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Original Article

Job satisfaction and rate of return on investment among pharmacology and toxicology PhD graduates in Iran: A cross-sectional study

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Abstract

Background: Job satisfaction has a profound impact on productivity, retention, and overall performance in specialized fields such as pharmacology and toxicology. Understanding the determinants of job satisfaction and the rate of return on investment (ROR) for advanced education in these disciplines is crucial for aligning educational programs with workforce demands and improving healthcare outcomes.

Methods: This cross-sectional quantitative study surveyed 60 PhD graduates (39 pharmacology, 21 toxicology) from Iran, who completed their programs within the past four years. Participants were selected via simple random sampling using Cochran's formula. Data, collected through an online questionnaire, covered demographics, employment status, job satisfaction, income alignment, and educational expenses. ROR was calculated using a standardized formula. Data analysis was performed using SPSS version 21.

Results: Mean job satisfaction scores were 2.03 (±0.52) for income-related items in pharmacology and 1.68 (±0.48) in toxicology graduates, indicating significant dissatisfaction. Satisfaction with professional associations was 1.95 (±0.44) for pharmacology and 1.32 (±0.51) for toxicology. Job content/identity and PhD relevance domains showed average satisfaction, with scores ranging from 2.98–3.64. The calculated ROR was 2.33% for pharmacology and 2.12% for toxicology graduates, reflecting full recovery of educational investments within four years.

Conclusion: The results highlight an urgent need for structural improvements in educational and professional systems to increase job satisfaction among pharmacology and toxicology PhD graduates. Addressing income disparities and strengthening the alignment between academic curricula and industry requirements are vital steps to cultivate a more motivated and effective pharmaceutical workforce, with positive implications for healthcare delivery and patient outcomes.

Introduction

Job satisfaction is a vital concept reflecting an individual's emotions and attitudes toward their employment, directly influencing workplace performance and productivity. It is shaped by factors including working conditions, interpersonal dynamics, career advancement opportunities, work-life balance, compensation, job responsibilities, management, organizational culture, and individual self-worth.[1-3]

Pharmacology and toxicology are specialized fields within pharmaceutical and medical sciences, crucial for public health and patient quality of life. Professionals in these areas contribute significantly to drug development, from research to clinical application, across academic institutions, pharmaceutical companies, regulatory bodies, and healthcare organizations. Diverse career paths, including teaching, research, clinical consulting, and drug safety, enable meaningful contributions. However, dissatisfaction can lead to reduced motivation, decreased productivity, increased turnover, and career changes, negatively affecting patient care quality.[4,5] Such dissatisfaction may also deter new graduates, further straining healthcare systems.[6]

Return on investment (ROR) is an economic indicator measuring income generated relative to costs. In education, ROR assesses financial benefits from academic

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investment against tuition and opportunity costs. This metric guides students in academic and career decisions and informs educational policymakers.[7,8] Analyzing ROR helps identify high-demand fields with substantial returns, guiding academic policies and resource allocation to enhance education and research quality.[9,10]

Examining job satisfaction and ROR in pharmacology and toxicology provides valuable insights into these disciplines' educational and professional frameworks. Assessing job satisfaction identifies strengths and weaknesses in workplace environments, to guide human resource strategies to enhance patient care and attract talent.[11,12] ROR analysis empowers students with informed choices and enables policymakers to allocate resources strategically. Thus, investigating job satisfaction and ROR can significantly improve education and research quality in pharmacology and toxicology, ultimately advancing healthcare systems and patient outcomes. This study systematically explores job satisfaction and ROR levels within these fields, considering current challenges.

Methods

This cross-sectional, descriptive-analytical survey was conducted in Iran among employed PhD graduates in pharmacology and toxicology who had completed their studies within the past four years. The sampling frame was developed using two sources: (1) the alumni email list of Tehran University of Medical Sciences (TUMS), the largest national training center in these fields; and (2) the membership directories of the Iranian Society of Pharmacology and the Iranian Society of Toxicology, which include graduates from multiple universities across the country.

Although these sources provided the most comprehensive accessible list of recent graduates, individuals not affiliated with these networks may have been missed. A total of 138 pharmacology and 122 toxicology graduates were identified. Using Cochran's formula for finite populations and a computer-generated random number sequence, 39 pharmacology and 21 toxicology graduates were selected through simple random sampling.

