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KNOWLEDGE AND AWARENESS LEVELS OF RADIATION RISK FROM MEDICAL IMAGING AMONG SAUDI POPULATION.

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Abstract

Introduction: Medical radiation imaging techniques enhance surgical outcomes and reduce patient morbidity. The International Commission on Radiation Protection emphasizes maintaining low feasible radiation exposure levels. Studies conducted in Saudi Arabia have revealed gaps in patient and physician awareness regarding radiation risks during medical imaging procedures. This study was conducted to assess knowledge and awareness levels of radiation risk from medical imaging among Saudi population.

Methodology: This cross-sectional study was conducted from July to November 2024 in KSA. The study intends to recruit participants via social media sites like Twitter, Snapchat, Instagram, and WhatsApp. The inclusion criteria are Saudi citizens, both males and females, from all provinces of Saudi Arabia, who agree to participate and complete questionnaires. Non-Saudi people and individuals under 18 years old are excluded. The minimum target sample size of 384 was calculated using a Rasosoft calculator, which had a 95% confidence level and a 5% margin of error.

Results: The study surveyed 726 participants to assess knowledge and awareness of radiation risks associated with medical imaging in the Saudi population. Findings revealed that 60.9% of respondents felt their physicians did not explain radiation risks, contributing to anxiety observed in 56.9% of participants. The majority (82.5%) reported awareness of these risks, primarily from the internet (51.9%). Despite perceived dangers, 50.4% exhibited low knowledge about radiation risks, with only 21.5% demonstrating substantial understanding. Significant correlations surfaced between knowledge levels and educational background (P=0.028) and occupational status (P=0.004), underscoring a crucial need for enhanced public health education, especially targeting younger demographics.

Conclusion: These findings underscore a critical need for enhanced educational initiatives aimed at improving knowledge and awareness of radiation risks associated with medical imaging among the

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Saudi population.

Keywords: Knowledge, Awareness, Radiation Risk, Medical Imaging, Saudi Arabia.

Introduction:

Ionizing radiation is a type of energy that can be electromagnetic waves or particles. Radiation exposure has its effects on any irradiated object cells. As a diagnostic tool in medical areas, it leads to various health concerns for the radiological health team [1,2]. Medical Radiation imaging techniques allow surgeons to visualize the anatomy in real-time and perform surgeries with a higher chance of success, reduce patient morbidity, and get imaging data before the patient leaves the theatre room [3]. The International Commission on Radiation Protection's Circular No. 60 (1990) emphasized the importance of radiation protection systems, recommending that practices should only be adopted if they significantly benefit society.[4]. In King Fahad Medical City Hospital in Saudi Arabia, a cross-sectional survey revealed that (20.8%) of patients were aware that radiation could cause cancer, and (49.3%) thought it could result in fetal anomalies [5]. Most patients (82%) in a Haider (2011) study conducted in Saudi Arabia did not know that they would be exposed to radiation during a CT scan. According to the survey, around two-thirds of the participants (63%) had not been told by the CT unit's operator, radiologist, or referring physician about the risk of radiation from CT scans [6]. Physicians' knowledge of the hazards associated with diagnostic testing for patient safety was assessed through a study. There are several gaps in public understanding, as acknowledged by approximately (73%) of them [7].

Objectives: This study aims to determine knowledge and awareness of radiation risks from medical imaging among the Saudi Arabian population.

Methodology:

Study design and Setting:

A questioner-based cross-sectional study was conducted from July to November 2024 among the Saudi population in the Kingdom of Saudi Arabia**.** A sample recruiting by social media sites (including Facebook, WhatsApp, Instagram, Snapchat, Twitter, and others) to find people from around Saudi Arabia.

Sample size:

The minimum sample size is 384 individuals in this study, according to the sample size estimate made using the Rasosoft calculator, which had a 95% confidence level and a 5% significance level.

The Sample size was estimated by using this formula:

n= P (1-P) * Zα 2 / d 2 with a confidence level of 95%.

n: Calculated sample size

Z: The z-value for the selected level of confidence (1- a) = 1.96.

