Medical Science

pISSN 2321–7359; eISSN 2321–7367

Parental involvement in medical imaging in the emergency department

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To Cite:
Al-Ghadeer HA, Alsubaie A, Alsowailem FA, Alhababi ZA, Alali KA, Almentakh AS, Aldandan JK, Al-Sakkak HA, Alzoayed MH, Alali AB. Parental involvement in medical imaging in the emergency department. Medical Science, 2022, 26, ms29e2041.
doi: https://doi.org/10.54905/disssi/v26i119/ms29e2041

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Peer-Review History
Received: 18 December 2021
Reviewed & Revised: 19/December/2021 to 10/January/2022
Accepted: 12 January 2022
Published: 14 January 2022

Peer-review Method
External peer-review was done through double-blind method.

URL: https://www.discoveryjournals.org/medicalscience

ABSTRACT

Background: Radiology uses different modalities to identify wide range of the problems, monitor response to treatment, and screen for diseases. As for children, parents or caregivers should be up-to-date about the benefits and risks of the management. Health care staff ordering or performing procedures have a communal responsibility to contact with the patients. *Methods:* A cross sectional study was conducted in AlAhsa, Saudi Arabia during the period from September to November 2021. Data were collected by using pre-structured questionnaire that distributed to parents whom visit ER department and their child went imaging study. The questionnaire consists of 4 parts (biographical data, sociodemographic data, child data and understanding the imaging procedure and radiation risks). *Results:* Out of 1344, 535 caregivers fulfilling the inclusion criteria completed the study questionnaire. The mean age of participants was 34.2 ± 11.8 years old. Exact of 374 (69.9%) care givers were females. A total of 455 (85%) caregivers reported that the physician explains the main reason of doing radiation, 144 (26.9%) told that the physician explains risk of radiation, and 269 (50.35%) worried about the radiation toward their child. Exact of 192 (35.9%) caregivers had good awareness level regarding medical radiation exposure while 343 (64.1%) had poor awareness level. *Conclusion:* the study caregiver's involvement regarding reasons of child exposure to medical radiation was high but the discussion regarding risks of exposure was unsatisfactory and below caregiver's expectations.

Keywords: Medical radiation, exposure, paediatrics, parents, emergency department, AlAhsa, Saudi Arabia.

1. INTRODUCTION

Radiology is using various modalities of imaging studies to identify a wide range of the problem, monitor response of treatment, and screen for diseases such as cancer (Margulis & Sunshine, 2000). CT scan is one of the modalities that are increasingly used in the emergency department due to high accuracy

and rapidity (Maitino et al., 2003; Rao et al., 2010; Bhargavan, 2008). Recently, the number and indication of CT scan are increasing (Mettler et al., 2000; Wiest et al., 2002). Previous study showed a dramatic increase in using CT for abdomen, chest, cervical spine, and head for adult from 2000-2005 (Broder & Warshauer, 2007). It accounted for 11% to 13% of all diagnostic procedures that used in the emergency department in United States (Lee et al., 2004). Previous research showed that the annual CT examination reached up to 100 million worldwide in which over 10% were performed on patients under age of 18 years (Kalra et al., 2004). Although CT scan provides more accurate diagnosis, it exposes the patient to high dose of radiation and that increase risk of developing biological effect such as cataract, skin injury, and malignancy particularly in children (Thomas, 2011). Pediatric patients are more sensitive to exposure to radiation, and they carry a long term risk of radiation-induced malignancy because of immature organs, long life expectancy, and exposure to high radiation dose to small cross sectional area (Hall, 2002). In 1902, it was the first reported cancer that induced by radiation, and in 1911, leukemia was reported (Upton, 1986).

Previous study showed that one abdomino pelvic CT grant 1:2000 risk of developing cancer (Dixon & Dendy, 1998). In 2007, approximately 2% of all cases of cancer in the united state were caused by medical imaging (Brenner & Hall, 2007). According to Berrington de Gonzales, (2009) cancers could be linked to CT scan every year. Previous research showed increase incidences of leukemia and brain tumor in the pediatric patients undergoing CT scan (Pearce, 2012). Despite all these facts, CT examinations and radiograph remain the diagnostic imaging of choice in the pediatric age group especially at emergency department. There is a five fold increase in number of CT scan that used for a pediatric patient in the emergency department (Broder & Warshauer, 2007).

