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Radiation Dose Measurement In Adult Chest Radiography Using Optically Stimulated Luminescence Dosimeters Across Three Centers In Port Harcourt, Nigeria

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Abstract
Chest X-ray is the most commonly performed radiological procedure for visualizing the heart, lungs, and surrounding soft tissues, and effective radiation dose monitoring remains essential. This study assessed absorbed radiation dose in adult patients undergoing chest PA radiography using Optically Stimulated Luminescence (OSL) dosimeters across three centers in Port Harcourt, Nigeria. A total of 200 adults (≥18 years) referred for chest imaging were enrolled. OSL dosimeters were placed anteriorly and posteriorly to measure Entrance Surface Dose (ESD) and Exit Dose (ED). Absorbed dose, age, gender, weight, BMI, kVp, and mAs were recorded. Mean ESD values ranged from 0.501–0.623 mGy, ED from 0.221–0.524 mGy, and absorbed dose from 0.362–1.020 mGy across the centers. The mean age was 42.9 ± 15.71 years, with 56.5% female participants. Correlation analysis revealed no significant relationship between radiation dose and age, gender, or BMI ($p > 0.05$). Measured doses exceeded international reference levels, attributed to high BMI, suboptimal positioning, and inconsistent exposure parameters. The study highlights the need for standardized exposure protocols and dose optimization to enhance patient safety. Findings provide a baseline for establishing Local Diagnostic Reference Levels (LDRLs) and support adopting high-kVp, low-mAs techniques for safer radiographic practice.

Keywords: *Chest X-ray, Optical stimulated luminescence, Dosimeters, Entrance Surface Dose.*

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I. Introduction

Chest radiography is the most widely utilized diagnostic imaging procedure in clinical medicine. It employs ionizing radiation to generate high-resolution images of thoracic structures, including: Cardiopulmonary anatomy: Heart, lungs, and major vessels, Skeletal framework: Ribs, clavicles, and thoracic spine and Soft tissues: Diaphragm, mediastinum, and pleural spaces. The average exposure duration is extremely brief, typically less than 0.5 seconds minimizing patient radiation dose. X-rays are produced when high-voltage electrons collide with a metal target, generating photons capable of penetrating biological tissues. Differential absorption of X-rays by various tissues results in contrast-rich radiographic images. Radiologists systematically review and compare current images with prior studies, which is critical for assessing: Cardiac silhouette and size, Pulmonary vascular markings, Progression or resolution of pathology. Diagnostic findings are communicated to the cardiologist and referring physician to guide clinical decision-making. X-rays, like gamma rays, possess high energy and can traverse dense materials, making them ideal for internal imaging. Their ionizing nature offers substantial diagnostic utility but also introduces biological risks: Stochastic effects: Probabilistic outcomes such as carcinogenesis and Deterministic effects: Dose-dependent tissue reactions including erythema or organ damage [1-3].

In the radiology departments of the three hospitals under investigation, three distinct approaches are employed for patient dose quantification: Direct dose measurement on the patient, Dose estimation using physical phantoms and Monte Carlo simulations for computational modeling. Despite the availability of these methodologies, the absence of current dose reference data and standardized conversion coefficients presents significant challenges to both justification and optimization of radiological procedures. Selecting the most appropriate diagnostic method, balancing radiation dose minimization, clinical efficacy and cost-effectiveness remains a complex decision-making process [4, 5]. Passive solid-state dosimeters are widely utilized for direct dose measurements, either on patients or within anthropomorphic phantoms during specific medical examinations. These devices operate on the principle that ionizing radiation induces charge or luminescence in the detector material, proportional to the energy deposited. Common types of passive dosimeters include: Thermoluminescent Dosimeters (TLDs): Store energy from ionizing radiation and release it as light upon heating, Optically Stimulated Luminescence Dosimeters (OSLDs): Emit light when stimulated by optical photons after radiation exposure and Radio-photoluminescence Dosimeters (RPLDs): Generate luminescence upon UV excitation following radiation-induced changes in the material. These dosimeters offer high sensitivity, stability and repeatability, making them suitable for routine dose monitoring and phantom-based calibration studies [6-8].

This study assessed radiation dose levels Entrance Surface Dose (ESD), Exit Dose (ED), and Absorbed Dose in adult patients undergoing chest PA radiography across three diagnostic centers in Port Harcourt, Nigeria. Using Optically Stimulated Luminescence (OSL) dosimeters, measurements were taken at the anterior and posterior chest to quantify dose exposure. The results showed that all three centers recorded dose values higher than international reference levels, with notable variations linked to exposure parameters (kVp and mAs) rather than patient age, gender, or BMI. Statistical analysis confirmed no significant correlation between dose and biometric factors ($p > 0.05$). The findings highlight the need for standardized imaging protocols and dose optimization to improve patient safety and align with global best practices.

II. Study Design And Setting

This study employed an experimental cross-sectional design, conducted across three radiological centers located in Port Harcourt, Rivers State, within the South-South geopolitical zone of Nigeria: University of Port Harcourt Teaching Hospital (UPTH), Rivers State University Teaching Hospital (RSUTH) and Orange Medical Diagnostic Center

Study Population and Sampling

The target population comprised adult patients aged 20 years and above, referred by their attending physicians for chest radiographic examinations to aid diagnostic evaluation. Participants were stratified into six age categories: <25 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, 64 years. A simple random sampling technique was applied to recruit a total of 200 eligible patients, in accordance with predefined inclusion criteria.