P: An estimated prevalence of knowledge

Q: (1 – 0.50) = 50%, i.e., 0.50

D: The maximum acceptable error = 0.05. So, the calculated minimum sample size was: n = (1.96)2 X

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0.50 X 0.50/ (0.05) 2 = 384.

Inclusion and Exclusion criteria:

The inclusion criteria were the Saudi population, males and females, ages 18 to 60 years old, from all provinces of the Kingdom of Saudi Arabia, and subjects who would agree to participate in this study and complete questionnaires. The exclusion criteria were the non-Saudi population, males and females under 18.

Method for data collection, instrument and score system:

Data collection was done using the participants' answers to the survey questions. The questionnaire consists of three parts. Part 1 starts with briefly describing the study and the consent question. Part 2 includes demographic information such as age, gender, residential area, and educational qualifications. Part 3 The participants were questioned whether they had read or heard about the risks of medical imaging. As well as their knowledge of the potential dangers of radiation. The participants were asked about the possible risks of radiation making them anxious and whether the potential risks affected their decision about doing the procedure. Suppose they did any medical imaging investigation. They were also questioned regarding Whether they think that frequent radiation exposure can cause cancer or infertility, as well as Whether radiation exposure in pregnancy can cause fetal malformations. With the author's permission, some survey questions were based on their questionnaire form [8].

Scoring system:

In all, 11 criteria assessed the participants' awareness and degree of knowledge. Five criteria are for demographics, and 11 are for awareness and knowledge. One point is given for correct answers, and zero points are given for incorrect answers. The overall level of knowledge was assessed using Bloom's cut-off point. The original Bloom's cut-off point is 80.0%-100.0%, 60.0%-70.0%, and 79.0%. Based on this cut-off point, the participants divided into three groups based on their scores. Knowledge scores varied from 0 to 18 points and were classified into three levels as follows: those with a score of 7 or below (≤7) were classified as having a low level of knowledge; those with scores between 8 and 9 as having a moderate level of knowledge, and those with scores 10 or above (≥10) as a high level of knowledge.

Pilot test:

Twenty people each received a questionnaire and were asked to complete it. This was done to assess the feasibility of the study and how easy the questionnaire was to use. Data from the pilot research were not included in the study's final analysis.

Analyzes and entry method:

The "Microsoft Office Excel Software" application (2016) for Windows entered data into the computer. After that, the data was moved to the IBM SPSS Statistics for Windows, Version 20.0 (Armonk, NY: IBM Corp.) statistical analysis tool, which is part of the Statistical Package of Social Science Software (SPSS) program.

Results:

It has been presented the sociodemographic characteristics of the study participants number 726 composed by female and male individuals that are 71, 5% respectively. The age distribution shows a young cohort as the mean of age here is 31.3 years and SD of 12.5, resulting in a wide age range and approx.; 42.7% of the people are below 24 years, 17.8% are over 45 years, all indicate the possibility

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of working on focusing with younger population in the context of this study. There is also great diversity in terms of educational qualifications, with 46.1% having a bachelor's, as well as only 1.0% having a doctorate. The geographical distribution shows the high membership of participants from the western region (47.8%) reaffirming existing regional inequality of representation. Just under half of the participants (40.4%) are students, the main reason for the educational concentration of the sample, and a lot of the rest are unemployed (18.5%) (Table 1).

Table (1): Sociodemographic characteristics of participants (n=726)

Parameter		***No.***	***Percent (%)***
Age (Mean: 31.3, STD: 12.5)	Less than 21	152	20.9
	21 to 23	147	20.2
	24 to 30	144	19.8
	31 to 45	154	21.2
	More than 45	129	17.8
Gender	Female	519	71.5
	Male	207	28.5
Educational level	Primary school	10	1.4
	High school	72	9.9
	Diploma	35	4.8
	University student	243	33.5
	Bachelor's degree	335	46.1
	Master's degree	22	3.0
	Doctorate	7	1.0
	None	2	.3
Nationality	Saudi	726	100.0
Residential area	Northern region	22	3.0
	Southern region	132	18.2
	Central region	57	7.9
	Eastern region	168	23.1
	Western region	347	47.8
Occupational status	Student	293	40.4
	Healthcare employee	69	9.5
	Non-healthcare employee	176	24.2
	Freelancer	21	2.9
	Unemployed	134	18.5
	Retired	33	4.5

As shown in figure 1, It is shown that the presented data presents some interesting trends regarding the frequency of radiation examinations in total sample of 726 participants. Additionally, we found a noticeable proportion, 31.1% (226 people), who had had only one radiation examination. In contrast, 13.5 percent (98 participants) said they had been subjected to these examinations twice. 24.1% (175 people) reported a response of three examinations; 22.3% (162 participants) reported having had more than three radiation examinations. On the contrary, a minority – 8.9% (65 individuals) – reported that they had never had any kind of radiation examination.

