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RESEARCH ARTICLE

INVESTIGATION OF GLASS CEILING SYNDROME AMONG RADIATION PROFESSIONALS: A COMPARATIVE ANALYSIS

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ABSTRACT

Background and Purpose: This study investigates the perception of the glass ceiling syndrome among radiology, nuclear medicine, and radiation oncology technicians in healthcare institutions in Turkey.
Methods: A comparative approach was used to examine the prevalence and impact of the glass ceiling on female workers. Data was collected via questionnaires from 311 participants in Turkey, and analyzed using descriptive statistics, chi-square analysis, and independent sample tests.
Results: The results indicate that 78.1% of the participants were women, 64% were medical imaging technicians and 65.3% were employed in private institutions. A significant difference was found in the total and subscale scores of the glass ceiling scale (excluding mentoring) based on gender ($p<0.05$).
Conclusion: This study enhances understanding of gender dynamics among radiation workers and highlights the need for targeted interventions to address the glass ceiling syndrome. The findings provide key insights for promoting workforce equity and organizational development in healthcare institutions.

Keywords: Gender disparities, radiology, nuclear medicine, radiation oncology, glass ceiling syndrome

INTRODUCTION

The term "glass ceiling syndrome (GCS)" refers to the invisible barriers that impede the career advancement of women and minority groups in the workforce, encompassing social, organizational, and individual factors. These deep-rooted prejudices hinder the professional development of these underrepresented groups, reflecting discrimination related gender and racial origins, as well as to disability, age, and sexual orientation.

The term "glass ceiling," originating in the United States during the 1970s, serves as a powerful metaphor to describe the unseen yet significant barriers encountered by individuals aspiring to reach leadership roles within organizations (1). Initially, the glass ceiling primarily refered to the challenges faced by women, but it later evolved to encompass a variety of dimensions, including discrimination based on race, disability, age, and sexual orientation. This phenomenon underscores the persistence of barriers that impede the upward mobility of women and minority groups, perpetuating inequality within organizational hierarchies.

The GCS is not merely a manifestation of individual limitations but a systemic issue rooted in attitudinal and organizational biases. Defined as "attitudinal or organizational biases that prevent qualified individuals from advancing to management-level positions", the glass ceiling reflects deep-seated prejudices that obstruct the professional growth of underrepresented groups. Some studies emphasize its various dimensions, including disability, age, and sexual orientation, alongside gender and racial inequality (2). Yıldız et al. reported a bias against female employees in the information technology sector, with male counterparts asserting that women will encounter significant challenges in this field (3). A similar study revealed the effects of gender discrimination, one of the problems working women face regarding promotion, on GCS (4). Gül and Oktay (2009) illustrate how married women, whether mothers or not, experience fewer promotional opportunities and rewards compared to their male counterparts, elucidating the intersectional nature of the glass ceiling (5). Cortis and Cassar (2005) highlight that the barriers encapsulated by the term "glass ceiling" are often difficult to identify and address explicitly (6).

Despite advancements in education and shifts in societal perceptions of gender roles, women continue to face significant disparities in career progression compared to their male counterparts, particularly in leadership positions. In Turkey, and in many other regions worldwide, women are markedly underrepresented in management positions across diverse sectors, including healthcare. This disparity is pronounced among female healthcare workers in radiation-related fields such as radiology, nuclear medicine, and radiation oncology, in which women encounter multiple barriers, ranging from organizational biases and cultural stereotypes to a lack of mentorship and support.

This research aims to evaluate the perception of the glass ceiling among female healthcare professionals in healthcare institutions in Turkey, in fields such as radiology, nuclear medicine, and radiation oncology and seeks to identify the specific obstacles contributing to the GCS. By revealing the relationship between socioeconomic status and the sub-dimensions of the GCS, this study provides insights into the factors that perpetuate gender inequality in radiation-related fields**.** The study aim to shed light on the underlying factors contributing to this effect, and contribute to foster a more inclusive and equitable work environment for female healthcare professionals in Turkey.

MATERIAL METHOD

Study Group

The research was reviewed and approved by Izmir Economy University, Health Sciences Research Ethics Committee (Date: 06.08.2024, Decision No: B.30.2.IEUSB.0.05.05-20-306). Power analysis was used to decide the size of the sample, which was drawn from employees the public and private sectors. The analysis determined a sample size of approximately 311 using simple random sampling, where the bound of error coefficient obtained from previous studies was 0.2 and the population variance was 4, with a total population of 1512 radiation professionals.

