

## **BARRIERS AND FACILITATORS TO BECOMING A MEDICAL PHYSICIST IN BANGLADESH**

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### **Abstract**

The notion of gender equity is debatable, and worldwide health professionals are exploring the argument. However, the contextual situation and experience are different in each country and vary across cultures. There is an extensive amount of literature that presents women's participation and involvement as increased in science, technology, engineering and mathematics over the last decades (Frize et al., 2022); however, there are variations in data and analyses documented which refer to the gender disparity of medical physicists (MPs) Worldwide (Barabino et al., 2020; Crowe and Kairn, 2016). Medical physics is one of the fields in health care where women are underrepresented, with only 29.8% of the workforce reported identifying as females in this sector (Tsapaki et al., 2018; Tsapaki and Rehani, 2015).

Historically, the healthcare profession is male-dominated (Witz, 1990), with women being underrepresented in many specialist fields like academic medicine, surgical specialities and leadership positions (Kramer et al., 2021). The Nursing profession is, however, excluded from this category and considered a woman's job. Furthermore, women's contributions to the healthcare industry are not frequently acknowledged (Paradis et al., 2021). Moreover, the career trail for men and women in the healthcare profession is suggestively different (Baig, 2020). Broadly, regarding leadership positions and the range of decision-making, there are observable gender discrepancies in the industry. One of the main reasons for this is social restrictions, which women in specific geographic locations like Bangladesh encounter frequently. The lack of support or a platform for women to practice their profession with autonomy impedes their progress or movement upward in their careers.

Women's unhindered involvement, participation and career development in patient care will improve healthcare provision, especially in caring for vulnerable patient groups like the elderly, individuals with significant co-morbidities, and minorities (Covington et al., 2020). In addition, involving more women in healthcare will not only reduce the gender disparity and empower them but also create a sense of confidence in the professions and services provided and, as a result, improve overall well-being. This study will aim to understand the views and experiences of gender-based discrimination among practising medical physicists in Bangladesh.

### **Keywords**

Gender Equity, Diversity, Medical Physicist, Under-Representation, Women in Health

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### **Introduction**

One of the most gender-diverse fields in Physics is Medical Physics, which represents only 29.8% of women worldwide (Tsapaki et al., 2018). Despite the extensive interest in this topic, little analysis can be related to the medical physics workforce (Crowe and Kairn, 2016). According to the International Organisation for Medical Physics (IOMP) survey published in 2015, the variations between men and women Medical Physicists (MPs) are from 0% to 100% based on the country's context. Besides, the proportion of women MPs is higher in developing countries and much lower in developed countries (Tsapaki et al., 2018). Above all, the underrepresentation of women in this field is linked with the participation of women in science and technology-based occupations. Although women's participation in science and technology education has increased over the last few decades compared to men's, this increased participation did not reduce the gender gap in this field along with the other

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traditional sciences. However, women's underrepresentation in professional and academic careers in science and technology is still high (Frize et al., 2022). The survey conducted by Tsapaki and Rehani (2015) showed that in Asia, only 28% of MPs are women. In addition, they stated that the original quantity of gender differences among existing MPs is unknown.

Evidence showed that for any research field or professional platform, gender balance is one of the main factors for development and a healthy working environment (Frize et al., 2022). Besides, much research suggests that gender norms and stereotypes are significant barriers to women's empowerment in any profession and society. In addition, social roles and power distance also obstruct women's development (Ali, 2014; Haliman et al., 2004). Baig (2020) argued that there are significant differences between men's and women's career paths within healthcare professions. One of the key reasons is that men's predominantly senior positions undermine the advancement of women in the career ladder, creating inequalities. Also, stress and burnout, career gaps due to childbearing and caring, and dropout create a significant gap in a leadership position.

This paper explores the discrimination in leadership positions among Medical Physicists in Bangladesh. This paper also questions the way discrimination is practised in a social setting where women are usually used as an instrument to achieve success in the families' male counterparts. Narrating this issue clarifies the positionality of women within the social and family structures in Bangladesh. Besides, this study examines the reasons for gender disparities in Medical Physicists' professions, discusses how to overcome this gap.

### Objectives

1. To examine the reasons for female medical physicists' underrepresentation in healthcare sectors.
2. To identify the response of medical physicists on gender inequality in the workplace and the plausible ways to eliminate this gap.
3. To investigate the obstacles that affect female medical physicists to promote their careers in healthcare.

### Increased Participation of Women in The Labour Market

Research suggests that historically, women moved from domestic to paid work outside the home (Shire and Nemoto, 2020). According to Burnette (2008), since the Industrial Revolution (1760-1830), women's participation in paid work outside the home has increased in Britain, which causes several disadvantages for them. In the United States, most women did not work outside the house until the late 20th century; a few engaged in paid work were young and unmarried. According to Brinton (1989), a similar scenario was found in Japan, where female participation in paid work was parallel to that of Western industrial nations. However, Japanese women were found to be engaged in various outside work such as sales, silk factories, cottage industries, coal mines, paid domestic work (maids) and agricultural labour in pre-war Japan (Lambert, 2007). After the Second World War, women's participation in paid work increased from 21.6% to 82% due to many social and economic changes in Canada (Moyser, 2017). However, researchers argued that no increased rates guaranteed women access to career ladders compared to men, as many women with paid jobs do not consider themselves career-women (Brinton, 1989; Hakim, 2000).