The U.S. food and drug administration has outline three strategies to decrease radiation dose for pediatric patients, one of the strategies is to minimalize inappropriate CT referral (Feigal, 2002). Parents might be the reason behind the rising demand for CT scan, because of highly demanding of rapid diagnosis and misconception that the diseases are accurately diagnosed by imaging study (Linton & Mettler, 2003). When medical imaging is performed, especially CT, patients have greater confidence in their diagnostic evaluation. According to previous research, adult patients don't fully comprehend the potential effect of ionizing radiation linked with CT scan (Lee et al., 2004).

In contrast, even with improvements in protocol optimization and scanner technology to reduce children's exposure, some patients have inaccurate information and refuse appropriate diagnostic imaging because they concern about iatrogenic effect, resulting in poor quality health care (Siegel et al., 2017). Therefore, there should be an effective communication between the patient and the health care provider regarding risks and benefits. There are few studies were done to assess patient knowledge about radiation exposure. This study aims to determine parental understanding of medical imaging radiation, as well as expectation from health care provider.

2. MATERIAL AND METHODOLOGY

An observational cross-sectional study was conducted during the period of September to November 2021 among citizen of AlAhsa, Saudi Arabia. The data were collected through a structure self-administrated questionnaire distributed online among visitor of Emergency department. The questionnaire consists of 4 parts (biographical data, sociodemographic data, child data and understanding the imaging procedure and radiation risks).

Inclusion Criteria

Parents with child his/her age up to 15 years old
Parents living in eastern province
Child expose to medical radiation at least one time during his life
Child expose to medical radiation ordered from emergency department

Exclusion Criteria

Parents with child his/her age are more than 15 years old.
Parents not living in eastern province
Child expose to medical radiation ordered from other department

Data analysis

A patient with score less than 60% of the total score was considered to have poor awareness while good awareness was considered if he had score of 60% or more of the total score. Descriptive analysis based on frequency and percent distribution was performed for all variables. Relations were tested using Pearson chi-square test and exact probability test for small frequency distributions.

3. RESULTS

A total of 535 caregivers fulfilling the inclusion criteria completed the study questionnaire. Participants' ages ranged from 18 to more than 45 years with mean age of 34.2 ± 11.8 years old. Exact of 374 (69.9%) care givers were females and 298 (55.7%) were children's mothers and 118 (22.1%) were their fathers. As for participants' profession, 201 (37.6%) were not employed, 154 (28.85) were non-health care workers and 180 (33.6%) were health care workers. Considering educational level, 425 (79.4%) were university graduated while 89 (16.9%) had secondary level of education. Monthly income of less than 5000 SR was reported among 174 (32.5%) caregivers, while 188 (35.1%) had monthly income of 10000-20000 SR (table 1).

Table 1 Socio-demographic data of study caregivers in AlAhsa, Saudi Arabia

Socio-demographic data	No	%
Age in years		
18-25	166	31.0%
25-35	121	22.6%
35-45	119	22.2%
> 45	129	24.1%
Gender		
Male	161	30.1%
Female	374	69.9%
Relation to the child		
Mother	298	55.7%
Father	118	22.1%
Others	119	22.2%
Profession		
Not employed	201	37.6%
Non-health care worker / student	154	28.8%
Health care worker / student	180	33.6%
Educational level		
Below secondary	21	3.9%
Secondary	89	16.6%
University / above	425	79.4%
Monthly income		
< 5000 SR	174	32.5%
5000-10000 SR	124	23.2%
10000-20000 SR	188	35.1%
> 20000 SR	49	9.2%

Table 2 shows Personal data of the child exposed to radiation, Eastern region, Saudi Arabia. Exact of 299 (55.9%) exposed children were males. The most reported kind of imaging study had they receive was X-Ray (67.3%), followed by CT scan (19.3%), MRI (12%), and ultrasound (1.5%). A total of 153 (28.6%) children were exposed to radiology at age 5-9 years, 144 (26.9%) were exposed at the age of 1-4 years while only 44 (8.2%) were exposed below 6 months of age. As for reasons of exposure to radiation, it was diagnostic for different disorders among 204 (38.1%) children, due to trauma among 184 (34.4%), and fall on head among 105 (19.6%) children. The most exposed area for radiation among the study children was head (43%), followed by extremities (31.6%), and chest (21.5%), and abdomen (16.8%).