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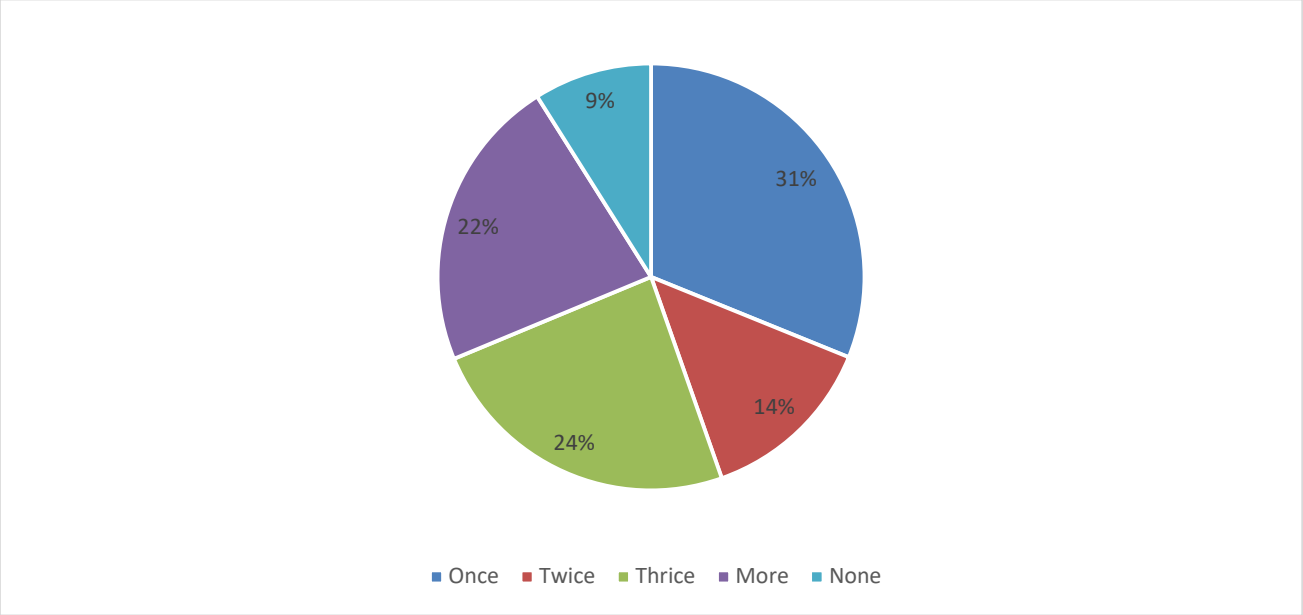
Figure (1): Rate of undergoing radiation examination among participants.



As illustrated in table (2), The data presents a comprehensive overview of the knowledge and awareness levels concerning radiation risks from medical imaging among a sample of 726 participants. Notably, a significant portion of respondents (60.9%) indicated that their referring physician did not explain the potential risks associated with radiation exposure, which could contribute to the reported feelings of anxiety; 56.9% expressed concern about these risks. Furthermore, the majority of participants (82.5%) claimed to have heard or read about risks related to medical imaging, predominantly sourced from the internet or social media (51.9%), highlighting an important avenue for public health education. A substantial number of individuals (68.5%) affirmed that frequent radiation exposure increases cancer risk, while 85% believed that radiation exposure during pregnancy could lead to fetal malformations.

Table (2): Parameters related to knowledge and awareness levels of radiation risk from medical imaging (n=726).

