CORRELATION OF ENTRANCE SKIN DOSE WITH BODY MASS INDEX OF PATIENTS UNDERGOING ROUTING X-RAY EXAMINATION AT FEDERAL TEACHING HOSPITAL GOMBE, NORTH-EASTERN NIGERIA

Abstract

ThisA study was conducted to assess confirm the amount of dose received by patients undergoing routine routing x-ray examinations at Federal Teaching Hospital, Gombe in GombeState, Nigeria. Entrance skin doses (ESDs) for different kinds of x-ray procedures, includePosterior Anterior (PA) and Lateral (Lat) chest, Anterior Posterior (AP) Abdomen, AP pelvis, AP and Lat lumber spine and PA and Lat skullwere assessed using standard exposure parameters.The sum of eighty (80)Data were obtained fromeighty (80) patients who werebeing exposed to k'diagnostic X-ray during their regular X-ray examinations. The patients'patient's ageranged fromfalls between1 to 80 years,while the weightwasisbetween 20kg andto 100kgand height of these patients wasfallenbetween 95.0cmandto 171cm. The skin dose of each patient waswere evaluated using a formula, which is based on the radiographic exposure parameters of kVp, mAS, SSD, the X-ray tube and the total filtration of the beams. The enumerated mean entrance skin dose ranged from falls between 0.016 mGy to 3.168 mGy. Eventually, the ESDs measured for thesethis type of x-ray procedures were found to be below the maximum permissible limits set by Nigeria Basic Ionizing Radiation Regulation [8]and all the examinations conductedshowedshows that there is a good correlation between the entrance skin doses andwith body mass indexfor the studied subjects.during diagnostic X-ray examination. This impliesshows that patients with higher body mass index will received more dose than the patients with low body mass index.

Key words: Skin dose, Body Mass Index, X-Ray Examination, Teaching hospital, Gombe

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Introduction

The main purpose of x-ray examination diagnosis is to generate patient's images with importantfeatures and adequate image quality to aid proper diagnosis and treatment of patients. in order to serve as a guide for practitioner to carry out an effective and efficient examination and treatment of different bad health conditions. Due to the risk associated withdanger relatedto the exposure of patients to x-raysduringwhile undergoing x-ray examinations, it is recommended that images of adequate quality for accurate diagnosisexamination are produced without any need for repetitionof exposure[1].

Although, patients would definitely obtain great advantage from diagnostic x-ray examinations, but their use is not completely without risks. As a result of this, every exposure to diagnostic x-rays need to be justified and optimized in terms of risk and benefit [3]. One of the major ways of assessing radiation dose received in diagnostic and therapeutic radiography is monitoring of patients during the examination [4].

Comment [DC1]: It is nice to provide brief introduction before stating the aim of the study.
Include the period of study and the study design.

Comment [DC2]: No citation in abstracts

Diagnostic X-rays are used for diagnosing~~identifying~~ diseases and other problems during medical examinations. The objective of any diagnostic X-ray examination is to produce images of patients with essential details and sufficient image quality so as to guide practitioners for effective and efficient diagnosis and treatment of various disease conditions. Because of the risks associated with the exposure of the patients to X-rays during the diagnostic X-ray examinations,[6] suggested that, there would be a need for improvement in producing an image containing all the necessary information required for accurate diagnosis which should lead to minimum dose exposure to the patient.

Materials and Method

The method of surveying in this work was based on the guideline established by the International Atomic Energy Agency (IAEA) protocols(Ref).This study covered the most common eight performed ~~comprises ofeight most common performed~~ diagnostic x-ray examinations, which are Posterior Anterior (PA) and Lateral (LAT) chest, Anterior Posterior (AP) Abdomen, AP pelvis, AP and LAT lumber spine and PA and LAT skull. The age range of subjectsstudied ~~range/interval considered~~ were: 1-10, 11-20, 21-30, 31-40, 41-50, 51-60, 61-70 and 71-80 years. If the patient age is > 10 than it was put in range 11-20, >20 in 21-30, >30 in 31-40, >40 in 41-50, >50 in 51-60, >60 in 61-70, >70 in 71-80. These intervals were chosen since results in literature follow~~s~~ the protocol [7]. Automatic exposure control **(**AEC) was positioned between the patient being x-rayed and the x-ray film cassette. X-rays passing through the patient also pass through this "AEC detector" before they strike the x-ray film. BSF was determined using 30cmx30cmx15cm phantom and conversion coefficients in term of surface dose. It depends on the type of the x-ray machine, the x-ray machine in the Federal Teaching Hospital was estimated as 2.9mmAl, that is the value for the BSF were determined to be 1.24gray/sievert

