ORIGINAL ARTICLE

Knowledge and Awareness of Jordanian Speech and Language Pathologists on Radiation Protection while Performing Videofluoroscopic Swallowing Study

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ABSTRACT

INTRODUCTION: Videofluoroscopic swallowing studies (VFSS) are essential diagnostic tools used by speech-language pathologists (SLPs) to assess dysphagia. However, VFSS involves ionising radiation exposure, making comprehensive radiation safety knowledge critical for minimising risks to both patients and healthcare providers. This study evaluates radiation protection knowledge and practices among Jordanian SLPs performing VFSS. **MATERIALS AND METHODS:** A cross-sectional survey was conducted among 115 Jordanian SLPs who perform VFSS. The validated 22-item questionnaire assessed demographics, professional experience, radiation safety knowledge, and current practices. Data was analysed using descriptive statistics and cross-tabulations to examine relationships between education level, experience, and radiation exposure practices. **RESULTS:** Significant knowledge gaps were identified in fundamental radiation safety principles. Only 20.9% of respondents accurately estimated the appropriate exposure times (≤5 minutes), while 38.3% overestimated the VFSS duration to 16-20 minutes. Although 35.7% reported using pulsed fluoroscopy, 34.8% were uncertain about their equipment type. Only 27.8% correctly identified scattered radiation as the primary exposure hazard. While basic protective equipment knowledge was adequate comprehensive shielding understanding was limited. Educational background influenced duration estimates, with master's degree holders reporting longer procedures compared to bachelor's degree practitioners. On-the-job training was the predominant source of radiation safety knowledge (46.1%), yet overall self-rated competency remained moderate to low. **CONCLUSION:** Jordanian SLPs demonstrate inconsistent radiation safety knowledge with significant gaps in exposure time limits, equipment specifications, and comprehensive protective practices. These findings highlight urgent needs for structured radiation safety education, standardised national guidelines, and interprofessional training programs to ensure safe VFSS procedures.

Keywords
Videofluoroscopic Swallowing Study, Dysphagia, Radiation protection, Speech-language Pathologists, Jordan, Patient safety.

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Received: 21st February 2025; Accepted: 30th October 2025

Doi: https://doi.org/10.31436/imjm.v25i01/2873

INTRODUCTION

Videofluoroscopic swallowing study (VFSS) is a critical instrumental assessment routinely performed by speech-language pathologists (SLPs) to evaluate dysphagia.[1] In this procedure, various food and liquid consistencies mixed with contrast material are presented to patients during an X-ray to assess swallowing anatomy and physiology. This procedure also facilitates the evaluation of swallowing manoeuvres and therapeutic strategies for managing dysphagia.[2] However, VFSS exposes both patients and healthcare professionals, including SLPs and radiologists, to ionising radiation. While the primary X-ray beam is directed toward the patient, scattered radiation resulting from deflection off the patient and surrounding surfaces poses potential exposure risks to

nearby healthcare workers.[3] Although scattered radiation doses typically remain below the annual occupational exposure limit of 20 millisieverts (mSv), cumulative exposure over time can heighten the risk of radiation-induced cancers.[4] Minimising radiation exposure during VFSS primarily involves three strategies: limiting exposure time, maximising distance from the radiation source, and employing appropriate protective shielding such as lead aprons and thyroid guards.[5-7] Additionally, radiologists must undergo specialised radiation safety training and use dosimetry badges to ensure they remain within safe exposure limits.[8]

While the American College of Radiology has provided radiology-focused guidelines,[9] a systematic review of VFSS protocols highlighted the lack of input from multidisciplinary teams and the insufficient evidence supporting many of the recommendations.[10] In response, the American Speech-Language-Hearing Association (ASHA) has delineated clear responsibilities for SLPs to enhance radiation safety during VFSS, emphasising collaboration with radiology teams, adherence to the As Low As Reasonably Achievable (ALARA) principle, and regular safety training.[11] Despite the availability of these robust international guidelines and recommendations, their implementation varies considerably across different healthcare settings and geographical regions. This variability is particularly pronounced in resource-limited contexts where institutional infrastructure, professional training frameworks, and regulatory oversight may differ substantially from settings where these guidelines were originally developed. Consequently, even with strong international guidance, translating these standards into consistent local practice remains challenging and highly context-dependent. In Jordan, the absence of standardised guidelines for VFSS conducted by SLPs has resulted in substantial practice variability, shaped more by individual clinician preferences than evidence-based standards.[12] This inconsistency is concerning as it can compromise assessment accuracy and increase unnecessary radiation exposure risks. Furthermore, limited hospital integration and variability in professional training exacerbate this issue, creating significant disparities in radiological knowledge and safety practices among SLPs.[13] Therefore, this study assesses the current knowledge and practices of Jordanian SLPs regarding radiation protection during VFSS. The aim is to identify gaps in awareness and promote safer, more standardised VFSS procedures, ultimately minimising radiation risks for both patients and practitioners.