Table 2 Personal data of the child exposed to radiation, AlAhsa, Saudi Arabia

Child data	No	%
Child gender		
Male	299	55.9%

Female	236	44.1%
What kind of imaging study had they received?		
X-Ray	360	67.3%
CT	103	19.3%
MRI	64	12.0%
US	8	1.5%
At which age had received imaging study?		
< 6 months	44	8.2%
6 months to one year	57	10.7%
1-4 years	144	26.9%
5-9 years	153	28.6%
10-14 years	85	15.9%
15+	52	9.7%
Reason of radiation		
Fall on head	105	19.6%
Trauma	184	34.4%
Diagnostic	204	38.1%
Chronic pain / headache	42	7.9%
Area of radiation		
Head	230	43.0%
Chest	115	21.5%
Extremities	169	31.6%
Abdomen	90	16.8%

Figure 1 shows Caregivers' involvement in medical imaging in emergency departments in Eastern region, Saudi Arabia. Exact of 455 (85%) caregivers reported that the physician explains the main reason of doing radiation, 144 (26.9%) told that the physician explains risk of radiation, and 269 (50.35) worried about the radiation toward their child.

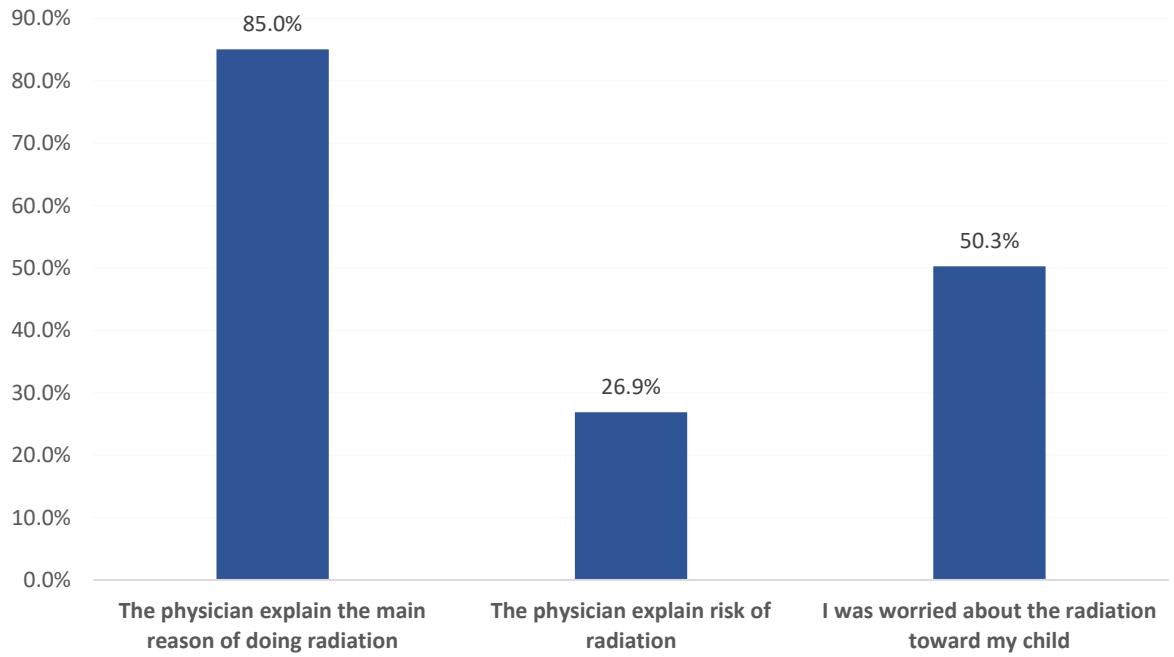

Figure 1 Caregivers' involvement in medical imaging in emergency departments in AlAhsa, Saudi Arabia