Parameter		***No.***	***Percent (%)***
Have you ever performed any medical imaging investigation? *	X-ray	422	58.1
	CT	248	34.2
	MRI	176	24.2
	Other	108	14.9
	I don't know	93	12.8
If you have undergone any type of radiation examination, how many times have you done?	Once	226	31.1
	Twice	98	13.5
	Thrice	175	24.1
	More	162	22.3

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	None	65	9.0
Did the referring physician explain the potential risks of radiation?	No	442	60.9
	Yes	284	39.1
Do you feel anxious because of the potential risks of radiation?	No	313	43.1
	Yes	413	56.9
Do the potential risks affect your decision to perform the procedure?	No	418	57.6
	Yes	308	42.4
Have you heard or read about the risks associated with medical imaging?	No	127	17.5
	Yes	599	82.5
If you answered "yes", where did you obtain it? *	TV or Radio	75	10.3
	Internet or social media	377	51.9
	Scientific journals	161	22.2
	People around	230	31.7
	Radiologist or Radiological technology	256	35.3
In your opinion, does frequent exposure to radiation increase the risk of cancer?	Yes	497	68.5
	No	41	5.6
	I don't know	188	25.9
Do you believe that frequent exposure to radiation can cause infertility?	Yes	314	43.3
	No	135	18.6
	I don't know	277	38.2
Do you believe that radiation exposure in pregnancy can cause fetal malformations?	Yes	617	85.0
	No	24	3.3
	I don't know	85	11.7
Is there a modality that you believe is more dangerous than others?	X-ray	82	11.3
	CT	112	15.4
	MRI	202	27.8
	Ultrasound	47	6.5
	Nuclear medicine	283	39.0

As shown in figure (2), Perceptions of danger for different medical imaging modalities are presented using a total sample of 726 respondents to highlight notable public opinion trends. Nuclear medicine was deemed as the very dangerous imaging modality by the respondents, with up to 39% of the respondents referring to a high concern about this technique. 112 respondents, about 15% of the sample, had closely followed computed tomography (CT).
On the other hand, 202 people, about 28 percent, believed that magnetic resonance imaging (MRI) was potentially dangerous. Perceived riskier were xray (82 (11%)) and ultrasound (47 (6%)).

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Figure (2): Illustrates which radiation modality is more dangerous among participants.