MATERIAL AND METHODS

A cross-sectional survey was conducted among Jordanian SLPs who perform VFSS. Ethical approval was obtained from the University of Kebangsaan Malaysia ethics committee (JEP-2023-785). Participants had to meet the inclusion criteria, which included holding a recognised qualification in speech-language pathology, certification from the Jordan Ministry of Health (MOH), and actively managing dysphagia cases. Technicians, defined as bachelor-level SLPs licensed by MOH to treat dysphagia under specialist supervision, were also included. Exclusion criteria included academic professionals without clinical caseloads, SLPs working abroad, and those without active dysphagia caseloads for the past three months. A simple random sampling method was employed, with an estimated sample size of 114 participants calculated using Andrew Fisher's Formula.

The questionnaire was distributed openly between February and April 2024 through multiple online platforms, and a total of 115 SLPs who met the inclusion criteria completed the survey. While a specific response rate could not be calculated due to the open distribution method, the sample size exceeded the calculated requirement and represents a substantial proportion of practising SLPs in Jordan who perform VFSS procedures. To minimise selection bias, several strategies were implemented: (1) distribution of the questionnaire through multiple channels including various social media platforms and WhatsApp groups to maximise reach across different practice settings; (2) clear specification of inclusion and exclusion criteria to ensure only eligible participants completed the survey; (3) recruitment of participants from diverse work environments and (4) voluntary participation with informed consent to reduce coercion bias. The survey consisted of 22 multiple-choice questions covering demographics, professional experience, frequency of

radiological exposure, safety practices, and competency levels regarding VFSS radiation exposure. Originally developed by Russell and System,[14] it was administered online in the English language.

Data Analysis

Survey responses were analysed descriptively using Microsoft Excel, with cross-tabulations conducted using the Statistical Package for the Social Sciences (SPSS) version 29.0 (IBM Corp., Armonk, NY, USA) to examine associations between education level, VFSS experience, and radiation exposure time.

RESULTS

A total of 115 participants who graduated and trained in Jordan completed the survey (Table I). Most respondents (71.3%) work at speech and language pathology centres and hold a technician license (53.2%). The educational backgrounds varied, with 37.6% holding bachelor's degrees, 15.6% holding master's degrees, and 4.4% holding PhDs. On-the-job training was the primary source of radiation safety knowledge for nearly half (46.1%) of the respondents. Dysphagia services were primarily provided to adults and geriatrics (65.2%), with fewer services offered to paediatrics (29.0%) and infants (6.2%). Most respondents had between 2 to 5 years of VFSS experience (33.9%), followed by those with over five years of experience (30.4%). However, overall, they reported performing fewer than five procedures per month, indicating limited clinical exposure despite years in practice.

Table II presents key findings on radiation knowledge and practices. Only 20.9% of respondents correctly estimated the radiation exposure time as ≤5 minutes, which aligns with ASHA guidelines, while the majority (38.3%) overestimated the exposure time at 15-20 minutes. Compliance with ASHA's recommended exposure limit (≤5 minutes) was low, with only 23.5% adhering and 41.7% unaware of the guideline. The understanding of radiation sources was limited, with 34.8% of respondents uncertain about the primary source of exposure.