The prevalence and impact of GCS was evaluated with employees working in three fields, radiology, nuclear medicine, and radiation oncology departments in both private (205, 65.9%) and public (105, 34.7%) institutions in different provinces of Turkey. Accordingly, the sample consists of 243 female (78.1%) and 68 male (21.9%) radiation workers. The majority, 200 participants (64.3%) had an associate degree. The distribution of professional roles within the sample is as follows: 199 (64%) were medical imaging technicians, 84 (27%) were radiotherapy technicians, 22 (7.1%) were radiation safety officers and 11(3.5%) were nuclear medicine technician. Strikingly, only 36 (11.6%) occupied managerial positions.

Glass Ceiling Scale Data Collection and Analysis

For the purposes of this research, following an extensive review of the relevant literature, a survey form was meticulously designed. The survey was administered to radiation workers between March 6 and April 18, 2024. Participants completed the survey online, and their participation was entirely voluntary.

The survey instrument comprised two sections. The first section contained questions about socio-demographic characteristics, and the second included questions designed to measure perceptions of the GCS. The responses were given using a 5-point Likert scale. Following a preliminary review of the dataset, responses were coded such that ‘I Strongly Disagree’ was assigned a value of 5 points. Reverse-coded items (questions 13-22) were adjusted accordingly, ensuring that higher scores indicated a higher level of perceived GCS. The full

Table 1. Cronbach's Alpha Coefficient of GCS and subscales

Scales	C Alpha Coefficient
All questions (GCS) (1-30)	0.785
TMR: Taking on Multiple Roles (1-5)	0.851
WPP: Women's Personal Preferences and Perceptions (6-12)	0.871
PIC: Perceptions of Informal Communication (13-15)	0.728
PD: Professional Discrimination (16-19)	0.886
M: Mentoring (20-22)	0.873
P: Prejudice (23-30)	0.924

questionnaire has been included as supplementary file (Appx 1).

Data were initially classified as discrete and continuous (n=311). The survey instrument was subsequently divided into subscales, and the reliability of the instrument was evaluated using Cronbach's alpha coefficient (Table 1). We calculated frequency tables (f, %) of categorical variables (Table 2) and descriptive statistics (mean ± std) of continuous variables of scores and demographic characteristics (Table 3). The normality of the continuous subscales was evaluated using the Kolmogorov-Smirnov test, which guided the determination of hypothesis testing methods. Hypotheses were tested using an independent two-sample t-test, which was applied to the total score of the GCS, while the Mann-Whitney U test was utilized for the subscales and other variables. Spearman and Pearson correlation coefficients were used according to the normality test and scale. All statistical analyses were performed using IBM SPSS 26.0 software. Although the significance level is generally set as 5%, it can also be set as 10% in some special cases (α = 0.05 and α = 0.10).

RESULTS

In the study examining radiation professionals' GCS, the internal consistency coefficient (Cronbach Alpha Coefficient) was first examined as the validity and reliability coefficient of the survey (Table 1). High Cronbach Alpha Coefficient values were found for the entire questionnaire and each subscale (r>0.70). This coefficient was used to examine whether the 30 questions in the scale collectively explained a homogeneous structure. A higher alpha value (maximum of 1) indicates that the scale itemsare consistent and measure the same construct.

In the first part of the survey, a frequency table of the radiation workers' demographic characteristics was created (Table 2). The majority in the sample were women (78.1%), predominantly employed as medical imaging technicians (64%) in private institutions (65.3%). This high percentage of women is one of the limitations of the study; however, this reflects the wider trends workers in this field throughout Türkiye.

Within the 30-item Glass Ceiling Scale, questions related to perceptions of informal communication (PIC), professional discrimination (PD), and mentoring (M) were reverse-coded. For the analysis, these items were re-coded before performing

Table 2. Descriptive statistics of discrete variables f (%)

Variables	f (%)	Variables	f (%)
Gender		**Institution**	
Female	243 (78.1)	Public	108 (34.7)
Male	68 (21.9)	Private	203 (65.3)
Management		**Education**	**f (%)**
Yes	277 (89.1)	High school	56 (18.0)
No	34 (10.9)	Bachelor's degree	198 (63.7)
Children		Associate degree	40 (12.9)
Yes	235 (75.6)	Postgraduate	17 (5.5)
No	76 (24.4)	**Position**	**f (%)**
Marital Status		Radiation Safety Officer	18 (5.8)
Married	94 (30.2)	Radiotherapy Technician	83 (26.7)
Single	207 (66.6)	Medical Imaging Technician	199 (64.0)
Divorced	10 (3.2)	Nuclear Medicine Technician	11 (3.5)

