, improving resource allocation, and enhancing the academic standing of universities at both national and international levels (14). Such assessments can provide valuable insights for university administrators to strengthen scientific output and address existing gaps. As a leading type I university in southern Iran, Shiraz University of Medical Sciences carries out a considerable volume of research annually. Strong collaboration among research units and good data access facilitated this study. University officials also actively address research challenges and seek strategies to improve productivity. Thus, the study's findings may inform future research policies at the university. Therefore, the present study evaluated the productivity of research projects leading to publications at Shiraz University of Medical Sciences in 2023.

Methods

This descriptive cross-sectional study was conducted in 2023 to assess the costs allocated to research projects and the scores of articles derived from them at Shiraz University of Medical Sciences. The study population included all research projects conducted at Shiraz University of Medical Sciences, completed by the end of 2022, and their articles published in reputable journals affiliated with Shiraz University of Medical Sciences. A total of 487 research projects were examined using a census approach.

At Shiraz University of Medical Sciences, the Integrated Research Affairs System (pazhoheshyar) is an information system that provides coherent data for effective decision-making and policymaking in research affairs. Experts and research administrators observe that the absence of such an integrated system for collecting, processing, storing, and disseminating research information has led to numerous challenges, most notably the lack of access to accurate and reliable research data needed for informed decision-making and effective policy formulation in the field of research (15). In Iran, research proposals submitted by researchers are typically approved by the research councils of universities and research centers before being implemented by the project managers. The outcome of an approved research project is usually a final report submitted to the supporting funding organization. Some research projects are converted into articles by the project managers and are published. In this study, the output from

the "pazhoheshyar" system at Shiraz University of Medical Sciences in 2022 was utilized to assess the productivity of research projects leading to publications.

Procedure

The required data, including the project tracking code, gender of the project leader, project type, submitting institution, project cost, journal name, journal index, journal cite score quartile and impact factor, were collected using an informational form designed in Excel 2019. To calculate the final score of articles from research projects, we used the Comprehensive Evaluation Guide for Research and Technology Activities of Medical Sciences Universities in Iran, approved by the Research and Technology Department of the Ministry of Health and Medical Education (16). According to this guide, articles are scored based on the type of article (e.g., original, review, case report) and the indexing database in which they are published. Table 1 summarizes the base scores. For instance, an original article indexed in ISI receives 2 scores, while a review article indexed in Scopus receives 1 score. Lower scores are assigned to letters, case reports, and editorials; higher scores are assigned to reviews and original articles. If an article is indexed in multiple databases, the score is calculated based on the highest-ranking index, with the following priority order: ISI > PubMed > Scopus > Emerging Sources (Table 1). In addition to the base score, bonus points are applied as follows:

- Articles published in ISI-indexed journals with an official impact factor (IF) 0.2 times the journal's impact factor are added to the article's base score.
- Articles published in Scopus Q1 journals receive an additional fixed bonus score.

It should be noted that when duplicate articles were found across multiple databases, the scoring was done in favor of the superior indexing database. All costs were initially recorded in Iranian Rials and then converted to U.S. dollars using the official exchange rate of 42,000 IRR per USD, as published by the Central Bank of the Islamic Republic of Iran for 2022 (17).

Statistical Analyses

This study was approved by the Ethics Committee of Shiraz University of Medical Sciences (Ethics Code: IR.SUMS.REC.1394.166). Data were collected using a structured Excel-based form. Descriptive statistics, including frequencies, percentages, mean article score per project, average cost per score, and average cost per project, were calculated using Microsoft Excel 2019.

Results

Of the 487 research projects reviewed, 276 (56.7%) were led by male principal investigators, while female researchers led 211 (43.3%). Non-thesis projects accounted for the highest proportion (35.9%), whereas research-based PhD projects had the lowest frequency (0.2%). These research projects generated 699.42 scores for the university, with the highest score of 233.6 attributed to articles from non-thesis projects. To achieve these points, Shiraz University of Medical Sciences allocated 674,802.40 USD to support the researchers. The highest average cost per score was related to postdoctoral projects at 3,736.56 USD. In comparison, the lowest was for projects from the Student Research Committee, at 501.7 USD. Moreover, the highest average cost per project was observed in postdoctoral projects (9,735.42 USD) and the lowest in thesis projects (535.48 USD) (Table 2).