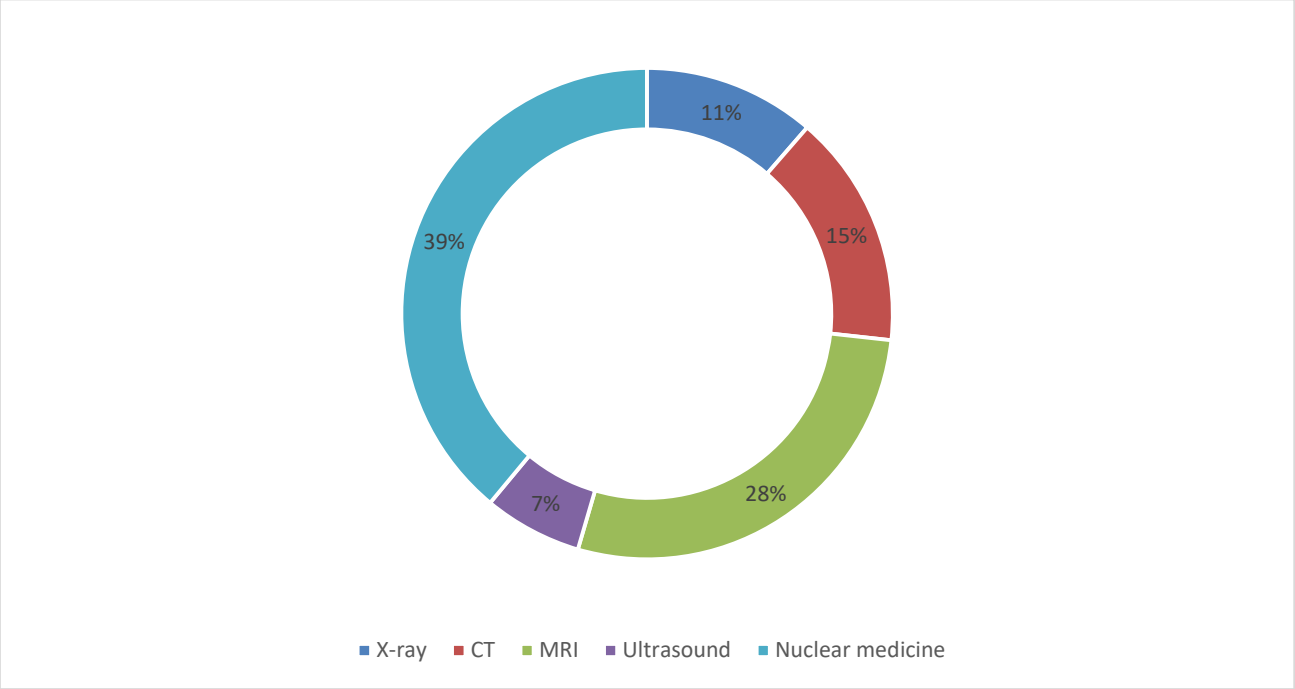

Table 3 shows how the presented data elucidates crucial insights into the knowledge and awareness of radiation risk from medical imaging on a sample population. Lack of knowledge and awareness is especially noteworthy because among the respondents, 50.4 percent exhibit only a low level of knowledge and awareness about the possible risks linked to medical imaging procedures. As opposed, only 21.5% of participants showed a rich richness of knowledge, while 28.1% fall in the moderate category.

Table (3): Shows knowledge and awareness levels of radiation risk from medical imaging score results.

	Frequency	**Percent**
High knowledge and awareness Level	156	21.5
Moderate knowledge and awareness	204	28.1
Low knowledge and awareness	366	50.4
Total	726	100.0

Table (4) shows that knowledge and awareness levels of radiation risk from medical imaging has statistically significant relation to educational level (P value=0.028), and occupational status (P value=0.004). It also shows statistically insignificant relation to gender, age, residential region.

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Table (4): Relation between knowledge and awareness levels of radiation risk from medical imaging and sociodemographic characteristics.

Parameters		***Knowledge and awareness level***		***Total (N=726)***	***P value****
		High or moderate knowledge level	**Low knowledge and awareness**		
Gender	Female	253	266	519	0.474
		70.3%	72.7%	71.5%	
	Male	107	100	207	
		29.7%	27.3%	28.5%	
Age	Less than 21	66	86	152	0.094
		18.3%	23.5%	20.9%	
	21 to 23	79	68	147	
		21.9%	18.6%	20.2%	
	24 to 30	78	66	144	
		21.7%	18.0%	19.8%	
	31 to 45	67	87	154	
		18.6%	23.8%	21.2%	
	More than 45	70	59	129	
		19.4%	16.1%	17.8%	
Educational level	Primary school	9	1	10	0.028
		2.5%	0.3%	1.4%	
	High school	28	44	72	
		7.8%	12.0%	9.9%	
	Diploma	12	23	35	
		3.3%	6.3%	4.8%	
	University student	123	120	243	
		34.2%	32.8%	33.5%	
	Bachelor's degree	171	164	335	
		47.5%	44.8%	46.1%	
	Master's degree	11	11	22	
		3.1%	3.0%	3.0%	
	Doctorate	4	3	7	
		1.1%	0.8%	1.0%	
	None	2	0	2	
		0.6%	0.0%	0.3%	
Residential region	Northern region	15	7	22	0.140
		4.2%	1.9%	3.0%	
	Southern region	66	66	132	
		18.3%	18.0%	18.2%	
	Central region	33	24	57	
		9.2%	6.6%	7.9%	
	Eastern region	87	81	168	
		24.2%	22.1%	23.1%	

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	Western region	159	188	347	
		44.2%	51.4%	47.8%	
Occupational status	Student	144	149	293	0.004
		40.0%	40.7%	40.4%	
	Healthcare employee	49	20	69	
		13.6%	5.5%	9.5%	
	Non-healthcare employee	88	88	176	
		24.4%	24.0%	24.2%	
	Freelancer	10	11	21	
		2.8%	3.0%	2.9%	
	Unemployed	56	78	134	
		15.6%	21.3%	18.5%	
	Retired	13	20	33	
		3.6%	5.5%	4.5%	

P value was considered significant if ≤ 0.05.