Table I: Demographic Information Questions of Jordanian SLPs (N = 115)

	Frequency	Percentages
What is your primary work setting?		
Speech and Language Pathology Centre	82	71.3
Special Education Pathology Centre	4	3.5
School or nursery	6	5.2
Hospital	12	10.4
Private (Home services)	11	9.6
What occupational licenses do you hold? (multiple answers allowed)		
Jordanian Ministry of Health Specialist	50	32.0
Jordanian Ministry of Health technician	83	53.2
Certificate of Clinical Competence in Speech-Language Pathology (CCC-SLP)	6	3.8
Clinical fellowship-SLP	3	1.9
Member of Special Interest Group	1	.6
Board-Recognised Swallowing Specialist	1	.6
What is/are the age groups you provide dysphagia services for? (multiple answers allowed)		
Provide dysphagia services for infants	10	6.2
Provide dysphagia services for paediatrics	47	29.0
Provide dysphagia series for adults/geriatrics	91	65.2
I am in an administration position / supervisory role	4	2.5
None applies to me	10	6.2
Please select the following that apply to you.		
Completed a bachelor's degree in SLP	77	37.7
Completed master's degree in SLP	32	15.6
Completed PhD in SLP	9	4.4
Completed a medical internship with VFSS exposure	3	1.4
Mentored graduate interns applying for VFSS	8	3.9
Mentored colleagues applying VFSS	21	10.3
Taught a graduate-level course on dysphagia	12	5.9
Lectured at the Jordan or national level on dysphagia.	39	19.1
It does not apply to me.	3	1.4
Where did you receive your radiation safety knowledge?		
Academic setting	49	29.3
Medical practicum	18	10.8
On-the-job training / in-services	77	46.1
Conferences and Seminars	2	1.2
Journals / Independent Study	21	12.6
How many years of experience performing VFSS?		
Less than one year	27	23.5
Between 1-2 years	14	12.2
Between 2-5 years	39	33.9
More than five years	35	30.4
What is the average number of VFSS completed per month?		
Less than two per month	54	47.0
3-5 patients per month	36	31.3
6-10 patients per month	18	15.7
More than ten patients per month	7	6.1

Competency in distance as a protective factor was low (M=2.02, SD=0.95), and understanding of exposure time management was similarly limited (M= 1.95, SD=0.93). Regarding collimation, only 20% correctly associated it with exposure reduction, while 32.2% erroneously believed it compromised image quality.

Table II: Levels of Radiation Knowledge and Practices Among Jordanian SLPs Questions.

	Frequency	Percentages
What is the estimated average radiation exposure time for the VFSS that you complete?		
< 5 minutes	24	20.9
6 - 10 minutes	9	7.8
11 - 15 minutes	25	21.7
16 - 20 minutes	44	38.3
> 21 minutes	1	0.9
I do not know	12	10.4
What is the type of fluoroscopy used?		
Pulsed Fluoroscopy	41	35.7
Continuous fluoroscopy	33	28.7
High-dose fluoroscopy	1	0.9
Unsure	40	34.8
Where does most of the radiation come from (excluding radiation beams)?		
Scattered Radiation	32	27.8
Sensitive Radiation	27	23.5
Termination Radiation	16	13.9
I do not know	40	34.8
Increasing the distance between the SLPs and the patient will		
Reduces radiation exposure to SLP	33	28.7
Increases the SLP's exposure to radiation	18	15.7
Increases the patient's exposure to radiation	34	29.6
I do not know	30	26.1
How should the staff alter her position to reduce radiation exposure?		
Take two steps backwards	12	10.4
Turn 90 degrees to face the patient	33	28.7
Turn 90 degrees to face the patient and take 2 to 3 steps back	27	23.5
I do not know	41	35.7
What is/are the additional shielding that should be used by staff to reduce radiation exposure?		
Staff 1-apron	2	1.7
Staff 3 Apron	3	2.6
Staff 2-Lead Gloves	3	2.6
Staff 1-Lead Gloves	31	27.0
Staff 3-Thyroid Shield	29	25.2
Staff 2-Thyroid Shield	6	5.2
Current shielding is sufficient	28	24.3
I do not know	13	11.3
When should the grid be removed?		
a 4-year-old patient	11	9.6
19-year-old-patient	19	16.5
a 40-year-old patient	32	27.8
I do not know	46	40.0
an 88-year-old patient	6	5.2
Collimation decreases radiation to the patient by?		
Increasing the field of exposure	14	12.2
It has no bearing on the field of exposure	23	20.0
Narrowing the field of exposure	23	20.0
Reduces the quality of the image	37	32.2
I do not know	18	15.7
What impact does magnification have on radiation exposure during the VFSS?		
Magnification increases the radiation dose to the patients	23	20.0
Magnification reduces the radiation dose to the patient	20	17.4
Magnification does not impact the radiation dose	28	24.3
I do not know	43	37.4
What will occur if lead-lined gloves are placed in the path of the primary X-ray beam?		
The fluoroscopy unit will automatically decrease the intensity of radiation	17	14.8
The fluoroscopy unit's intensity of radiation remains the same	32	27.8
The fluoroscopy unit will automatically increase the intensity of radiation	19	16.5
I do not know	47	40.9
Which of the following could be used to limit radiation exposure during the VFSS?		
Implement magnification mode to decrease exposure; SLP and Radiologist / Tech coordinate when to do the fluoroscopy	35	30.4
Use an intermittent beam-on/off during imaging	33	28.7
I do not know	47	40.9
Per ASHA's recommendation, the fluoroscopy time should not exceed how many minutes?		
≤ 5	27	23.5
> 5	40	34.8
I do not know	48	41.7
When positioning patients in the field of interest, the operator should?		
Approximate placement of the fluoroscope and intermittently exposing the patient to radiation	31	27.0
Continuously exposing patients to radiation to fine-tune their fields of interest	17	14.8
Increase the patient's distance from the fluoroscope and use continuous exposure to fine-tune the field of interest	9	7.8
Use magnification to ensure the appropriate field of interest is obtained in a timely manner	21	18.3
I do not know.	37	32.2