For each patient; age, sex, weight, height and chest thickness were recorded and corresponding technical parameters of exposures (kV, mAs and focus to skin distance FSD) were also recorded. Although the National Radiological Protection Board [9] recommended that measurement of patients' dose be directly measured on Thermo-Luminescent Dosimeters (TLDs), free-air measurement of a tube's radiation output together with the calculation of Entrance Skin Dose using standard factors can also be employed in appropriate circumstances. [5]. In this work, we employed calculation of entrance skin dose (ESD) based on standard exposure data due tounavailability~~unreadily availability~~ of TLD chips and TLD reader in the hospital. The mean ESD was determine ~~by evaluation~~ from the x-ray tube parameters and ~~exposure~~ radiographic exposure parameters using mathematical equation by [10] for calculating entrance skin dose:

$$ESD = BSF \times T \times OP \times \left(\frac{FFD}{FSD}\right)^2 \times mAs \qquad (1)$$

where: OP = the output in mGy/mAs of the x-ray tube at 80KVp~~80 KV~~ at FFD ~~a focus distance~~ of 1m normalized to 10mAs

mAs= product of the tube current (in mA) and the exposure time (s).

FSD= focus to skin distance (in cm)

FFD = focus to film distance

Comment [DC3]: Long sentence. Recast/fragment to make it clearer.

Comment [DC4]: Give the reference

Comment [DC5]: delete

Comment [DC6]: before this, tell us the patients' preparation and positioning for the investigation

Comment [DC7]: write full at first instance

Comment [DC8]: say the type, name, constitution and model of the phantom

Comment [DC9]: what?

Comment [DC10]: How?

Comment [DC11]: How were these measured?
Was there any institutional ethical approval for conducting this study? If so provide its reference number in the text.
Also include a statement to show that there was consent from the patiens.

Comment [DC12]: Provide a sketch diagram of the experimental setup.
Also define T in the equation.
Indicate also the period of the study.

BSF= the back scatter factor ranging from 1.2 to 1.4 for x-ray spectra

The body mass index (BMI)was~~is then~~calculated by dividing the subject's weight by the square of his/her height.

$$BMI = Weight(Kg) \div (Height)^2 m^2 \quad (2)$$

~~While~~Effective dosewas~~is~~ evaluated using the equation:

$$H = \sum_T (W_T \times ESD_T)\,(3)$$

where W_T is the weighting factor and ESD_T is the entrance skin dose of the respective tissue

Comment [DC13]: Which weighting factor? Tissue or radiation? specify

Data analysis

Comment [DC14]: Say how data analysis was done and how results were presented.

Results and Discussion

Table 1 shows the distribution ofbiodata~~biographical data~~ of the patients, based on different age group and some machine parameters were also recorded. The determined mean for tube potential (KV), tube current and exposure time (mAs), output of x-ray (OP) and focus distance surface for chest LAT, pelvis AP, skull LAT, abdomen AP and lumber spine LAT were recorded.

Table1: patients' information and exposure parameters for x-ray examinations. (Ranges in parenthesis)

AgeRange (Years)	Examination	Projection	Number of Patients	Weight (Kg)	Mean Kvp (Kv)	MEAN mAs (mAs)	Mean Dose (mGy)	Height (m)	BMI (Kg/m²)		
1-10	Chest	LAT	2	23	30	12	0.027	0.96	24.96		
	Pelvis	AP	3	24	35	12	0.080	1.00	24.00		
	Skull	LAT	4	20	30	10	0.146	0.97	21.26	59.0	0.0146

Comment [DC15]: This table is too bulky. Present only patient biodataie age, gender, height, weight and BMI in table 1.
Use other tables or figure to present the result.
Example table 2 can contain information about age and results for chest(AP and Lat), table 3 for pelvis, table 4 for skull etc for the the body parts. You may use figures for some.