Figure 1 compares total article scores and average cost per score (USD) across project types. Non-thesis and grant-based projects showed the highest research output, while postdoctoral projects had the highest cost per score. In contrast, the Student Research Committee and grant-based projects demonstrated the highest productivity.

The results showed that the highest and lowest numbers of completed research projects in 2022 were related to the Faculty of Medicine (31.4%) and PhD by Research Projects (0.2%), respectively.

Table 1: Article Score Based on Database Type

Index Type	Original Article	Review Article	Editorial/Research Letter	Case Report	Letter to the Editor
ISI	2	2	1	1	0.3
PubMed	1.5	1.5	0.75	0.75	0.2
Scopus	1	1	0.5	0.5	0.1
Emerging Source	0.75	0.75	0.25	0.25	0.1

Table 2: The distribution of the frequency of scores and costs of research projects based on the type of project

Project type	Number of Completed Projects	Index Score	IF score	Q1 score	Total article score	Total cost (USD)	Avg Article Score per	Avg Cost per Score (USD)	Avg Cost per Project (USD)
Thesis-based	131	94.5	17.15	14	125.65	70,147.96	0.96	558.28	535.48
Postgraduate	99	94.25	23.71	19	136.96	208,936.21	1.38	1,525.53	2,110.47
Postdoctoral	11	16	6.66	6	28.66	107,089.67	2.6	3,736.56	9,735.42
PhD by Research	1	2	0.37	1	3.37	4,093.10	3.37	1,214.60	4,093.10
Non-thesis	175	168.75	39.85	25	233.6	197,384.70	1.33	845	1,127.90
Student Research Committee	14	16.5	4.13	2	22.63	11,352.42	1.62	501.7	810.89
Grant-based	56	91.75	33.8	23	148.55	75,798.33	2.65	510.3	1,353.54
Total	487	483.75	125.67	90	699.42	674,802.40	1.44	964.8	1,385.63