Table III presents the mean scores and standard deviations for the knowledge and practices of Jordanian SLPs related to radiation safety and dosimetry tools. Knowledge of dosimetry tools was highest for fetal badges but lower for wrist badges. Primary shielding, such as lead aprons and thyroid shields, was widely used, while the use of lead gloves and eye protection needs improvement. Collaboration with radiology technologists was strong; however, knowledge of collimation and magnification was lacking, with 12.2% and 37.4% of respondents being unaware of their effects. Confidence in discussing radiation risks with families was low. The primary sources of knowledge included radiology technologists and SLP co-workers, while radiation safety officers and medical physicists were less frequently cited.

Table III: Knowledge and Practices Regarding Radiation Safety and Dosimetry Tools

Dosimetry tool	Mean	SD	Rank	Importance Level
Fetal dosimetry badge (during pregnancy)	1.98	0.91	1	High
Dosimetry badge (outside lead)	1.90	0.86	2	Medium
Dosimetry badge (under lead)	1.77	0.79	3	low
Ring or wrist dosimetry	1.48	0.79	4	low
Shielding options use				
Piece lead vest/apron	3.06	1.07	1	High
Thyroid shield	2.94	1.00	2	Medium
Piece lead vest / pelvic apron (not pregnant)	2.46	1.04	3	Medium
Piece lead vest / pelvic apron (during pregnancy, if applicable).	2.38	0.97	4	Medium
Remain in the control booth / behind other glass lead barriers.	2.09	0.83	5	Medium
Lead eye shields or lead glasses	1.39	0.72	6	Low
Lead gloves.	1.35	0.73	8	Low
Team members who operate during VFSS.				
SLPs	3.22	1.03	1	High
Radiology Technologist	3.17	1.03	2	High
Radiologist	2.68	0.94	3	Medium
Radiation exposure limits				
SLP requests continuation of VFSS beyond radiation exposure.	1.88	0.88	1	Low
SLP ends VFSS before satisfaction because radiation exposure limits exceed ASHA / institutions' radiation exposure guidelines.	1.77	0.85	2	Low
The level of time families express their concerns regarding radiation associated with the VFSS and SLPs' confidence in responding in descending order.				
SLP's confidence in responding to families	2.36	0.96	1	Medium
Families express their concerns regarding radiation associated with the VFSS	1.98	0.78	2	Low
Indicate the percentage of radiation safety and knowledge you received from the following professionals.				
Radiology technologist	3.24	1.39	1	Medium
SLP co-worker and SLP supervisor	3.18	1.17	2	Medium
Graduate school dysphagia faculty	2.60	1.07	3	Medium
SLP internship supervisor	2.24	0.89	4	Low
Radiation safety officer	1.90	0.94	5	Low
Medical physicist radiologist	1.51	0.79	6	Low
Other physician	1.39	0.72	7	Low
Rate your competency with the following topic.				
Shielding the SLP	2.81	1.10	1	Medium
Shielding patients	2.49	1.05	2	Medium
Patient education regarding radiation	2.37	1.14	3	Medium
Distance	2.02	0.95	4	Low
Radiation exposure time	1.95	0.93	5	Low
Dosimetry tools and report interpretation	1.83	0.95	6	Low
ALARA	1.57	0.93	7	Low
Principle/Inverse square law.	1.51	0.91	8	Low