The most notable changes in the labour market in the last 50 years have been caused by the growth of female participation and their position at work. During the 1980s and 1990s, the massive reconstructions in every part of society create a more substantial role for women in the labour market (Chaykowski and Powell, 1999). This trend indicates that women are near shattered glass ceilings and gender inequality that exists in society. However, this did not reduce the gender gap in specific male-dominated occupations, such as law, medicine and traditional sciences. The relationship between gender and professions is always ignored as men control most successful and renowned jobs worldwide. Equal opportunities, workplace customs, social norms, and lack of support for work-life balance restrain women from entering specific industries and occupations (Yellen, 2017). Besides, occupational segregation by sex is not only taking place through the types of work women do and choose [horizontal segregation] but also through hierarchical position [vertical segregation] in the labour market (Hakim, 1993).

Due to social obligations, women must divide themselves between paid and unpaid domestic jobs. For the last 50 years, dual-earner has increased worldwide, and working parents feel they are running out of time (Lippe et al., 2006). Due to the family need (reducing the burden on men, the ideology of a single breadwinner), women were out for paid work (Costa, 2000; Lippe et al.; 2006; Khan, 2007). However, several types of research have shown that this combination of paid employment and domestic work puts women at greater risk of deciding which roles they should prioritise (Pavalok and Henderson, 2006).

Although women have a choice in some societies to work outside the home, no one shares their burden of family responsibilities and completes them. Therefore, most women are forced to choose certain occupations like part-time jobs (school teachers), low-paid jobs with fewer commitments, seasonal jobs, and temporary jobs to have a better work-family balance (Walthery, 2007). Hence, the increased percentage of women in the labour market failed to reduce the gender gap in certain occupations like lawyers, Doctors, engineers and research-based work.

Women were excluded from specific occupations and leadership roles, which needed more time and were free from household responsibilities. So, it is vital to identify the constraints between women's job preferences and career progression. At the same time, whether work-life balance impacts women's overall participation in paid work or not.

According to Beede et al. (2011), women's involvement in science, technology, engineering and mathematics (STEM) is significantly less (25%), although half of the workforce in the USA are women. Besides, women with STEM degrees are interested in joining education and healthcare innovation instead of STEM occupations in the USA. Similarly, the lack of inequality found in women's participation in the STEM field is documented in Europe and the rest of the world (Barabino et al., 2020). The potential factors contributing to these discrepancies are the lack of role models in the STEM fields, gender stereotypes, and lack of work-life balance or flexible working options (Beede et al. 2011).

### **Women's Under-Representation in Healthcare: The Evidence**

Recognising gender-based discrimination (to women and girls) and targeting to end it in every sector is one of the crucial goals of sustainable development set by the United Nations (UN,2015). Achieving this goal is impossible without women's equal participation in each aspect of society. Literature suggests that women experience more discrimination and barriers in their career development than men worldwide. Therefore, women's career development is complex, and the success rate is low (Lipshits-Braziler and Tatar, 2012; Cardoso and Marques, 2008). Besides, it is essential to have diversity in the healthcare workforce to decrease gender disparities. Underrepresenting any specific population creates inequalities in this profession (Keshet et al., 2015).

A considerable amount of research is documented about the feminisation of the health workforce in global health research (Baig, 2020; Shannon et al., 2019) because women have been underrepresented in these occupations for many years. History revealed that women were excluded from medical school from medieval times until the mid-20<sup>th</sup> century. The late 20<sup>th</sup> century is considered the 'feminisation of medicine' due to the number of females entering medical school (Baig, 2020).

The scenario has shifted from exclusion to female majority for some countries' medical graduates. Around the world, feminisation in medicine has taken place in a diverse range of countries like Bangladesh, Canada, Israel, Mozambique, Oman, the UK and the USA (Shannon et al., 2019). Not only in medicine but also women are expected to increase their participation in dentistry to 28% by 2023 globally (Le et al., 2017). At the same time, the World Health Organisation (WHO) analysed 104 countries and recorded that 67% of health workforces are women globally, and 79% of them are nurses and midwives. In comparison, most males choose to become physicians, dentists and pharmacists (Boniol et al., 2019). WHO also reports that from 2000 to 2017, there was an increase in female physicians by 13% in OECD countries. However, this increased percentage is way behind the WHO Global Strategy on Human Resources for Health: Workforce 2030 (GSHRH) target.

### **The Gender Gap Among Medical Physicists**

There is little worldwide data except the survey published by the International Organization of Medical Physics (IOMP) in 2015. The study revealed gender disparities in the medical physicist's positions worldwide. The distribution of female MPs by geographical region is in Africa 33%, Middle East 50%, Asia 35%, Latin America 24%, North America 24%, And Europe 47% (Tsapaki and Rehani, 2015). According to Covington et al. (2020), the percentage of 23% of female MPs in the USA does not indicate a lack of awareness in this field. However, it represents apparent gender diversity, including the other traditional sciences professions. In their study, a significant gap was identified in leadership positions among all the fields of Medical Physicists in the USA. Moreover, they identified that women occupied 12% of clinical leadership positions in the USA, 14% in Canada, and 18% in other countries worldwide till 2019. Though it was the first study that revealed the statistics of gender diversity, it is visible that the number of women holding chief, directorship positions, and principal or programme directors is very few. However, they also argued that the percentage of award winners is also less compared to the female participants in the medical physicist position worldwide. Women received fewer grants and awards compared to their male colleagues. Specifically, the Department of Radiation Oncology represents fewer women in leadership positions due to several barriers to equity (Ahmed et al., 2015). Furthermore, Knoll et al. (2019) theorise that those women intentionally excluded them from leadership positions due to different barriers.

### **Research Methodology**

This is a qualitative and exploratory study designed with a case study approach. Primary data were collected through eight in-depth interviews (IDIs) conducted in Dhaka, the capital of Bangladesh, where all female medical physicists live. In-depth Interviews were conducted in December 2022 and were facilitated by the researchers. The identities of the participants and the hospitals are kept anonymous for research ethics purposes. The interview was

conducted with the full consent of the respondents.