	Abdomen	AP	0	0	0	0	0.005	0.00	0.00	0.0	0.0000
	Lumber Spine	LAT	1	25	30	12	0.061	0.95	27.70	56.0	0.0051
11-20	Chest	LAT	1	36	45	12	0.053	1.22	24.91	62.0	0.0044
	Pelvis	AP	0	0	0	0	0.005	0.00	0.00	0.0	0.0000
	Skull	LAT	3	45	50	12	0.241	1.38	23.63	71.0	0.0201
	Abdomen	AP	2	37	45	10	0.871	1.24	24.96	68.0	0.0871
	Lumber Spine	AP	4	38	50	10	0.274	1.21	25.95	61.0	0.0274
21-30	Chest	LAT	2	70	50	20	0.341	1.51	24.31	113.0	0.0171
	Pelvis	AP	2	58	56	20	0.590	1.51	25.44	91.0	0.0295
	Skull	PA	2	56	61	20	0.563	1.42	30.25	57.0	0.0282
	Abdomen	AP	2	61	63	22	0.509	1.44	30.38	63.0	0.0231
	Lumber Spine	AP	2	55	56	22	0.299	1.49	25.22	76.0	0.0136
31-40	Chest	PA	3	74	76	22	0.429	1.62	28.20	121.0	0.0195
	Pelvis	AP	3	76	75	28	0.501	1.55	31.63	87.0	0.0178
	Skull	LAT	0	0	0	0	0.005	0.00	0.00	0.0	0.0000
	Abdomen	AP	1	67	75	28	0.752	1.67	24.02	79.0	0.0269
	Lumber Spine	AP	3	80	77	32	0.718	1.66	29.03	84.0	0.0224
41-50	Chest	LAT	1	86	60	34	0.379	1.65	31.59	103.0	0.0111
	Pelvis	AP	1	80	74	38	0.812	1.70	27.68	63.0	0.0214
	Skull	PA	2	75	60	38	0.794	1.58	30.04	57.0	0.0209
	Abdomen	AP	4	70	56	41	0.976	1.69	24.51	67.0	0.0238
	Lumber Spine	AP	2	67	84	42	0.971	1.66	30.48	87.0	0.0231

51-60	Chest	LAT	4	89	76	42	0.871	1.71	30.44	123.0	0.0207
	Pelvis	AP	4	90	80	42	0.608	1.69	31.51	91.0	0.0145
	Skull	PA	1	82	66	42	0.894	1.61	31.63	88.0	0.0213
	Abdomen	AP	0	0	0	0	0.005	0.00	0.00	0.0	0.0000
	Lumber Spine	LAT	1	77	50	26	0.987	1.68	27.28	92.0	0.0340
61-70	Chest	PA	5	89	60	28	0.773	1.61	34.34	132.0	0.0276
	Pelvis	AP	1	99	72	26	0.654	1.59	39.16	73.0	0.0252
	Skull	LAT	1	88	68	38	0.456	1.68	31.18	76.0	0.0120
	Abdomen	AP	2	71	60	32	1.912	1.69	24.86	96.0	0.0598
	Lumber Spine	AP	1	79	56	30	1.543	1.68	27.99	67.0	0.0514
71-80	Chest	PA	2	100	85	30	0.820	1.71	34.20	114.0	0.0273
	Pelvis	AP	2	97	85	30	0.890	1.69	33.96	67.0	0.2967
	Skull	PA	2	87	80	32	0.609	1.68	30.82	78.0	0.0190
	Abdomen	AP	2	79	50	20	1.998	1.61	30.48	67.0	0.0999
	Lumber Spine	LAT	2	85	78	30	2.996	1.57	34.48	87.0	0.0999

Table 2 shows thecalculated~~evaluated~~ESD~~entrance skin dose~~ (mGy) for each range of age for eachexamination with corresponding values of BMI. The ESD and BMI~~Body Mass Index~~ were 0.064, 0.213, 0.312, 0.481, 0.556, 0.511, 0.824, 1.428 (mGy) and 24.48, 24.48, 27.12, 28.22, 28.86, 30.22, 31.51~~and~~ 32.79 kgm^2 respectively. Comparative account on the mean entrance skin dose received by different age groups with corresponding body mass index values are presented numerically in **table 2** and **figure 1**.The mean entrance skin dose received by patient belonging to age groups of 0–10 years and 11–20 years, respectively, ranged from 0.064 to 0.213 mGv and body max index 24.48kg/m^2. Likewise patients between (21–30 years age group) and 31 – 40 years were found to receive an mean entrance skin dose ranging between 0.460 and 0.481 mGy and 21.07– 22.58 kg/m^2 respectively. The table have clearly shown

Comment [DC16]: Not clear. Delete.

Comment [DC17]: Not clear.
You may put it this way: The mean ESD was 0.06mGy for patients in 0-10years and 0.213mGy for those in the 11- 20 years age group.
Meanwhile, note that the information in your result text for table 2 does not tally with the contents of table 2. Eg there is no ESD of 0.213mGy in the table. Likewise there is no BMI of 24.48kg/m^2 in table 2. Please recheck.