Table IV: The relationship between different levels of education and VFSS experience to the average radiation exposure time (N = 115)

	average radiation exposure time during VFSS (minutes)					
	<5	6 - 10	11 - 15	16 - 20	> 21	I do not know
Bachelor's degree in SLP	24 (32.4%)	8 (10.8%)	12 (16.2%)	18 (24.3%)	1 (1.4%)	11 (14.9%)
Master's degree in SLP	0	1 (3.1%)	8 (25%)	23 (71.9%)	0	0
PhD in SLP	0	0	5 (55.6%)	3 (33.3%)	0	1 (11.1%)
Total	24 (20.9%)	9 (7.8%)	25 (21.7%)	44 (38.3%)	1 (0.9%)	12 (10.4%)
Less than one year of experience	12 (44.4%)	4 (14.8%)	0	0	0	11(40.7%)
Between 1-2 years of experience	7 (50%)	0	5 (35.7%)	2 (14.3%)	0	0
Between 2-5 years of experience	1 (2.6%)	1 (2.6%)	13 (33.3%)	24 (61.5%)	0	0
More than five years of experience	4 (11.4%)	4 (11.4%)	7 (20%)	18 (51.4%)	1 (2.9%)	1 (2.9%)
Total	24 (20.9%)	9 (7.8%)	25 (21.7%)	44 (38.3%)	1 (0.9%)	12 (10.4%)

Table IV shows the relationship between education level, VFSS experience, and average radiation exposure time during VFSS assessments. Chi-square analysis revealed a statistically significant association between education level and estimated exposure time (χ^2=40.23, p<0.001, Cramer's V=0.418). Bachelor's degree holders more frequently reported shorter exposure times (32.4% estimated to be ≤5 minutes), whereas master's degree holders predominantly reported longer durations (71.9% estimated to be 16-20 minutes). PhD holders primarily estimated 11-15 minutes (55.6%). A significant association was also found between years of VFSS experience and exposure time estimates (χ^2=88.02, p<0.001, Cramer's V=0.505). Participants with less than 1 year of experience showed the highest uncertainty (40.7% unsure of the appropriate duration), while those with 2-5 years of experience predominantly reported 10-20 minutes (94.8%), and those with over 5 years of experience reported 15-20 minutes (51.4%).

DISCUSSION

This study represents the first exploration of radiological safety knowledge and practices among SLPs in Jordan. In this country, the field of speech-language pathology has been developing since 1992, offering both Bachelor's and Master's Programs.[15] Despite the longstanding role of SLPs in managing dysphagia across diverse populations, limited data exist on their adherence to radiological safety guidelines in VFSS, which is a procedure that is integral to the assessment and intervention planning for swallowing disorders. The findings reveal significant inconsistencies in radiation safety knowledge among Jordanian SLPs, with significant gaps in fundamental concepts despite moderate clinical experience. Approximately one-third of participants were unaware of the specific fluoroscopy equipment they utilised, while only 27.8% correctly identified scattered radiation as the primary exposure hazard during VFSS procedures. Furthermore, the uncertainty regarding pulsed versus continuous fluoroscopy is particularly concerning, given that pulsed fluoroscopy can reduce radiation dose by up to 64% compared to continuous fluoroscopy when appropriately implemented. The misconception held by 32.2% of participants that X-ray beam collimation reduces image quality represents a fundamental misunderstanding of dose reduction techniques that improve image quality while minimising radiation exposure. These deficiencies align with international concerns regarding inadequate radiation safety education in allied health curricula. Similar knowledge gaps have been documented in Australia, Canada, and the United States, where radiographers frequently assume primary responsibility for advising SLPs on safety protocols.[16]