Table 3. Descriptive Statistics of Variables, GCS and Subscales

Variables	X±Sd (Median)	Min-Max
Age	27.29±8.72	18-57
Experience	6.15±7.93	1-32
Management	4.86±4.72	0-20
GCS	106.95±13.85 (108)	67-150
TMR: Taking on multiple roles	18.28±5.15 (19)	5-25
WPP: Women's personal preferences and perceptions	28.06±5.96 (29)	7-35
PIC: Perceptions of Informal Communication	8.39±3.40 (8)	3-15
PD: Professional Discrimination	11.07±4.91 (11)	4-20
M: Mentoring	7.51±3.52 (7)	3-15
P: Prejudice	33.62±7.08 (6)	8-40

statistical calculations. Consequently, a higher score on the Glass Ceiling Scale indicates a greater perception of obstacles, discrimination, difficulties, and prejudice, thereby reflecting a stronger perception of the GCS. The possible GCS scale scores range between 30 and 150, and scores closer to 150 indicates a greater perception of obstacles, discrimination, difficulties and prejudice.

The average score on the Glass Ceiling Scale was approximately 107 (106.95 ± 13.85). The average age of the participants was 27.29 years, their average length of professional experience was 6.15 years, and the average time spent in managerial positions was 4.86 years (Table 3).

An examination of the correlation coefficients between the scales and variables using the correlation matrix (Spearman correlation) revealed that gender was the only variable significantly associated with both the GCS and its subscales, except for Mentoring (Table 4). However, a noteworthy case emerged regarding the PIC and PD variables. Although these variables were not statistically significant at the 0.05 level, their p-values were very close to this threshold. Consequently, a significance level of 0.10 was considered appropriate. From a statistical point of view, this relationship is expected to become stronger as the sample size increases. In such large samples, there is a high probability that a significant relationship will emerge between these two variables and gender. No significant correlations were observed in the correlation matrices (Spearman and Pearson) between GCS and its subscale scores and any other variable except for gender. Therefore, in alignment with the study's objectives, statistical analyses primarily focused on the role of gender.

The Kolmogorov-Smirnov test, conducted with a 5% error margin, indicated that only the total score (GCS) followed a normal distribution ($p > 0.05$), and not the other subscales ($p<0.05$). It should be noted that in this test, the H_0 hypothesis established that the data came from a normal distribution. In this case, rejecting the H_0 hypothesis indicates that the data did not come from a normal distribution and non-parametric tests should be used. In particular, normal distribution was not found for the variables of age, experience, and years in management($p<0.05$). Consequently, an independent two-sample t-test was conducted to determine whether the mean GCS score differed between gender groups. To assess whether the mean subscale scores varied between the groups, an independent two-sample Mann-Whitney U test, a non-parametric test, was performed (Table 5).

Hypothesis tests were conducted to identify the differences between the gender groups in GCS and subscale scores, and t-test showed a statistical difference according to gender in GCS means ($p <$

Table 4. Correlation values (r) of scales with gender

Correlation (Gender)	p-value	r
GCS	0.000*	-0.439
TMR: Taking on multiple roles	0.001*	-0.191
WPP: Women's personal preferences and perceptions	0.023*	-0.129
PIC: Perceptions of Informal Communication	0.052**	-0.110
PD: Professional Discrimination	0.051**	-0.111
M: Mentoring	0.166	-0.079
P: Prejudice	0.000*	-0.357
p: *<0.05, **<0.10		

Table 5. Hypothesis tests of the Glass Ceiling Scale and its subscales

	Female (f=243) X±Sd(M)	Male (f=68) X±Sd(M)	Test value	p-value
GCS	110.06±12.54(110)	95.82±12.61(95)	8.27*	0.000*
TMR: Taking on multiple roles	18.81±4.92(19)	16.37±5.50(16)	6069.5**	0.001*
WPP: Women's personal preferences & perceptions	28.56±5.53(29)	26.28±7.06(28)	5783.5**	0.023*
PIC: Perceptions of Informal Communication	8.58±3.37(9)	7.72±3.45(7.5)	6993.5**	0.052**
PD: Professional Discrimination	11.37±5.02(11)	10.00±4.39(9.5)	6989.0**	0.051**
M: Mentoring	7.67±3.59(7)	6.94±3.25(6.0)	7360.0**	0.165
P: Prejudice	35.05±6.11(37)	28.52±7.98(30.0)	4200.5**	0.000*