Table 3 shows Caregivers' awareness of medical radiation exposure, Al Ahsa region, Saudi Arabia. Exact of 76.8% not experience pain undergoing the X-ray or CT. Also, 73.3% of the participants know that there are external rays exposed to the child every day, 63% reported that danger of diagnostic rays differs when exposed to different parts of the body, and 54.8% think that the risks from radiation from X-ray/CT are more harmful in younger children than adults. A total of 69.2% of the care givers know that X-Ray uses radiation during its procedure while 55.5% know that about CT scan. Also, 52% of the caregivers know that there are specific strategies by hospitals to reduce the amount of radiation exposure and 81.7% told that technician is the person who does the radiography.

Table 3 Caregivers' awareness of medical radiation exposure, AlAhsa, Saudi Arabia

Caregivers' awareness	No	%
I think the patient will experience pain undergoing the X-ray or CT		
Yes	63	11.8%
No	411	76.8%
I don't know	61	11.4%
I think the risks from radiation from X-ray/CT are more harmful in younger children than adults		
Yes	293	54.8%
No	108	20.2%
I don't know	134	25.0%
The radiation from X-Ray can increase a child's lifetime risk of developing cancers		
Yes	162	30.3%
No	162	30.3%
I don't know	211	39.4%
The radiation from CT can increase a child's lifetime risk of developing cancers		
Yes	154	28.8%
No	151	28.2%
I don't know	230	43.0%
Do you think that there are external rays exposed to the child every day?		
Yes	392	73.3%
No	59	11.0%
I don't know	84	15.7%
Are there more radiations in one x-ray than the external ones that a child is exposed to in a year?		
Yes	203	37.9%
No	86	16.1%
I don't know	246	46.0%
The danger of diagnostic rays differs when exposed to different parts of the body?		
Yes	337	63.0%
No	59	11.0%
I don't know	139	26.0%
Is the amount of radiation adjusted according to the size of the child?		
Yes	239	44.7%

No	81	15.1%
I don't know	215	40.2%
Are there specific strategies by hospitals to reduce the amount of radiation exposure?		
Yes	278	52.0%
No	49	9.2%
I don't know	208	38.9%
Which of the following rays uses radiation during its procedure?		
X-Ray	370	69.2%
CT	297	55.5%
MRI	250	46.7%
Ultrasound	66	12.3%
Who does the radiography?		
Physician	70	13.1%
Technician	437	81.7%
Dont know	28	5.2%

Figure 2 shows Overall caregivers' awareness level of medical radiation exposure, Eastern region, Saudi Arabia. Exact of 192 (35.9%) caregivers had good awareness level regarding medical radiation exposure while 343 (64.1%) had poor awareness level.

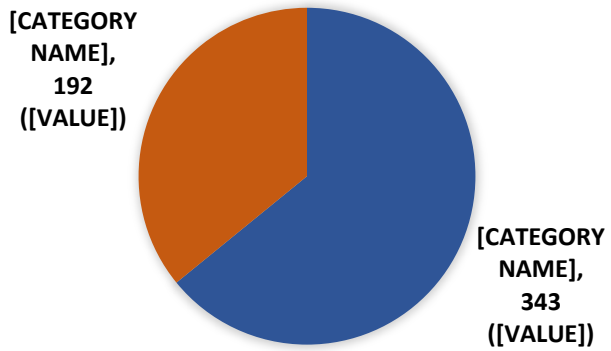

Figure 2 Overall caregivers' awareness level of medical radiation exposure, AlAhsa, Saudi Arabia

Table 4 shows expectation of caregivers from healthcare provider regarding medical radiology exposure involvement. Exact of 511 (95.5%) of the study participants think it is important for physician to discuss the reason for performing a diagnostic radiology, and 465 (86.9%) think it is very important that physician discuss with the patient the risks or benefits of diagnostic radiology rather than make the decision himself. A total of 331 (61.95) participants reported that they preferred exposure to more radiation for an accurate diagnosis while 137 (25.6%) don't care. Exact of 471 (88%) participants reported that they prefer to receive information about the risks of diagnostic radiology from their treating physician, 40 (7.5%) accept to receive information from other health care staff while 15 (2.8%) preferred posters and purchases as a source for their information and 9 (1.7%) reported for internet.