Again you just presented result without discussion. Since you joined result presentation and discussion, one expects to see how your results relates to work in literature and its implications/your inferences about the result.

that a patient with high Body Mass Index received high Entrance Skin Dose that is, if the Body Mass Index decrease Entrance Skin Dose also decreases (that is, Body Mass Index is directly proportional to Entrance Skin Dose).

Table 2: Mean ESD and BMI according to~~corresponding to the~~ age range

Comment [DC18]: Tally table content with what you presented in the text.

Age Range~~/ Interval~~	BMI (kg/m^2)	Mean Entrance Skin Dose (mGy)
1-10	19.58	0.064
11-20	19.89	0.289
21-30	21.07	0.460
31-40	22.58	0.481
41-50	28.86	0.786
51-60	24.17	0.673
61-70	31.51	1.068
71-80	32.79	1.463

Table 3 shows the estimated ~~values~~ entrance skin dose values compared with internationally~~international~~ established diagnostic reference levels and published works. The obtained values were below theinternationally~~international~~ established diagnostic reference levels.

Table 3: Comparison of mean Entrance Skin Dose (mGy) with others published and established ESD forradiographic procedures

Comment [DC19]: Be consistent in how you present your tables. You either choose to include vertical and horizontal lines or remove them. Follow the author instruction presented by the journal on this.

Examination Type	Present study	Reference[10]	Reference [11]	Reference[2]
Chest PA and LAT	0.46	0.43	0.31	0.99
Abdomen AP	0.88	-	-	2.01

Pelvis AP	0.52	1.31	-	1.76
Lumber AP and LAT	0.98	3.25	5.95	2.18
Skull PA and LAT	0.46	-	-	1.91

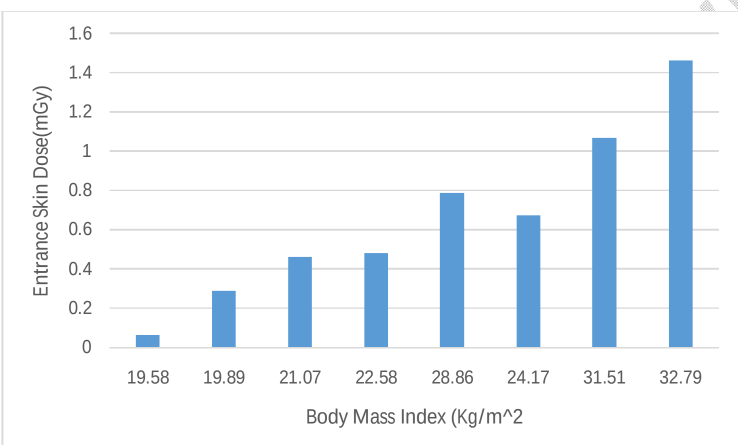

Figure 1: Chart showing Entrance Skin Dose against Body Mass Index

Comment [DC20]: Apart from the age the information here is the same as in table 2. So of what value is the fig? So I advise delete

It is clearly shown from figure 1, that a patient with high Body Mass Index received high Entrance Skin Dose that is, if the Body MassIndex decrease Entrance Skin Dose also decreases (that is, Body Mass Index is directly proportional to Entrance Skin Dose).

Conclusion

In ~~At~~ this work, the results of entrance skin dosesof patientswho underwent routine ~~undergoing routing~~ x-ray examinations at Federal Teaching Hospital, Gombecorrelated with body mass index are presented. The results showed that the~~amount of~~ entrance dose is directly proportional to the body mass index, that is the ~~the~~ higher the body mass index the higher the ~~amount of~~ entrance skin dose received by the patient. In addition, ~~the results of this study showed that~~ the ESD to~~of~~ patients at Federal Teaching Hospital, Gombewas compared to the results previously obtained~~presented~~ in Kashan, Iran. [2] and those reported by [10] and [11]. The values of ESD obtained in this study were found to be lower than ~~that of~~ already established and published references

Rec and lim

Comment [DC21]: Include recommendations and limitation of the study

References

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Comment [DC22]: Include place of publication

Comment [DC23]: Remove parenthesis and put the year before the page

Comment [DC24]: You are mixing up referencing styles. Please keep to the recommended journal style.

Comment [DC25]: Include journal name, issue number and page(s)

Comment [DC26]: Please keep to the recommended journal style.

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Comment [DC30]: Provide complete reference

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