### Data Collection and Data Analysis

The aim was to find the reasons behind the under-representation of female medical physicists in Bangladesh and how to facilitate their journey to leadership positions. Although the focus was to explore the nature of the problems of specific gender groups, two male MPs were also interviewed to compare the nature of the issues female MPs face in this position. Due to the smaller number of female MPs clinically active in this field, researchers used personal networks to communicate with the participants. All of the participants in this study were conducted and interviewed via telephone. Six out of eight female MPs were interviewed as there was no choice to decide on random participants based on age, years of experience and positions. The remaining two MPs were unavailable due to personal reasons. The participants of this study have different work experiences, ranging from 0 to 18 years. Data collection and analysis follow the interpretivism paradigm, and the data have been collected in naturalistic ways, as suggested by Paradis et al., 2021 Hannum et al., 2019; Saunders et al., 2012 and Yin, 2003. The Interview was not recorded to protect the participants' privacy and vocal identity. The main discussion of the participants was noted down and transcribed on the same day. This study follows thematic analysis in an inductive approach, and common themes of the survey have been predetermined based on the current literature review. From the collected data, findings have been analysed and chosen in a synthesised manner without using any particular software. Due to a limited number of interviews, it has used codes for all the participants.

The participants were eligible for this study because they were practising medical physicists in a different hospital in Bangladesh. Descriptive statistics summarised all the participant’s characteristics [Table 1].

## Demographic Data

Table 1: Participant’s characteristics (N=8)

Criterion	Total Participants (n=8)	
Gender	Female	Male
No. of Participants	6	2
<b>Age</b>		
25 - 30	3	0
31 - 35	2	0
36 - 40	0	0
41 - 45	1	1
46-50	0	1

Years of experiences		
Less than 1 year	1	0
1 - 5	4	0
5 - 10	0	0
10 -15	1	1
16 - 20	0	1
Job Rank		
Medical Physicists	6	1
Senior Medical Physicists	0	1
Relationship Status		
Married	4	2
Unmarried	2	0
Care Responsibilities		
Child care	1	1
Elderly care	6	0

\*SMP- Senior Medical Physicists, MP- Medical Physicists.

### Interview

The semi-structured questionnaires on different areas of the position of Bangladeshi medical physicists were developed by adapting the Paradis et al. (2021) theme. Besides, the guidance and theme for the qualitative investigation were adopted from other academic research for medical physicists (Schuster et al., 2022; Paradis et al., 2021; Zyl et al., 2020). The final interview questionnaires contained three themes: the impact of work-life balance, discrimination, reasons for women’s underrepresentation and finding solutions. Each participant was interviewed for around one hour, and no honorarium was provided. All the participants willingly participated after knowing the background of the research. Besides, all the necessary steps were taken to protect the participant’s privacy and confidentiality.

### Findings and Discussion of Qualitative Data:

For this study, only the interview technique was used as a data collection method. A combined analysis was formed from the collected data to understand Bangladesh's under-representation of female medical physicists. Besides, all the results were divided into **five** different themes: i) the impact of household responsibilities on career and work, ii) types of obstacles and discrimination faced in the workplace, iii) the reasons for the under-representation of women in this field, iv) the ways to improve the gender disparity in this field, and v) Government and

organisation's support strategies to minimise the gender gap.

**Theme 1: The impact of household responsibilities on career and work-**

All the participants, male and female MPs, agreed and described that in the family, women carried out the majority, in some cases, all the household responsibilities. Those included child care/ elderly care and any family-related mental stress and workload (Paradis et al., 2021; Ezzedeen et al., 2018; Addagabottu & Battu, 2015). None of the male participants is responsible for all the main household work, like cleaning, cooking or child care/ eldercare, although their partners work full-time. At the same time, all the married female participants agreed that their husbands are supportive at home to complete the household tasks. Therefore, they can continue this job. In addition, all four female participants' husbands are also Medical Physicists, two of them working in the same organisation. This is an added benefit for women when the partner/ husband understands the job responsibilities or the related stress and pressure. As stated by Participants B, C, and D.

“As my husband is also a medical physicist, he understands the work pressure and responsibilities. He helps to complete the household work as well. In addition, our workplace is also the same. I can sometimes request to alter the schedule so one can be at home and complete the necessary household responsibilities. However, I must complete all the tasks for my children and in-laws.

Although we work in two organisations, my husband is supportive and understanding. I appreciate that my husband does help me with some work, and it is a great help compared to my friends and family who do not get any help or mental support from their husbands (Participant F).”

Among all the female participants, only Participant B have children, though the remaining have responsibilities for eldercare, either parents or in-laws. All the participants reported that having a spouse who will take care all or partial household responsibilities is the key to continuing the jobs. For example, both the male participants (G and H) have two jobs as they do not participate in household duties. Therefore, they can maintain their work-life balance as they only work outside, not at home.

**Theme 2: Types of Obstacles and Discrimination Faced in the Workplace-**

The respondent expressed their disappointment about the discrimination they faced in the workplace. All the female participants were concerned about the workload they had to manage during their working hours. They also questioned the distribution of tasks between male and female colleagues. In addition, male colleagues transferred their work, asked for support, and left for unauthorised tea/ coffee breaks, cigarette breaks, and personal work during office hours. Some were unavailable within the department during the scheduled time. The problem is severe in some places as all of the senior MPs are male, which gives excessive privilege to male colleagues not to focus on their work. There are gender-based biases found in the workplace during work allocation. According to participants A, B, C, D & F, the workload distribution is unfair. Participants believe this is due to gender differences. Also, as per the culture, it is acceptable that women will work more than men. Moreover, workplace discrimination on holiday allocation, promotion, yearly increments, and credit transfer is standard in every workplace. Nevertheless, male colleagues take on simple work and leave early, affecting female colleagues and patient care.