An online questionnaire was distributed to all selected participants. Two follow-up email reminders were sent at one-week intervals. No incentives were provided, and no participants were excluded. All selected individuals completed the questionnaire, resulting in a 100% response rate.

Data Collection Tools

Data were collected from September to November 2023 using a five-section questionnaire[13]:

1. Demographic information: Included age, gender, marital status, number of children, PhD university, graduation year, employment province, and PhD program entry year.
2. Employment details: Information on job titles, workplaces, employment mode (full-time/part-time), and employment duration.
3. Job satisfaction: Items adapted from a validated questionnaire by Foroughi Moghadam et al assessing pharmacists' job satisfaction in Iran. Items included: "How satisfied are you with your income level?" "How satisfied are you with your professional association?", and "How optimistic are you about your professional future?" Since our study used the same items without modification, psychometric testing was not repeated.[14]
4. Income and social status: Adapted from Foroughi Moghadam et al,[14] assessing perceived appropriateness of income relative to knowledge and position, fairness of income compared to other medical professions, adequacy of income for living expenses, and alignment between current position and initial PhD expectations.
5. Financial expenditures: Developed based on Carvajal and Popovici, collecting data on expenses during the PhD program (tuition, accommodation, food, transportation) and monthly income during the first four years post-graduation to calculate ROR.[13]

Data Analysis

Descriptive statistics, including frequency tables, summarized demographic and employment data. Although Likert-scale items are ordinal, composite scores for job satisfaction were treated as continuous variables, consistent with established social science practice for multi-item scales.

Normality of all variables—including age and job satisfaction scores for subgroups (gender, presence of children, pharmacy ownership, and employment in a pharmacy)—was assessed using the Kolmogorov-Smirnov test. All variables were approximately normally distributed ($P > 0.05$).

Based on these results, parametric analyses were applied: one-sample t-tests, independent t-tests, and Pearson correlation coefficients. Non-parametric alternatives were considered, but parametric tests were used due to their robustness with multi-item scales showing near-normal distributions.

Rate of Return Calculation Method

The ROR was calculated using the equation proposed by Carvajal and Popovici for pharmacy education, which determines ROR.[13] The equation below, where Bt represents income received in year t, Ct denotes costs incurred in year t, r is the ROR, and t is time spent in education, was solved for ROR using Maple 2022 software.

In our study, costs included tuition fees, accommodation, and living expenses incurred during the PhD program, while benefits were defined as the net income earned by graduates during the first four years following graduation.

Inflation and exchange rate fluctuations were excluded to maintain focus on real domestic returns in the Iranian context. Opportunity costs (i.e., potential earnings if graduates had entered the workforce earlier) were not included due to a lack of reliable data.

$$\sum_{t=1}^{n} \frac{B_t - C_t}{(1+r)^t} = 0$$

Ethical Considerations

This study was registered with the ethical codes of the IR.ABZUMS.REC.1401.268 and IR.ABZUMS.REC.1401.266. Participants were informed of study objectives, and electronic informed consent was obtained. Data were recorded and presented in a coded format to ensure participant anonymity.

Results

Participants

A total of 60 PhD graduates participated: 39 pharmacology and 21 toxicology. Males predominated in the toxicology group, while pharmacology had a more balanced gender distribution. Pharmacy founders and those employed in pharmacies were more common in the pharmacology group. Most participants in both groups were neither founders nor pharmacy employees (Table 1).

Job Satisfaction

Table 2 presents a condensed summary of job satisfaction among employed Pharmacology and Toxicology PhD graduates, including mean scores, significance after Bonferroni correction, and effect sizes (Cohen's d). Domains were grouped as follows: Income-related, Professional associations, Job content/identity, and PhD relevance. The full list of questionnaire items is provided in Table S1 (Supplementary file 1).

Income-related domain: Pharmacology graduates reported significant dissatisfaction across all income-related items, including "satisfaction with income level," "appropriateness of income relative to position and knowledge," "fairness of income compared to other medical professions," and "adequacy of income for basic living needs" (mean 2.03, Cohen's d = -1.04, $P < 0.05$). Similarly, toxicology graduates expressed significant dissatisfaction on the same items (mean 1.68, Cohen's d = -1.49, $P < 0.05$).

Professional associations: Satisfaction with professional associations was significantly below average for both pharmacology (mean 1.95, d = -1.08) and toxicology graduates (mean 1.32, d = -2.24, $P < 0.05$).