While participants demonstrated relatively strong knowledge of basic protective equipment, such as lead aprons and thyroid shields, which are likely attributable to visible departmental protocols and warning signage, only 27% could accurately identify comprehensive shielding requirements. This selective knowledge pattern mirrors findings in Jordanian dental radiography practices, where protective equipment awareness varied significantly despite widespread recognition of radiation safety importance.[17] Additionally, family concerns about radiation exposure tend to be low, as most prioritise the diagnostic benefits of VFSS over exposure risks; a trend also observed in studies where parents showed moderate concern levels regarding radiation exposure relative to diagnostic accuracy.[3] Current clinical practice guidelines

emphasise the importance of informed consent and patient education for VFSS procedures.[18] However, effective patient counselling about radiation exposure requires a comprehensive understanding of radiation safety principles by the clinician. The knowledge gaps identified in this study may compromise SLPs' ability to provide accurate information during the informed consent process, particularly regarding radiation risks and safety measures. This finding aligns with recent emphasis on effective interprofessional teamwork and clear communication protocols as prerequisites for safe radiological practice.[19]

Misconceptions were particularly significant regarding procedural timing. While ASHA recommends ≤5 minutes of exposure, 38% of SLPs believed VFSS takes 15-20 minutes. Educational background significantly influenced procedural duration estimates, with master's degree holders reporting longer assessment times (71.9% estimated 15-20 minutes) compared to bachelor's degree practitioners (32.4% completed assessments under 5 minutes). While extended procedures may indicate thoroughness, they also increase cumulative radiation exposure for both patients and clinicians. The discrepancy between reported procedural times and recommended guidelines suggests inadequate familiarity with efficient assessment protocols and time-saving techniques. Less experienced SLPs (<1 year) demonstrated the greatest uncertainty regarding appropriate exposure times, highlighting the critical importance of structured mentorship and competency-based training during early career development. Without consistent reinforcement through standardised protocols, even experienced clinicians may develop suboptimal practices that compromise both safety and diagnostic efficacy. This misjudgment, exacerbated by logistical issues including team availability, patient preparation, and institutional workflow, indicates a lack of familiarity with time-efficient practices.[16]

Although many SLPs possess strong clinical knowledge, there is a pressing need to improve their understanding of procedural logistics and radiation safety, as gaps remain in awareness of exposure limits and adherence to established guidelines.[20] This knowledge gap not only raises safety concerns for SLPs during VFSS but also highlights the necessity of aligning SLP training with the standards provided to radiologists and other healthcare professionals to reduce radiation risks and improve patient care coordination. To address these gaps, integrating VFSS-focused radiation protection training into graduate programs and continuing professional development is recommended. National guidelines co-developed by SLPs, radiologists, and medical physicists could standardise practice. Future research should explore the impact of such interventions through longitudinal outcomes and simulation-based training assessments.

The findings of this study, however, are limited by its reliance on self-reported survey data, which may introduce response bias and limit causal inference regarding the relationship between education, experience, and safety practices. The sample size of 115 participants, although representative of active practitioners, may not fully capture the diversity of practice settings and institutional policies across Jordan. Future research should incorporate longitudinal designs and objective competency assessments to evaluate the effectiveness of training interventions.

CONCLUSION

Jordanian SLPs exhibit variable and often limited application of radiation safety principles in VFSS. Although protective equipment, such as lead aprons and thyroid shields, is commonly used, uncertainty persists regarding the optimal procedure duration, fluoroscopy settings, and shielding placement. These findings underscore the urgent need for structured, interdisciplinary training and national VFSS safety guidelines tailored to the Jordanian context. Ongoing professional education, grounded in international best practices and supported by regulatory frameworks, can help ensure that VFSS procedures are both diagnostically effective and radiologically safe for all stakeholders.

FUNDING DISCLOSURE AND CONFLICT OF INTEREST

The authors report no conflicts of interest in relation to this study. This research was self-funded by the authors.

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