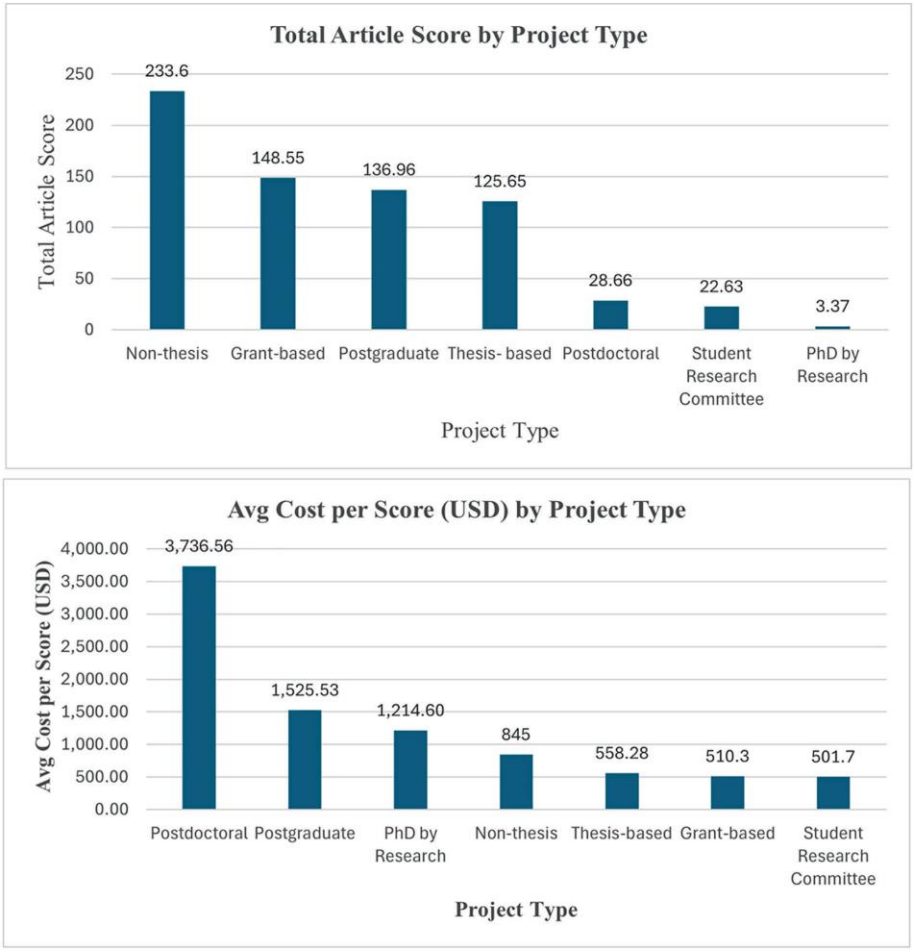

Figure 1: Total Article Score and Average Cost per Score (USD) by Project Type

The highest article score was associated with projects from the Faculty of Medicine, with a score of 196.35. The highest and lowest average cost per score was related to the Faculty of Paramedical Sciences projects (9,976.03 USD) and Grant-based projects (510.25 USD). Additionally, the highest average cost per project was related to Postdoctoral projects (9,735.42 USD), and the lowest average cost per project was related to the Faculty of Dentistry projects (751.12 USD). The highest score per project was related to the PhD by Research projects (3.37), followed by Grant-based projects (2.65) and Postdoctoral projects (2.6) (Table 3).

Figure 2 compares total article scores and average cost per score (USD) across faculty/center types. School of Medicine and Research Center projects showed the highest research output. Despite having the lowest total score among the faculties, the Faculty of Paramedical Sciences projects had the highest average cost per score. In contrast, grant-based and Dentistry school projects demonstrated the highest average cost per score (USD).

Table 3: The distribution of the frequency of scores and costs of research projects based on the type of faculty/center

Faculty/Center	Number of Completed Projects	Index Score	IF Score	Q1 Score	Total Article Score	Total Cost (USD)	Avg Article Score per Project	Avg Cost per score (USD)	Avg Cost per Project (USD)
Medicine	153	142	32.35	22	196.35	141,524.43	1.28	720.78	925
Health Sciences	29	18	4.03	4	26.03	37,285.48	0.9	1,432.40	1,285.70
Nursing & Midwifery	17	14	0.7	2	16.7	22,756.87	0.98	1,362.69	1,338.64
Dentistry	35	28.5	5.68	6	40.18	26,289.29	1.15	654.29	751.12
Paramedical sciences	8	1.5	0	0	1.5	14,964.05	0.19	9,976.03	1,870.51
Pharmacy	9	10	5.46	4	19.46	24,268.93	2.16	1,247.12	2,696.55
Management & Medical Information	11	6.25	0.91	0	7.16	14,574.19	0.65	2,035.50	1,324.93
Rehabilitation Sciences	18	19	1.65	4	24.65	19,331.79	1.37	784.25	1,073.99
Nutrition & Food Sciences	13	9	2.58	2	13.58	12,612.48	1.04	928.75	970.19
Advanced Sciences and Technologies	7	6	1.24	0	7.24	23,337.55	1.03	3,223.42	3,333.94
Grant-based	56	91.75	33.8	23	148.55	75,798.33	2.65	510.25	1,353.54
Postdoctoral Projects	11	16	6.66	6	28.66	107,089.67	2.6	3,736.56	9,735.42
PhD by Research	1	2	0.37	1	3.37	4,093.10	3.37	1,214.56	4,093.10
Research Centers	119	119.75	30.24	16	165.99	150,876.30	1.4	908.95	1,267.87
Total	487	483.75	125.67	90	699.42	674,802.40	1.44	964.8	1,385.63