p-value: *<0.05, **<0.10; Test value: * t test, ** Mann Whitney U test

0.05). In addition, the results of this test showed that women (110.06) had higher scores than men (95.82). Similarly, a statistical difference based on gender in subscale score medians was determined using Mann Whitney U test. A difference was observed based on gender, particularly in taking on multiple roles (TMR), women's personal preferences and perceptions (WPP) and P subscale medians, showing that this perception was higher in women ($p < 0.05$). No difference was observed based on gender in M subscale median ($p > 0.05$), but the difference based on gender in PIC and PD subscale medians only narrowly exceeded the 5% significance level and reached a statistically acceptable result at 10%. Here, it was concluded that women had a higher perception than men.

Since only gender had a relationship with the GCS score, it was decided not to examine the statistical differences between the groups for other categorical variables. This study reveals that gender plays an important role in the perception of the glass ceiling, and that women have higher GCS perception in all subscales except mentoring (M). However, unlike gender, GCS perception is not related to position, education, institution, age, experience or length of management experience.

DISCUSSION

Despite the increase in the number of women in the workforce in Turkey and globally, they continue to face significant barriers to reaching senior management positions. According to TUIK (Turkish Statistical Institute) 2022 data, 79.3 percent of managerial positions in Turkey are held by men, and only 20.7 percent by women (7). The United Nations Gender Social Norms Index Report further highlights that gender biases persist worldwide, even in developed countries (8).

In this study, 76% of the 311 participants agreed or strongly agreed that women's career development was negatively impacted by societal norms assigning excessive familial responsibilities to women. The dual burden of family roles and the demanding work tempo of managerial positions hinders women's career progression, and advancement is further affected by maternal duties, which often result in prolonged absences from the workplace. Similar findings were reported by Öztürk and Bilkay (2016), who concluded that women bear a disproportionate share of family responsibilities, leading to a higher likelihood of men occupying senior management positions (9). Additionally, Kıraç et al. found that, among female employees, 63.7% believed that women should be given more opportunities for promotion, 46.4% believed that women were assigned too many family responsibilities, and 32.8% believed that senior management positions were more often given to men (10). Kılıç and Çakıcı (2016) found that married women have a lower perception of the GCS compared to single women, and that the perceived impact of "Family Life," a sub-dimension of the GCS, was found to vary according to profession, age, and number of children (11).

Age is another factor influencing the perception of the glass ceiling. Kurtaran et al. found that female healthcare workers under 25 and those aged 26-35 experienced greater occupational discrimination, compared to those aged 46-55 (12). Additionally, female healthcare workers with higher levels of education reported more professional discrimination than those educated to only primary level.

In this study, it was determined that radiation workers, especially women, had high glass ceiling scale scores, both overall, and in all subscales. Statistically, it was found that gender discrimination was found in all except the mentoring (M) subscale of the glass ceiling scale score.

Several factors contribute to women's greater difficulty in competing for high-level positions. One critical factor is the misalignment between social expectations of the role of women and the realities of working life. Women often face obstacles such as responsibilities towards their spouses and children, which may conflict with the demands of work-related travel, prolonged meetings, and professional social events (13).

Chapman et al. emphasized that career development for female radiation oncology specialists is adversely affected by gender discrimination and societal gender perceptions in Japan and the United States (14). Thus, even in technologically advanced countries, this discrimination reflects social injustice and negatively impacts scientific progress and patient outcomes.

Many studies worldwide indicate that women in the health sector receive lower salaries and have fewer promotion opportunities than men (15-17). Research in Turkey confirms that GCS is prevalent in the healthcare sector, making it difficult for women to reach managerial positions. Despite women's high labor force participation rate in the health sector, their representation at management levels remains low. This study further supports these findings, demonstrating that women in radiation-related fields face significant barriers, particularly in informal communication and professional discrimination, which often hinder their upward mobility. Similarly, Çankaya and Çiftçi's (2022) study explores the prevalence of GCS in healthcare and its effects on female employees (18). Kalafatoğlu and Torun (2022) analyze the difficulties and gender wage gaps that women face in reaching managerial positions in healthcare (19). A previous study, Soysal and Baynal (2016), also examines the GCS experienced by women in Turkey's healthcare sector and its impact on career development (16).