“I not only work more than my male colleagues, but sometimes they also steal my work credit and present it to the senior. As the senior is male, I cannot argue and prove that I did a good job and should be praised. Not only that, during vacation time, women should get priority as we do most of the household responsibilities, but our male colleagues always get priority on booking the holiday. Sometimes male colleagues take more leaves, which is unnoticed”.

“I did not manage to get all my holidays since my career started. I only get the government holidays when the hospital is closed. I cannot take the remaining entitlement every year because my male colleagues are not supportive. Either they book holidays without telling me, so when I request it, I get rejected; sometimes, if I tell them I will book my holiday any particular week, one calls off sick. I automatically have to go to work due to work pressure. This becomes a norm at the workplace, and no one bothers about my complaint because I am the only female colleague here [ participant A].”

Participants also worried about the promotion systems. There are no systematic policies for promotions in any workplace.

“My name was at the top for the senior MP position. However, when the result was declared, I found that one of my male colleagues was promoted. The rumour is that he snatches the

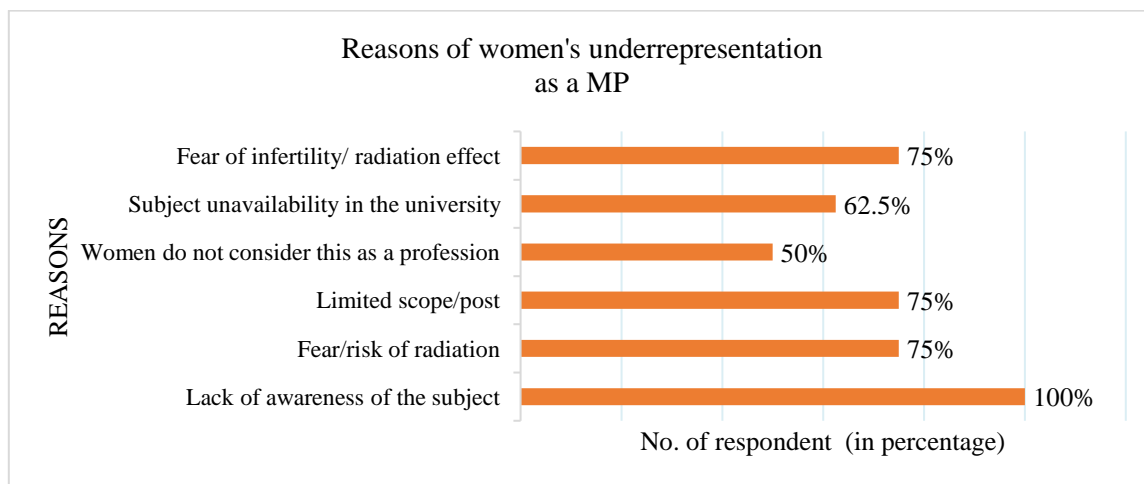
promotion by political influences [ Participant A].”

“The department head handles promotion. There are no rules, systems, or criteria for promotions in my workplace. So, the promotion occurs based on a personal relationship or favouritism, which is unfair [ Participants B, C, D, & F].”

It is reported that male technicians who work with female MPs often do not appreciate their work compared to their male colleagues. Discrimination regarding pay, promotions, and workload is visible and experienced by every female MP in this sector. Moreover, all participants are disheartened that considering their performance, qualifications and experiences, they are also a valuable part of the organisation. This feeling is not sustained due to oppression by their male counterparts [ participants A, B, C, D, E & F].

**Theme 3: The reasons for the under-representation of women in this field:**

There are many reasons both male and female participants identify for women’s under-representation in this field; lack of awareness about the profession is considered the key reason among them. All eight interviewees indicated that society is not aware of this profession. Therefore, parents and kids are unaware that there is a profession called Medical Physicists, which they can consider as a future profession. The remaining reasons are various.