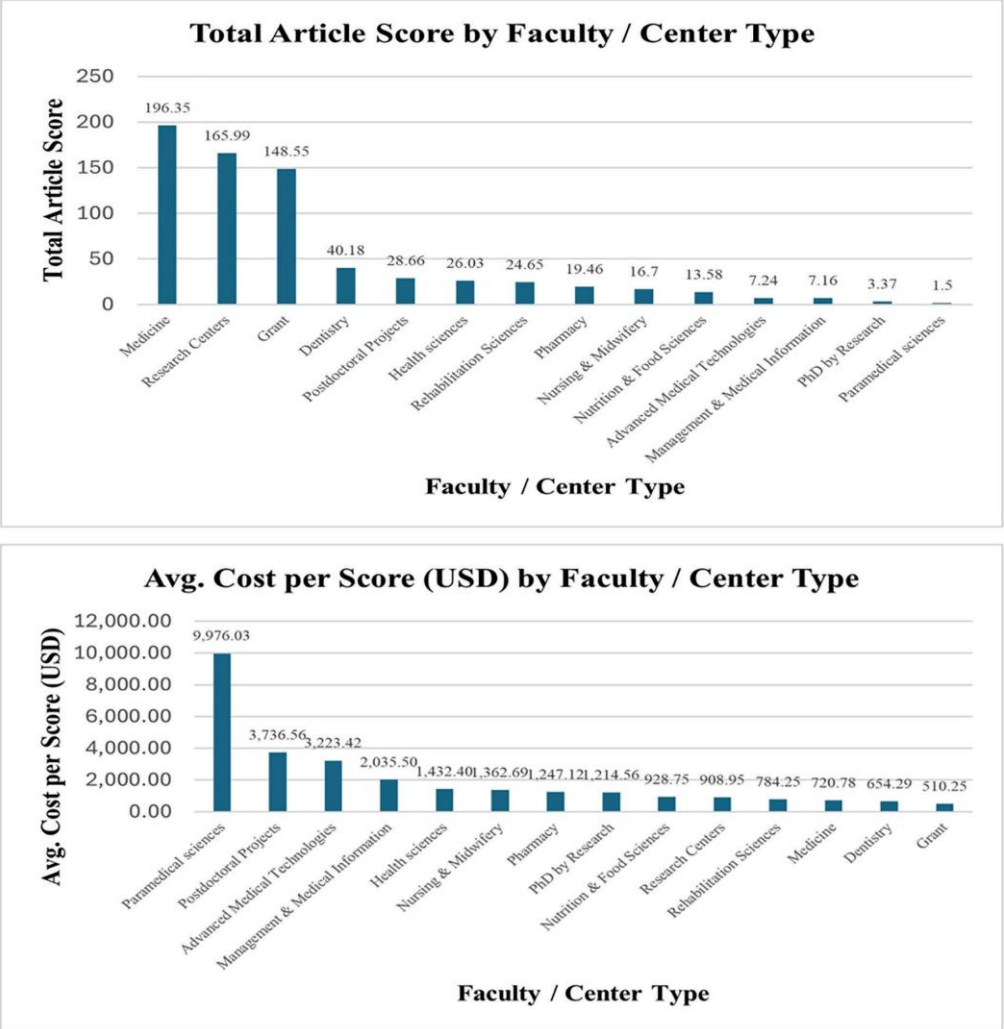

Figure 2: Total Article Score and Average Cost per Score (USD) by Faculty / Center Type

Discussion

Health research systematically produces and tests knowledge across various sciences to help improve individual and community health (18). The growing expectations of higher education have increased financial pressures on institutions, leading them to seek solutions. Two main strategies are proposed: using non-governmental funding sources and improving the efficiency of financial resource allocation. Reforming this allocation system is a key tool for managing higher education and effective policymaking (19). This study evaluated the productivity of research projects that resulted in published articles affiliated with Shiraz University of Medical Sciences. The cost of each project was considered as the input, while the number of publications, journal impact factor, quartile ranking, and indexing score were considered output indicators. In the present study, more than half (56.7%) of the principal investigators of research projects were men. In the study by Tamblyn et al. (2018), the majority of research grant applicants in Canada were also men (66.2%) (20). In the study by Pagel (2015) conducted in the United States, women also had fewer publications than men (21). The results of the present study were consistent with those of other studies. In addition to conducting research projects and writing articles, female faculty members also have household responsibilities, limiting their academic writing time. On the other hand, male faculty members tend to view article writing as a primary part of their profession, which may lead to higher research output and a greater number of publications.

In our study, 674,802.40 USD was allocated to 487 research projects, averaging approximately 1,385.63 USD per project. In contrast, the Foundation for Anesthesia Education and Research (FAER) in the United States awarded 391 grants amounting to 448.44 million USD—a clear indication of the substantial investment in anesthesiology research in high-income countries. Such funding mechanisms have significantly supported academic advancement and research productivity in anesthesiology (21). According to a study by Gahramani et al. (2021), there is a statistically significant positive correlation between the volume of research funding and faculty research output, indicating that financial support is a motivating factor that enhances academic performance (19). While some countries in the Eastern Mediterranean Region have increased their investment in research—for example, Iran's gross domestic expenditure on research and development (GERD) rose from 0.59% in 2006 to approximately 4% in recent years—the share explicitly dedicated to health research remains limited (22, 23). This underscores the need for strategic priority-setting to ensure that available resources are directed toward national and regional health needs, as highlighted in WHO recommendations and supported by empirical evidence on the link between investment alignment and health system performance (22).