Discussion:

The purpose of the present study was to examine knowledge and awareness levels of radiation risks from medical imaging in the Saudi population. This is a very important investigation because of the ever-increasing dependence on medical imaging technologies that are, on one hand useful for diagnosis and treatment but, on the other hand, expose us to potential radiation exposure. Previous studies have documented large gaps in patient and physician awareness of these risks especially in the context of Saudi Arabia [9,10]. Consistent with the literature, results from our study reveal alarming embarrassment in knowledge, awareness and deficiencies, most of which need to be addressed through targeted educational interventions.

Our results suggest that the majority of participants (60.9%) said the healthcare provider did not discuss potential risks exposure of radiation. This finding is consistent with previous work [9,11] showing that healthcare professionals tend to be inadequate at conveying the risks associated with radiation to patients. Communication problems can create extra anxiety among patients; of our study respondents' 56.9 percent were worried about radiation risks. It is not without reason that this anxiety exists, since studies show that inadequate knowledge about radiation increases patients' fears while avoiding necessary imaging procedure could have been increased [12,13].

Finally, our work showed that although 82.5 percent of participants had heard or read about radiation risks, primarily through social media, this exposure did not translate into a comprehensive understanding of the risks. Similar to other studies, this phenomenon has also been documented in which information collected from nonprofessional sources are usually of the depth and accuracy to make an informed decision. [14,15]. Concerningly, social media constitutes a prime source of information on radiation risks, which can propagate myths and unfounded beliefs as regards the radiological safety of medical imaging practices [16,17].

Our study's demographic analysis showed a young population — mean age 31.3 years — and a large proportion of students (40.4%). This demographic insight further suggests that educational interventions should focus on younger people, likely who might be more easily convinced to learn about radiation safety and risks [18,19]. Prior studies have established that leveraging proper engaging and interactive teaching methods targeted educational programs can really boost levels of knowledge and awareness

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among certain demographics [20,17].
As far as specific imagining modalities, nuclear medicine was the most feared imagery (39 percent of respondents indicated high concern with this modality). This view is upheld by other studies indicating that nuclear medicine is a dominant radiation source and thus causes heightened public concern [9,10]. Additionally, the suspicion of CT and MRI scans among participants, to a significant degree, echoes a more general public suspicion with these modalities associated with radiation exposure [11,10].
In spite of the appalling lack of knowledge highlighted in our study, it is interesting to note that some 68.5 percent of the participants responded affirmatively to the question if exposure to radiation was too frequent would cause cancer to develop. Although the former is positive, one does not necessarily have an insight into the complexities of radiation safety risk management. Other work has demonstrated that although risk awareness is important, patients and healthcare providers must also understand radiation safety principles for safe and informed decision making [21, 22]. The present study also has its limitations. One limitation is that we depend on self-reported data whereby participants may exaggerate what they know or are aware of. Moreover, the cross-sectional nature of the study impairs the derivation of causal relationship between demographic variables and the levels of knowledge. Additionally, social media is not being utilised as a method to recruit participants, and thus may exclude certain populations, such as individuals over 65 who may not actively interact on these media [23,24]. Future research would benefit from use of longitudinal designs and more diverse recruitment strategies to obtain a richer understanding of the radiation awareness experiences of diverse populations.

Conclusion:
Results from this study convey a pressing need for greater educational efforts in the Saudi population to enhance knowledge and consciousness of radiation risk linked to medical imaging. This research provides insights to help understand the gaps in understanding and to leverage it and as a result, it can help educate patients as well as help make practices safer and provide better patient outcomes. To stoke a safety and radiation exposure awareness culture in both adventure and medical imaging targeting fans of all ages, it's imperative to integrate targeted educational programmes.

Acknowledgement:

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Ethical approval:

After fully explaining the study and emphasizing that participation is optional, each participant gave their informed consent. The information gathered was safely stored and utilized exclusively for study.

Funding:

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Conflict of interests:

The authors declare no conflict of interest.

Informed consent:

Written informed consent was acquired from each individual study participant.

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Data and materials availability:

All data associated with this study are present in the paper.

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