Job content/identity: Among pharmacology graduates, "satisfaction with being a specialist" and "perceived need to revise current professional position" were significantly above average ($P < 0.05$), while other items—including overall job satisfaction, satisfaction with job position, job security, professional future outlook, and alignment between current and expected positions—showed average satisfaction ($P > 0.05$). For toxicology graduates, items such as overall job satisfaction, job position satisfaction, job security, and specialist identity also indicated average satisfaction ($P > 0.05$). Effect sizes were small for both groups (Pharmacology: d = 0.12; Toxicology: d = -0.21), suggesting limited practical differences in this domain.

PhD relevance: Toxicology graduates rated the relevance of PhD coursework to their current job significantly above average (mean 3.64, d = 0.44, $P < 0.05$), while pharmacology graduates reported moderate satisfaction (mean 3.38, d = 0.31, $P > 0.05$). Detailed item-level statistics are provided in Table S2 (Supplementary file 1).

ROR

The real rates of return (excluding inflation and exchange rate fluctuations) were 2.33% for pharmacology and 2.12% for toxicology graduates (Table 3), indicating full recovery of initial educational costs within four years.

Table 1. Frequency Distribution of Demographic Variables of Pharmacology and Toxicology Graduates

Variables	Pharmacology		Toxicology	
	No.	%	No.	%
Sex				
Female	19	48.7	6	28
Male	20	51.3	15	72
Pharmacy founder				
Yes	13	33.3	3	14
No	26	66.7	18	86
Employed in pharmacy				
Yes	15	38.5	4	19
No	24	61.5	17	81

Table 2. Summary of job satisfaction domains among pharmacology and toxicology PhD graduates

Domain	Question (Representative)	Pharmacology			Toxicology		
		Mean	Significant (Bonferroni)	Cohen's d	Mean	Significant (Bonferroni)	Cohen's d
Income-related	Satisfaction with income / Fairness / Adequacy	2.03	Yes	-1.04	1.68	Yes	-1.49
Professional associations	Satisfaction with professional association	1.95	Yes	-1.08	1.32	Yes	-2.24
Job content/identity	Satisfaction with being a specialist / Hope for the future / Match with expectations	3.51	No	0.12	2.98	No	-0.21
PhD relevance	Relevance of PhD coursework to a job	3.38	No	0.31	3.64	No	0.44

Table 3. Average costs, benefits, and net returns of pharmacology and toxicology graduates in the first four years post-graduation (in thousand Rials)

Year	Toxicology			Pharmacology		
	B_t-C_t	C_t	B_t	B_t-C_t	C_t	B_t
First	7252.74	3472.62	10725.36	2072.92	2150.25	4223.17
Second	7987.07	3964.29	11951.36	2931.18	3245.15	6176.33
Third	11109.41	4869.05	15978.46	6162.48	3712.80	9875.28
Fourth	12623.00	6166.67	18789.67	7846.25	4000.74	11846.99

Bt: Benefits (net income received in year *t* post-graduation), **Ct:** Costs (tuition, accommodation, and living expenses in year *t* of the PhD program), **Bt – Ct:** Net financial gain in year *t*, **Notes:** Inflation and exchange rate fluctuations were excluded to focus on real domestic returns. Opportunity costs were not included due to a lack of reliable data. The ROR was calculated using these values as described in Section 2.3.

Pharmacology graduates earned 133% of their investment, while toxicology graduates earned 112%.

Discussion

The evolving role of pharmacologists and pharmacists in healthcare systems underscores the increasing importance of job satisfaction for workforce performance and retention.[14] Their responsibilities now include clinical decision-making, patient counseling, and interprofessional collaboration, necessitating supportive work environments that acknowledge their contributions to patient care.[15]

Our study reveals a complex satisfaction pattern among pharmacology and toxicology PhD graduates. Income-related dissatisfaction was the primary concern. Pharmacology graduates reported significant dissatisfaction regarding income level, appropriateness of income relative to position/knowledge, fairness compared to other medical professions, and adequacy for basic needs, while toxicology graduates exhibited even larger negative effects. Satisfaction with professional associations was notably low for both groups.[5,14]