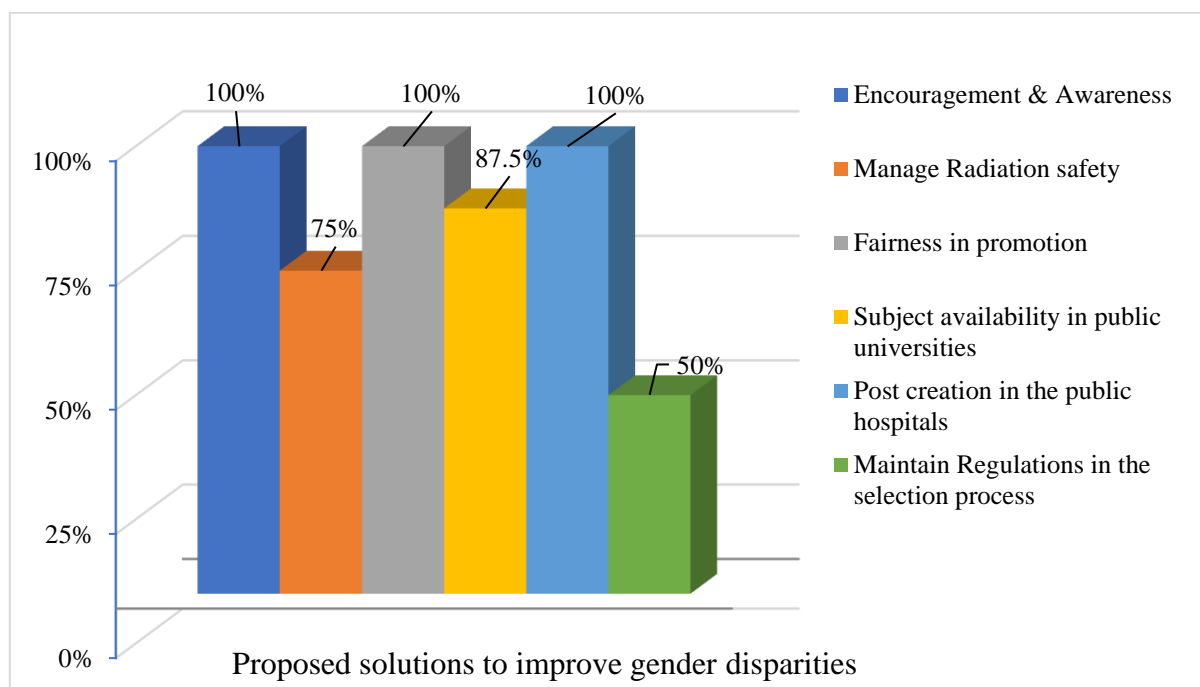


**Figure 1: Various reasons for women’s underrepresentation as Medical Physicists**

The above charts show that various reasons reduce women’s participation in this field. First, there is a lack of awareness of the subject area among Bangladeshi students and guardians. All the participants, both male and female, agreed with this reason. A student does not know about the subject and its future progress as a career. At the same time, guardians also do not know about this profession. Even though there is demand for female MPs in this profession, governments and educational institutions have no noticeable initiatives to expand this profession to fill the gap between demand and supply. Second, fearing the risk of radiation health and its side effects is the second most crucial factor for women not to take MP as a career. The fear of radiation on overall health or any particular organ made this profession least attractive to families, society and women. In addition, the fear of infertility [effect of radiation] plays a vital role in medical Physicists not becoming a demanding profession among women [participants A, D, E, F, G, H]. Moreover, the same number of participants highlighted this profession’s scope shortage. There are no posts as an MP in any of the government’s hospitals in Bangladesh. Technologists and other professionals are covering the medical physicist’s positions in the government hospital in Bangladesh. Therefore, few posts within private hospitals and clinics cannot meet demand. Thirdly, the subject of medical physicists is not available in every university in Bangladesh. There is only one private university in Bangladesh [Gono \*Bishwabidyalay-meaning \*University\* in the Bengali language] that offers full-length B.Sc. and M.Sc. programmes in Medical Physicists and Biomedical Engineering. This is one of the limitations of not having enough female graduates in this subject. Fourth, the reasons women do not consider MP as a career overlap with the previous explanations. Family, school, and societal influences are vital in choosing a higher education subject in Bangladesh. When these institutions are unaware of any particular topic and its impacts on society, it automatically reduces the number of participants [ participants A, B, E & F].

**Theme 4: The ways to improve the gender disparity in this field:**

Gender disparities among Medical Physicists [MP] are visible in Bangladesh. All the participants identified the reasons for these disparities and proposed some solutions to these problems. The combination of the suggestions is as follows:



**Figure 2: Proposed solutions to improve gender disparities.**

All the participants agreed that there should be more encouragement and awareness programmes to promote Medical Physicists [MPs] as a subject and career for women. The government and private organisations can initiate this awareness programme. At the same time, subject availability in different private universities will accelerate this promotion. Post-creation can be another solution. Besides fairness in advertising, more regulations to minimise the radiation effects and the selection process can improve the scenario. However, all the participants agreed it would take time to see visible progress in Bangladeshi Medical Physicists' professions.

### Key Role Players

#### ***Government and Private organisation's support strategies to minimise the gender gap***

Participants from this study provided several examples of ways in which the government of Bangladesh and private organisations can minimise the gender gap, including both institutional and policy developments. Creating many posts in government hospitals is one of the crucial decisions governments can take to encourage both males and females to choose medical physics as a subject to study. Moreover, the Bangladeshi government can encourage public and private universities to offer diverse subjects related to Medical Physics and Biomedical engineering. Post-creation and subject availability in universities nationwide will boost the profession and bring more students into this profession. In addition, private organisations [clinics and hospitals providing cancer treatment] can arrange workshops at the school and college level for parents and society about the importance of this subject for the country's future. At the same time, it is essential to highlight that this subject has demand overseas. So, whoever wants to build a career in the science and research field can choose this subject as a career path for the future. In addition, the government can make it mandatory for all cancer care hospitals and clinics to have a specific number of female MPs in their organisation. This will force management to recruit more females. It is inevitable that women only decide to study those subjects where jobs are available. Therefore, they would not risk studying subjects with limited posts and no prospects. Respondents reported that more advertisements from the government and private hospitals on job vacancies would encourage more women to study this subject and be actively involved in medical physicist careers.

Support from government and private organisations can successfully navigate the career path for students who were studying Science at the secondary level and lost their career prospects at the graduate level due to a lack of opportunities. Several respondents also expressed their views on professional courses offered by government and private organisations related to becoming a Medical Physicist. The offer of professional short courses will support women who have a science background to join in this field. However, this can temporarily minimise the gap between males and females in this profession. In addition, respondents expect to see support from professional bodies at national and international levels to promote research and guidelines for the government related to safe working environments. However, respondents acknowledge that the professional body will need help overcoming social and cultural barriers to make a positive impact and integrate medical physics as a stable career for women. This should be eliminated by national awareness in due course.

Another important feature for women to join the career of Medical Physicists is the encouragement from the family or society. Out of 6 female respondents, 4 of them said they wanted to be a doctor and failed to join the medical college. They continued to study science and later joined the hospital to serve patients directly in a different way. The support and encouragement came from the family.