Consequently, the literature clearly shows that the glass ceiling remains a significant issue. The results of this study, emphasize the need for targeted interventions addressing the specific barriers faced by women in radiation-related healthcare fields. To address this problem, it is important to create more opportunities for women in both public and private institutions, and to develop supportive work environment to help them balance home and work responsibilities. These measures could create a more equitable representation in managerial roles and promote the overall advancement of women in the workplace.

Through this research, we seek to identify actionable insights and recommendations to promote gender equity and inclusivity within the fields of radiology, nuclear medicine, and radiation oncology. The results underscore the need for comprehensive strategies to address and mitigate the effects of the GCS. Essential steps toward fostering a more inclusive and equitable work environment are implementing mentorship programs, promoting gender-sensitive organizational policies, and creating support networks. By recognizing and dismantling the barriers, healthcare institutions can ensure that all employees, regardless of gender, have the opportunity to achieve their full potential.

Addressing the GCS is crucial for promoting gender equality and enhancing women's professional growth in radiation-related healthcare roles. This research provides a foundational understanding of the challenges faced by female healthcare workers in Turkey and offers actionable strategies to create a more supportive and equitable professional environment.

However, the demographic composition of the sample, predominantly women and employees from private hospitals, limits the generalizability of the findings to the broader population of radiation professionals in Turkey. Future research should aim to include a more balanced representation of genders and occupational settings to provide a more comprehensive understanding of the glass ceiling syndrome in these fields.

A thorough understanding of the underlying causes of these barriers is essential for organizations to implement effective strategies that promote inclusive environments and ensure equal opportunities in leadership advancement. Furthermore, fostering a more inclusive organizational culture can enhance equity in career progression, enabling employees to reach their full potential. Ultimately, such efforts would contribute to the overall improvement of the healthcare system.

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Supplementary Material 1. Survey of the study

SECTION I			
	Demographic Information		
Age:	…….		
City of Employment:	……		
Gender:	□ Female	□ Male	□ Other
Marital Status:	□ Single	□ Married	□ Divorced
Children:	□ Yes	...(number of children)	□ No
Education Level:	□ Primary School		
	□ High School Graduate		
	□ Associate Degree Graduate		
	□ Bachelor's Degree Graduate		
	□ Postgraduate (Master's/PhD)		
Workplace:	□ Private	…….	
	□ Public	……	
Professional Experience:	……. years		
Position at the Workplace:	□ Radiation Safety Officer		
	□ Nuclear Medicine Technician		
	□ Radiotherapy Technician		
	□ Medical Imaging Technician		
Management Role:	□ Yes	□ No	
Duration as a Manager:	……. years		

SECTION II					
	Glass Ceiling Barriers Scale (GCBS)				
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Women should choose less demanding jobs to maintain a healthy balance between work and family life.					
Working life prevents women from fulfilling their family duties.					
Being married or having children negatively affects women's job performance.					
The current or future thought of having children limits women's career goals.					
Working life makes it difficult for women to balance work and family.					
Women are reluctant to seek promotions or higher positions.					
Women think they cannot cope with the challenges they may face in achieving their career goals.					
Women think they cannot cope with the challenges they may face in achieving their career goals.					
Women accept the negative biases against them in the workplace.					
Female employees abandon their career plans due to the feeling of not dedicating enough time to their spouses and children.					
Women cannot accept the requirements and necessities of career advancement.					
Women do not aspire to rise further for fear of harming their family life.					
Men are given more opportunities than women for career advancement.					
Women struggle to enter male-dominated communication networks.					
Cultural values prevent women from participating in off-work activities, especially with male-dominated senior management.					
The business world operates according to men's rulesHigh-level positions in institutions are predominantly given to men.					
High-level positions in institutions are predominantly given to men.					
It is believed that senior positions are not suitable for women in institutions.					
The distribution of tasks within the institution is different for men and women.					
There are not enough female role models to guide women in career advancement.					
Women cannot find female mentors in institutions with male-dominated senior management.					
There is no one to help women overcome obstacles in their career development.					
Women are not as determined as men in their careers.					
Due to emotional decision-making, women are unsuccessful in senior positions.					
Women lack the capacity for quick and logical decision-making.					
Women dislike long working hours, intercity, or international travel.					
Women cannot adapt to harsh working conditions.					
Communicating with women in the workplace is difficult.					
Women cannot show as much resilience to workplace challenges as men.					
Men are more suited for senior management positions than women.					