Table 4 Expectation of caregivers from healthcare provider regarding medical radiology exposure involvement

Expectations	No	%
Do you think it is important for physician to discuss the reason for performing a diagnostic radiology?		
Yes	511	95.5%
May be	21	3.9%
No	3	.6%

Do you think it is very important that physician discuss with the patient the risks or benefits of diagnostic radiology rather than make the decision himself?		
Yes	465	86.9%
May be	48	9.0%
No	22	4.1%
Prefer to be exposed to more radiation for more accurate diagnosis or less radiation with less accurate diagnosis		
Exposure to more radiation for an accurate diagnosis	331	61.9%
Low radiation exposure vs. an inaccurate diagnosis	67	12.5%
There is no difference for me	137	25.6%
How would you like to receive information about the risks of diagnostic radiology?		
From treating physician	471	88.0%
Other health care staff	40	7.5%
Internet	9	1.7%
Posters & purchases	15	2.8%

Table 5 shows distribution of caregivers' awareness of medical ration exposure by their personal data. Good awareness level was detected among 47% of caregivers aged 18 to 25 years compared to 26.9% of those who aged 35-45 years old with recorded statistical significance (P=.003). Also, 53.3% of caregivers who were health care workers had good awareness level versus 22.4% of non-employed caregivers (P=.001). A total of 37.6% of university graduated caregivers had good awareness regarding medical radiation exposure in comparison to 4.8% other with below secondary level of education (P=.009). Additionally, 53.1% of care givers with monthly income exceeding 20000 SR had good awareness level compared to 25% of others with monthly income of 5000-10000 SR (P=.003). Good awareness was detected among 52.5% of caregivers receive their information from health care staff compared to 11.1% who depend on internet for having their information (P=.031).

Table 5 Distribution of caregivers' awareness of medical ration exposure by their personal data

Factors	Awareness level				p-value
	Poor		Good		
	No	%	No	%	
Age in years					
18-25	88	53.0%	78	47.0%	.003*
25-35	82	67.8%	39	32.2%	
35-45	87	73.1%	32	26.9%	
> 45	86	66.7%	43	33.3%	
Gender					
Male	98	60.9%	63	39.1%	.305
Female	245	65.5%	129	34.5%	
Relation to the child					
Mother	201	67.4%	97	32.6%	.132
Father	74	62.7%	44	37.3%	
Others	68	57.1%	51	42.9%	
Profession					
Not employed	156	77.6%	45	22.4%	.001*
Non-health care worker / student	103	66.9%	51	33.1%	
Health care worker / student	84	46.7%	96	53.3%	

Educational level					
Below secondary	20	95.2%	1	4.8%	.009*$
Secondary	58	65.2%	31	34.8%	
University / above	265	62.4%	160	37.6%	
Monthly income					
< 5000 SR	114	65.5%	60	34.5%	
5000-10000 SR	93	75.0%	31	25.0%	.003*
10000-20000 SR	113	60.1%	75	39.9%	
> 20000 SR	23	46.9%	26	53.1%	
What kind of imaging study had they received?					
X-Ray	224	62.2%	136	37.8%	.177$
CT	65	63.1%	38	36.9%	
MRI	49	76.6%	15	23.4%	
US	5	62.5%	3	37.5%	
Did the physician explain the, main reason of doing radiation?					.278
Yes	296	65.1%	159	34.9%	
No	47	58.8%	33	41.3%	
Did the physician explain risk of radiation?					.500
Yes	89	61.8%	55	38.2%	
No	254	65.0%	137	35.0%	
How would you like to receive information about the risks of diagnostic radiology?					
From treating physician	304	64.5%	167	35.5%	.031*
Other health care staff	19	47.5%	21	52.5%	
Internet	8	88.9%	1	11.1%	
Posters & purchases	12	80.0%	3	20.0%	