I wanted to be a doctor but failed to admit to medical college. I then decided to study a subject connecting me to serving the patient [ participants B, D, E, F].

After I finished my Master's in Sciences, I was confused about what to do as a career. My brother is a doctor. He encouraged me to become a medical physicist [Participant A].

## Discussions

To the best of our knowledge, this is the first qualitative study that formally investigated the career progression of female medical physicists in terms of work-life balance in Bangladesh. It also integrates several essential understandings that are relevant to the study. Female medical physicists struggle to reconcile home and career, though the problems are interrelated to the long-established social-cultural phenomenon. Some of the specific conflicts described by the study participants were exhaustion due to excessive amount of work and household responsibilities, inequalities of distribution of work, favouritism in approval of holidays and sick leave, family priorities due to elder care/ child care, and lack of career progress due to limited posts. Although the partners of the female MPs support completing some household tasks, due to cultural pressure, many responsibilities must be completed by women. This is also a common culture in Bangladesh; women do more tasks at the workplace than their male counterparts. This complaint comes from the female MPs who explained how their male colleagues take unscheduled breaks, [tea/ cigarettes] attend telephone calls during work, and sometimes unavailable/ no show after completing the official register/the clock in. These behaviours also create unexpected/ unnecessary pressure on the female peers during the shifts. These behaviours are gender-based because a male colleague will not do the same to another colleague to clarify the name/ fame. The respondents are very concerned about this gender-based discriminatory behaviour and the extra peer pressure they receive from peers [participants A, B, D, F]. In this study, the female MPs are concerned with their lack of time investment in their career due to unequal distribution of work at the workplace and home and lack of career progression and advancement due to limited opportunities in this field. This study's result is similar to the other research that was observed previously on physicians, nurses and doctors in the healthcare sectors [ Dastan et al., 2019; Dousin et al., 2019; Khattar, 2019; Yamazaki et al., 2017]. In this study cohort, the two male respondents also agreed that they are not worried about the main household work because their wives complete most of it [Participant G]. This statement confirms the scenario because the male respondent has two jobs, which is only possible when they have limited tasks at home. They could focus more on their career and earnings and less on work-life balance. All the female respondents confirmed that they have caregiving responsibilities at home [one of them has childcare as well], which makes the medical physicist job more challenging than those who do not. This was emphasised in the result section, theme-1, where participants mentioned that they are more likely to have less physical and mental pressure than their families and friends in other professions while husbands are not supportive.

Some strategies for minimising the gender gap and encouraging more women to join this profession have been suggested in this study. One key finding is that there are no Senior female Medical Physicists [SMP] in Bangladesh within the clinical team. Out of 25 active medical physicists in Bangladesh, only eight are female (BMPS,2021).

## Conclusion

The gender disparities in leadership positions do not represent women's overall participation in the Medical Physicists field worldwide. However, a clear gap is found in every sector of the medical physicist profession, which is a significant concern. A thorough occupational analysis has yet to be conducted on Bangladesh's clinical medical physics fields. All the current research represents patient care, clinical trials, and the study of different methods in cancer care. Hence, this study is the first to try to do a comprehensive occupational analysis based on gender representation. The absence of this study in Bangladesh creates concern about the progress of this field as a career among the female population. At the same time, it enacts challenges for policymakers to display efforts in their initiatives to represent the status of clinical medical physics in Bangladesh. Few women are working as Medical Physicists [ MPs] in Bangladesh. Therefore, it was evident that this number does not represent any leadership positions in this sector within the country. The motivation for this study was to display the actual picture based on data and support the plausible advancement in the Bangladeshi healthcare system. Thus, the professional clinical medical physicist's role was analysed and presented the current status. The data shows that Bangladesh is not nearly fulfilling the international recommendation for female MPs. However, government and private initiatives together would be able to resolve this problem for the specific sector of radiation oncology.



**Limitations and future work**

There are a few limitations that need to be acknowledged. First of all, it only used the case study approach. Secondly, software was not used for this qualitative study, like NVivo or Atlas. Ti etc. Thirdly, this study only focused on female medical physicists who are active clinically. However, further investigation could be developed involving all the non-active female [academic institutions] MPs who have completed their studies. The data was collected only from one country [Bangladesh], which could be expanded to neighbouring countries or based on regions like Asia, Africa, Europe, etc. The number of participants is small, although 75% of the total female MPs were interviewed. Besides, the interview was not recorded using any modern technology. The privacy issue and concern of data protection were among the main concerns for the participants, which may cause any critical information to be skipped. Another major obstacle was time constraints. All the participants work full-time and have family responsibilities in different forms; getting the appointment and engaging them in a lengthy discussion was the most challenging part of this study. Further exploratory research can be conducted with a hypothesis, and mixed methods can be used to capture the view of the non-clinical female physicists who are out of the practice. The more extensive population study will benefit the healthcare sector but needs funding. The current research offers valuable and timely insights to promote medical physicists as a career. Future success depends on executing the proposed solutions and the multiple initiatives from government and private organisations within the healthcare sector.