The highest average cost per research project was associated with postdoctoral projects (9,735.42 USD), PhD by research projects (4,093.10 USD), and projects from the Faculty of Advanced Sciences and Technologies (3,333.94 USD). The lowest average cost per research project was related to thesis-based projects (535.48 USD) and projects from the School of Dentistry (751.12 USD). The findings of this study are reasonable, as research projects at higher and postgraduate levels are generally more specialized and costly. Moreover, projects from the School of Advanced Sciences and Technologies are typically applied and product-oriented, often requiring laboratory activities and advanced and expensive materials and equipment, demanding higher funding. On the other hand, thesis-based projects and projects from the School of Dentistry are usually presented as part of the curriculum for medical and dental students. These studies are often questionnaire-based and descriptive, thus not very costly.

The highest average cost per research score was associated with projects from the School of Paramedical Sciences (9,976.03 USD) and postdoctoral projects (3,736.56 USD). The lowest average cost per research score was related to Student Research Committee projects (501.7 USD) and grant-based projects (510.3 USD). In a study by Jamali et al. (2014), the scientific output of faculty members from the School of Paramedical Sciences at Mashhad University of Medical Sciences was analyzed based on the number of publications indexed in the Scopus database. Their findings indicated that the Optometry and Laboratory Sciences groups had the largest share of the school's research output (24). The university's policies regarding

the payment structure for research project costs may influence the points awarded. Specifically, grant projects are paid in two installments, with the second installment contingent on the publication of an article. This approach may have incentivized and motivated researchers to publish articles related to these projects. A plausible explanation for this is the institutional requirement for postdoctoral researchers to publish at least one article to graduate. This requirement likely incentivizes a greater time, effort, and resource investment to ensure successful publication, increasing the cost per research point. Moreover, postdoctoral projects often involve more advanced, specialized, or experimental research, which tends to be resource-intensive. Therefore, the publication requirement, combined with the complexity of postdoctoral research, likely contributes to the elevated cost per unit of research output.

Financial resource allocation mechanisms directly impact higher education, motivating faculty to improve performance in competitive environments and enhance research quality, and indirectly, inform research policymaking, increase accountability, improve efficiency, reduce inequalities, and address societal needs. Knowledge production and scientific advancement through research projects are fundamental missions of universities, and the efficiency of academic research systems depends heavily on the quantity and quality of inputs, particularly research funding and its allocation (19). Financing academic research is crucial, as research budgets influence research direction and development. The funding structure should align with societal needs and each country's conditions and institutional context (25). Research grants are specific portions of university budgets allocated to faculty to support research activities. While the overarching goal of funding is consistent across institutions, allocation and utilization methods vary based on each university's internal policies. University research management focuses on three key areas: securing research funds, developing allocation systems, and supervising and refining financial oversight. Friedman has highlighted the various dimensions of research funding in higher education. At the same time, Leefner (2003) and Spatis (2004) pointed to the growing role of private and non-governmental sectors in financing research and awarding grants to distinguished faculty (26, 27). Buttel's (1986) study explored university-industry collaboration in funding faculty research (28). In medical education, research productivity is typically measured by the number of publications assessed through bibliometric methods (23). However, evaluating research outcomes solely based on the number of published articles is not sufficient. Rather, assessing the quality of these publications, their ability to address regional issues, and their impact on public health is also essential.

This study's key strength lies in its quantitative, indicator-based approach to evaluating research productivity, using metrics like publication count, journal impact factor, quartile ranking, and indexing score. Including cost as an input adds realism to the analysis. However, limitations include its focus on a single university, a one-year time frame, and the exclusion of qualitative factors like researcher experience and institutional support. Additionally, using the official exchange rate may distort international comparisons. Future research should use multi-year, multi-institutional data and incorporate qualitative indicators for a more comprehensive assessment.

Conclusion

The study's findings show a significant variation in research productivity relative to funding across different projects and university departments. Projects from the School of Paramedical Sciences and postdoctoral research, while contributing to the overall research output, were associated with the highest costs per research score, highlighting potential inefficiencies in resource utilization. In contrast, the Student Research Committee and grant-based projects yielded more productivity outcomes, suggesting that these funding models offer better returns on investment. Future policy decisions should consider these disparities to ensure limited financial resources are directed toward the most effective and sustainable research activities.

Ethical Approval

This study was approved by the Ethics Committee of Shiraz University of Medical Sciences (Ethics Code: IR.SUMS.REC.1394.166).

Conflict of Interest

There are no conflicts of interest.

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