P: Pearson X2 test $: Exact probability test * P < 0.05 (significant)

4. DISCUSSION

Health care provider is responsible to provide rationale exposing children to ionising radiation. Though the patient's opinion should also be considered in the decision-making process, the child parents should be given explanations before consent is taken (Malone et al., 2012; European, 2014). Informing patients / child parents about the potential hazard of ionising radiation is recommended (European, 1997), and European Union Council Directive (2014) emphasizes evidence on the benefits and the risks. Additionally, reference to law about patient rights, patients / child parents should be aware of the benefit and possible risks of a radiation exposure besides other options (Finlex, 1992). As for children, parents or caregivers should thus be up-to-date about the benefits and risks of the management even without asking. Health care staff ordering or performing procedures have a communal responsibility to contact with the patients (WHO, 2016). The current study aimed to assess awareness of medical radiation exposure among caregivers and to estimate the parental involvement in medical imaging in emergency departments.

Regarding parental involvement in medical imaging in emergency departments, the study results showed that vast majority of the participants were told about the main reason of doing radiation for their children but only one quarter of them reported that the benefits and risk of radiation were explained by their child treating physician. This explains that about half of the participants worried about radiation towards their children. The reported role of physician regarding explaining reasons of requiting radiation imaging for their children was concordant with the care givers expectations where more than 95% of the care givers think it is important for physician to discuss the reason for performing a diagnostic radiology. On the other hand, the reported physician role in explaining risks of exposure to medical radiation was below the caregiver's reported expectation where more than three quarters think that it is very important that physician discuss with the patient the risks or benefits of diagnostic radiology rather than make

the decision himself. The surprising finding was that two thirds of the care givers preferred exposure to higher doses of radiation to have more accurate diagnosis while one quarter doesn't care about that. These findings were concordant with what reported by Oikarinen et al., (2019) who found that 83 of the parents received satisfactory information on the reason of the examination, 23% received information on other options and 7%, on radiation dose. A study reported that adults expect to have further information about imaging study that would be undergone to (Ukkola et al., 2016).

Another study regarding children showed that the treating staff of the radiology department explained the reasons but less explanation was given about the risks (Portelli et al., 2018) which matches the current study findings. Thornton et al., (2015) conducted a study regarding information in linking with imaging in a cancer care setting. Majority of the participants, including parents of children with malignancy, reported that the referrer did not initiate benefit–risk conversation. As for parental awareness regarding medical radiation exposure, the current study showed that one third of the parents had good awareness level.

Awareness was significantly higher among young aged parents with high level of education, parents who work at health care field, and those who had their information from health care staff. Similar findings were reported by Hartwig et al., (2013) where 40% of the interviewed parents were knowledgeable regarding long-term negative effects with medical imaging. Also, there are many studies revealed a poor knowledge regarding radiation exposure from medical imaging in adults (Moore, 2014; Caoili et al., 2009).

5. CONCLUSION

In conclusion, the study caregiver's involvement regarding reasons of child exposure to medical radiation was high but the discussion regarding risks of exposure was unsatisfactory and below caregiver's expectations. Also, caregivers' awareness of medical radiation exposure was not high where one out of each three participants had good awareness level. Preferecne of having information from the treating physician was the dominant among study caregivers which put more load and increase physicians' responsibilities to cover all issue with patients before exposing their child to radiation. Improving emergency department physician's communication skills and legislation awareness is highly recommended to be aware of patients' rights regarding involvement in treatment protocol and decision making.

Acknowledgements

We thank the participants who were all contributed samples to the study.

Author contribution

All authors of this study were equally involved in the design of the study, data collection, analysis, drafting and correction of the final draft, and the author was responsible for the proper implementation of the study at all stages. There is no author whose name is not listed in the authors list.

Informed consent

Written & Oral informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

Ethical approval

The study was approved by the King Fahad Hospital-Hofuf (ethical approval code: 50-EP-2021).

Funding

The study did not receive any external funding

Conflict of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

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

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