**References**

- Ahmed, A. A., Holliday, E., Chapman, C. H., Thomas, C. R., Jaggi, R., Deville, C., (2015): Diversity in the Oncological workforce: Losing ground and narrowing the gap comparison of radiation oncology (RO) and haematology oncology (HO), *Int Journal of Radiation Oncology, Biology- Physics*, Vol-93, Issue-3, E375, DOI: <https://doi.org/10.1016/j.ijrobp.2015.07.1504>.
- Ali, R. (2014). Empowerment beyond resistance: Cultural ways of negotiating power relations, *Women's Studies International Forum*, Vol- 45, p: 119-126.
- Addagabottu, R. S., & Battu, N. (2015). A study on the variables that influence the work-lifeBalance of women doctors and nurses with special reference to government and privatehospitals of Guntur district. *International Journal of Research in Management & BusinessStudies*, 2(3), 33-39.
- Baig, L. A., (2020): Women Empowerment of Feminism: Facts and Myths about Feminization of Medical Education, *Pakistan Journal of Medical Sciences*, Vol-36, No-3, pp: 303-305, DOI: <https://doi.org/10.12669/pjms.36.3.2396>
- Barabino, G., Frize, M., Ibrahim, F., Kaldoudi, E., Lhotska, L., Marcu, L., Stoeva, M., Tsapaki, V., and Bezak, E. (2020): Solutions to Gender Balance in STEM Fields Through Support, Training, Education and Mentoring: Report of the International Women in Medical Physics and Biomedical Engineering Task Group, *Science and Engineering Ethics*, Vol-26, pp: 275-292, DOI.org/10.1007/s11948-019-00097-0.
- Beede, D., Julian, T., Langdon, D., McKittrick, G., and Doms, m., (2011): Women in STEM: A gender Gap to Innovation, Economics and Statistics Administration, U. S. Department of Commerce, ESA Issue Brief, 04-11, August-2011, available on#; <https://files.eric.ed.gov/fulltext/ED523766.pdf>, accessed on 22/05/2023 at 12:23
- Brinton, C, M (1989): Gender Stratification in Contemporary Urban Japan, *American Sociological Review*, Vol-54, No-4, pp. 549-564.
- Burnetter, J., (2008): Women's work in the British Industrial Revolution, *Economic History Association*, available at: <http://eh.net/encyclopedia/women-workers-in-the-british-industrial-revolution/>
- Costa, L, D., (2000): From Mill Town to Board Room: The Rise of Women's Paid labour, *Journal of Economic Perspectives*, Vol-14, No-4, pp. 101-122.
- Corwe, B.S., Kairn, T., (2016): Women in medical physics: a preliminary analysis of workforce and research participation in Australia and New Zealand, *Australasian College of Physical Scientists and Engineers in Medicine*, Vol-39, pp: 525-532. DOI 10.1007/s13246-016-0428-z
- Covington, L. E., Moran, M. J., and Paradis, C. K., (2020): The state of gender diversity in Medical Physics, *American Association of Physicists in Medicine*, Vol-47, No-4, pp: 2038-2043, <https://doi.org/10.1002/mp.14035>.
- Dastan, I., Al-Samarraie, M. A. M., & Jadoo, S. A. A. (2019). Female doctors are moreemotionally exhausted than their male counterparts in Iraq. *Journal of Ideas in Health*, Vol-2,No-1, pp: 75-79.
- Dousin, O., Collins, N., & Kaur Kler, B. (2019). Work-life balance, employee job performanceand satisfaction among doctors and nurses in Malaysia. *International Journal of HumanResource Studies*, Vol-9, No-4, pp: 306-319.
- Ezzedeen, S. R., Budworth, M. H., & Baker, S. D. (2018). Can I have it all? Emerging adultwomen's positions on balancing career and family. *Equality, Diversity and Inclusion: AnInternational Journal*, 37 (6), 566-581. <https://doi.org/10.1108/EDI-06-2017-0138>