Despite this, they reported above-average satisfaction with being a pharmacology specialist and a perceived need to revise their professional position, alongside average job security and overall job satisfaction. Similarly, toxicology graduates expressed significant dissatisfaction with income, professional associations, and professional future prospects. However, they found their PhD coursework highly relevant to their current jobs,[16] while overall job satisfaction, job position, job security, and specialist identity were rated as average. These findings suggest that intrinsic motivation, professional identity, and alignment with PhD training may buffer some negative effects of income and organizational dissatisfaction, consistent with small effect sizes observed in the Job content/identity domain.[17]

The contrast between low financial satisfaction and average general job contentment suggests that intrinsic motivation and professional identity buffer negative financial effects.[18,19] According to Deci and Ryan's self-determination theory, intrinsic motivation enhances engagement even when extrinsic rewards are limited.[20,21] Additionally, studies on healthcare professionals highlight that a strong professional identity can sustain engagement despite economic concerns. Positive specialist identity may thus sustain engagement despite income concerns, highlighting the importance of non-monetary factors.[22]

Economic analyses provide further context. Real rates of return (ROR) were 2.33% for pharmacology and 2.12% for toxicology graduates, indicating full recovery of educational investments within four years. Pharmacology graduates achieved a 133% return and toxicology 112% over initial costs. The relatively low ROR among Iranian PhD graduates may reflect structural labor market factors, including lower starting salaries, delayed financial benefits, and national wage distribution patterns.[23] While these rates suggest long-term financial viability, initial income dissatisfaction may explain some negative perceptions, emphasizing the need for early career support, mentorship, and financial planning.[13]

Workload and organizational factors also influence job satisfaction and stress. High workload, inadequate staffing, and administrative burdens contribute to pharmacist burnout.[24,25] Although our study did not measure workload, average satisfaction with job security and future outlook might reflect stable conditions. These factors warrant future research due to their known impact on well-being.[25] Leadership style and workplace culture are also crucial; transformational leadership is linked to improved satisfaction and retention.[26] Given the below-average satisfaction with professional associations in our cohort, strengthening their support and advocacy roles could enhance professional fulfillment.[27] Additionally, considering sociodemographic variables (age, gender, career stage) could enable targeted interventions, as they heterogeneously influence job satisfaction.

This study has several limitations that should be considered. The cross-sectional design precludes causal inference, and reliance on self-reported data may introduce recall bias. The relatively small sample size may limit generalizability to all pharmacology and toxicology graduates in Iran. Furthermore, the opportunity costs of delayed workforce entry were not included in ROR calculations. Future studies should address these limitations by employing longitudinal designs, larger samples, and more comprehensive economic modeling.

Ultimately, enhancing job satisfaction among

pharmacology and toxicology graduates is vital for improving patient care outcomes through increased engagement, motivation, and retention. Healthcare systems and academic institutions should implement multifaceted strategies addressing financial concerns, professional development, leadership support, and workload management to optimize these professionals' contributions to healthcare delivery.

Conclusion

This study underscores a critical need for systemic improvements in both educational and professional landscapes for pharmacology and toxicology PhD graduates in Iran. Findings demonstrate how to moderate job satisfaction, primarily driven by income disparities and perceived mismatch between academic training and labor market realities. While ROR calculations suggest long-term recovery of educational costs, the modest percentages highlight limited immediate financial benefits for advanced degrees in these fields. Addressing income disparities, strengthening professional organizations, and enhancing curriculum alignment with industry demands are crucial. Implementing multifaceted strategies to improve job satisfaction will cultivate a more motivated and effective pharmaceutical workforce, ultimately benefiting healthcare delivery and patient outcomes.

Limitations

The sampling frame included only TUMS alumni and members of two professional societies, which may have missed graduates outside these networks and introduced selection bias. The 100% response rate, although achieved through follow-up reminders, is unusual for online surveys and may reflect participation bias. Additionally, the cross-sectional design limits causal inference and generalizability.

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Authors' Contribution

Conceptualization: Sevda Shayesteh, Zahra Sharif, Reza Shahi.
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Competing Interests

The authors declare no conflict of interest.

Ethical Approval

The project was determined to comply with ethical principles, national norms, and standards for conducting medical research in Iran. This study was registered with the ethical codes of the IR.ABZUMS.REC.1401.268 and IR.ABZUMS.REC.1401.266.

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Supplementary Files

Supplementary file 1 contains Tables S1-S2.

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