- Frize, M., Tsapaki, V., Lhotska, L., Da Silva, M.M.A., Ibrahim, F., Bezak, E., Stoeva, M., Gilda, B., Lim, S., Kaldoudi, E., Tan, H. P., Marcu, G. L., (2022): Women in Medical Physics and Biomedical Engineering: past, present and future, *Health and Technology*, Vol-12, pp: 655-662.
- Hakim, C., (1993): Segregated and Integrated Occupations: A New Approach to Analysing Social Change, *European Sociological Review*, Vol-9, No-3, pp: 289-314.
- Hakim, C., (2000). *Work-lifestyle choices in the 21st century: Preference theory*. Oxford, UK: Oxford University Press.
- Heilman, M. E., Wallen, A. S., Fuchs, D., and Tamkins, M. M., (2004), “Penalties for success: Reactions to women who succeed at male tasks”, *Journal of Applied Psychology*, Vol-89 No-3, pp: 416- 427.
- Keshet, Y., Popper-Giveon, A., and Liberman, I., (2015): Intersectionality and underrepresentation among health care workforce: the case of Arab physicians in Israel, *Israel Journal of Health Policy Research*, Vol-4, No-18, DOI: 10.1186/s 13584-015-0004-0.
- Khan, A., (2007): Women and Paid Work in Pakistan, Social Sciences Research, Pathways of Women’s Empowerment South Asian Research Programme, *Pakistan Scoping Paper*, available at: [http://www.researchcollective.org/Documents/Women\\_Paid\\_Work.pdf](http://www.researchcollective.org/Documents/Women_Paid_Work.pdf)
- Khattar, S. (2019). Women in Modern Medicine in India: Progression, Contribution, Challenges and Empowerment. *Australasian Accounting, Business and Finance Journal*, 13(2), 88-106.
- Kramer, M., Heyligers, I.C. & Könings, K.D., (2021): Implicit gender-career bias in postgraduate medical training still exists, mainly in residents and in females. *BMC Medical Education*, No-253, <https://doi.org/10.1186/s12909-021-02694-9>
- Knoll, M.A., Glucksman, E., Tarbell, N., and Jagsi, R., (2019): Putting women on the escalator: how to address the ongoing leadership disparity in radiation oncology, *International Journal of Radiation Oncology, Biology- Physics*, Vol-103, Issue-1, pp:5-7
- Lambert, A. P., (2007): The Political Economy of Postwar Family Policy in Japan: Economic Imperatives and Electoral Incentives, *The Journal of Japanese Studies*, Vol-33, No-1, pp:1-28
- Lippe, T. V. D., Jager, A., & Kops, Y. (2006). Combination Pressure: The Paid Work-family Balance of Men and Women in European Countries. *Acta Sociologica*, Vol-49, No-3, pp:303-319
- Le, T.A.N., Sasso, A.T.L. and Vujcic, M., 2017. Trends in the earnings gender gap among dentists, physicians, and lawyers, *The Journal of the American Dental Association*, Vol-148, No4, pp.257-262.
- MBPS (2021): Bangladesh Medical Physics Society, History of BMPS, accessed on 21/04/2023 at 13:30, available on: <https://bmps.org.bd/history-of-bmps/>
- Paradis, C. K., Ryan, A. K., Schmid, S., Moran, M. J., Laucis, M. A., Chapman, H. C., Bott-Kothri, T., Prisciandaro, I. J., Simiele, J. S., Balter, M. J., Matuszak, M. M., Narayana, V., Jagsi, R., (2021): Gender Differences in Work-Life Integration among Medical Physicists, *American Society of Radiation Oncology*, Vol-6, No-5, 100724, DOI: <https://doi.org/10.1016/j.adro.2021.100724>.
- Pavalok, K. E. and Henderson, A. K (2006): Combining Care Work and Paid Work; Do workplace policies make a difference? *Research on Aging*, Vol-28, No-3, pp359-374.
- Schuster, J. M., Saeed, H., Puckett, L.L., Moran, J. M., Howell, K., Thomas Jr, C., Offerman, S., Suneja, G., and Jagsi, R., (2022): Gender Equity in Radiation Oncology: Culture change is a Marathon, Not a Sprint, *Advances in Radiation Oncology*, Vol-7, No-4, pp:100937-100944.
- Shire, A, K and Nemeto, K., (2020): The Origins and Transformation of Conservative Gender Regimes in Germany and Japan, *Social Politics*, Vol-27, No-3, pp: 432-448.
- Tsapaki, V., Rehani, M.M., (2015): Female medical physicists: The results of a survey carried out by the International Organization for Medical Physics. *Physica Medica*, Vol-31, pp: 368-373. Appen
- Tsapaki, V., Tabakov, S., Rehani, M.M., (2018): Medical physics workforce: a global perspective. *Physica Medica*, Vol-55, pp: 33–39.
- United Nations (2015). The Millennium Development Goals Report 2015; available at: [https://www.un.org/millenniumgoals/2015\\_MDG\\_Report/pdf/MDG%202015%20rev%20\(July%201\).pdf](https://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf) accessed on 2nd January 2023.
- Walthery, P., (2007): Preferences vs Constraints revisited: Multilevel Modeling of Women’s Working Time Preferences in England and Scotland, *CCSR Working paper*, available at: <http://hummedia.manchester.ac.uk/institutes/cmist/archive-publications/working-papers/2007/2007-07-preferences-vs-constraints-revisited.pdf>
- Witz, A., (1990): Patriarchy and professions: The gendered politics of occupational closure. *Sociology*, Vol-24, No-4, pp: 675-690.
- Yamazaki, Y., Uka, T., & Marui, E. (2017). Professional fulfilment and parenting work-lifebalance in female physicians in Basic Sciences and medical research: a nationwide cross-sectional survey of all 80 medical schools in Japan. *Human resources for health*, 15(1), 1-10.
- Yellen, L. J., (2017): The history of women’s work and wages and how it has created success for us all, The Bookings, Gender Equality Series, available at:

<https://www.brookings.edu/essay/the-history-of-womens-work-and-wages-and-how-it-has-created-success-for-us-all/>

Zyl, M. V., Haynes, E. M. K., Batchelar, D., and Jakobi, J. M., (2020): Examining gender diversity growth as a model of inclusion of all underrepresented persons in medical physics, *American Association of Physicists in Medicine*, Med Phys, Vol-47, No-12, pp: 5976-5985.

### Appendix: List of participants and their details

SL	Parti- cants	Age	Marital Status	Qualifications	Designations	Experiences by years	Work Region	Interview Date
1	A	46	Single	B.Sc. (honours') in Physics, M. Sc in Medical Physics, two years online Residency course from AMPLE, IAEA & 3-month Fellowship By IAEA.	MP	13	Dhaka	19/12/2022
2	B	33	Married	B.Sc. (honours') in Medical Physics, M. Sc in Medical Physics	MP	5	Dhaka	19/12/2022
3	C	30	Married	B.Sc. (honours') in Medical Physics, M. Sc in Medical Physics	MP	3	Dhaka	20/12/2022
4	D	29	Married	B.Sc. (honours') in Medical Physics, M. Sc in Medical Physics	MP	2	Dhaka	20/12/2022
5	E	28	Single	B.Sc. (honours') in Medical Physics, M. Sc in Medical Physics	MP	Nine months	Dhaka	23/12/2022
6	F	35	Married	B.Sc. (honours) in Chemistry, M. Sc in Medical Physics	MP	5	Dhaka	23/12/2022
7	G	40	Married	B.Sc. (honours) in Physics, M. Sc in Medical Physics, two years online Residency course from AMPLE, IAEA	MP	14	Dhaka	25/01/2022
8	H	46	Married	B.Sc. (honours') in Physics, M. Sc in Physics, M. Sc in Medical Physics, PhD in Physics.	SMP	16	Dhaka	25/12/2022

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Conflict of Interest: None

Ethics approval: Not applicable

Consent to participant: Verbal/ during an interview

Consent to publication: Verbal/Applicable.