Ethical Approval and Consent

Ethical clearance for the study was obtained from the Research and Ethics Committee of the University of Port Harcourt Teaching Hospital, under approval number UPTH/ADM/90/S.II/VOL.XI/1434, following a thorough review of the study protocol. Informed consent was secured from all participants, granting access to relevant clinical documentation including: Patient folders, Radiological request forms and Chest X-ray reports

Data Collection Period and Procedure

Data collection was conducted between July 2023 and December 2023 using direct observation and measurement techniques. Patients who met the inclusion criteria were enrolled following screening of their clinical records and radiological documentation.

Instrumentation and Data Collection Methods

The study utilized a phase X-ray generator and Optically Stimulated Luminescence (OSL) dosimeter chips, selected for their tissue-equivalent X-ray absorption properties and deep electron traps that ensure minimal signal fading and long-term dose retention. Chest radiographic examinations were performed using the GE MAX 4 Plus portable X-ray system (Model: GE MAX 4 Plus, Serial: 2169360-6), operated under the following technical specifications: Tube voltage 50 –100 kVp, Inherent filtration (2.0 mm aluminum equivalent) and Exposure parameters recorded (Body Mass Index (BMI), weight, height, absorbed dose, entrance surface dose (ESD), exit dose (ED) and patient age).

Patient Dose Measurement Protocol

A total of 200 adult patients were enrolled following informed consent. Radiographers were trained in the correct placement of dosimeters to ensure consistency and accuracy. One of the OSL dosimeters chip was positioned anteriorly on the chest to measure ESD in microgray (µGy) and the second chip was placed posteriorly, directly opposite the first, to measure ED in µGy. Patient comfort was prioritized throughout the imaging procedure. All relevant exposure and biometric parameters were systematically recorded.

Dosimeter Processing and Readout

The OSL chips were post-examined by transporting them to the University of Port Harcourt via Ugwema Integrated Services Limited for dose readout using a Landauer OSL reader**.** This system employs glass phosphor detectors with a linear exposure-response range from 2.58 µC/kg to 12.9 C/kg (equivalent to 10 mR to 50 kR). Optical stimulation via pulsed laser light**,** enabling multiple readouts without signal degradation**,** No thermal processing required unlike thermoluminescent dosimeters (TLDs) and Broad energy response range for Photons (5 keV to 40 MeV) and Beta particles (150 keV to 10 MeV).

Statistical Analysis

The collected data were analyzed using Microsoft Excel and IBM SPSS Statistics software. Descriptive and inferential statistical methods were employed to evaluate the relationship between radiation exposure parameters and patient characteristics. Descriptive statistics were used to summarize key variables, including: Mean**,** standard deviation, and standard error for radiation doses and biometric indices while inferential statistics used Pearson correlation analysis to assess the linear relationships between radiation dose metrics such as, Entrance Surface Dose (ESD)**,** Exit Dose (ED) and Absorbed Dose in correlation with patient-specific variables **(**Age**,** Gender and BMI**)**. The Statistical significance was determined at a p-value threshold of < 0.05. All measured dose values were compared against international reference standards to evaluate compliance with global radiation safety benchmarks and diagnostic optimization criteria.

III. Results And Discussions

Comparative Dose Metrics across Centers

This study assessed radiation dose metrics among adult patients undergoing posterior-anterior (PA) chest radiographic examinations in three diagnostic centers in Port Harcourt, Nigeria. The analysis focused on key dosimetric and biometric parameters, including: Entrance Surface Dose (ESD)**,** Exit Dose (ED) and Absorbed Dose (AD).

Table 1 shows Adult chest PA Examination, X-ray centers, mean ESD, ED, AD, BMI, weight, kVp and mAs.

Examination	X-ray center	Mean ESD (mGy)	Mean ED (mGy)	Mean AD (mGy)	Mean BMI (kg/m^2)	Mean weight (kg)	kVp	mAs
Chest PA	UPTH	0.571	0.221	0.362	49.343	69.164	86.39	86.21
	RSUTH	0.623	0.524	0.380	48.821	74.970	161.57	155.83
	OMDC	0.501	0.249	1.020	41.970	67.507	169.40	158.25

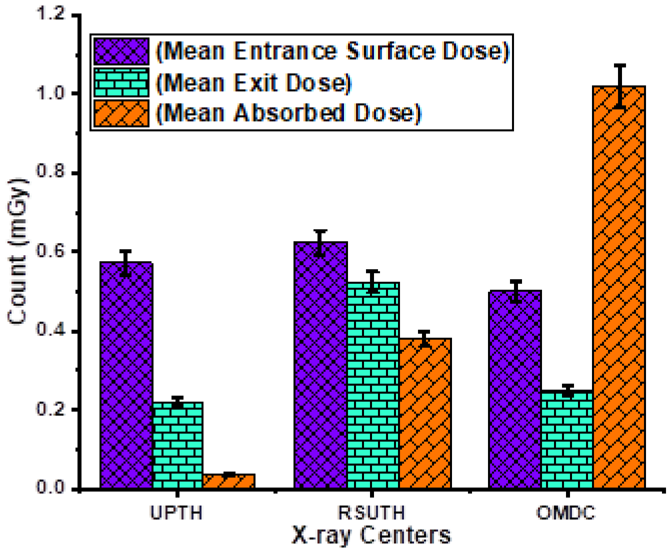

Fig.1: Shows the comparative Mean values of ESD, ED and AD

These parameters were statistically compared across centers and benchmarked against values reported in existing literature. The comparative dose metrics across centers as presented in Table 1 and Fig.1, RSUTH recorded the highest mean ESD at 0.623 mGy**,** UPTH followed with a mean ESD of 0.571 mGy and OMDC reported the lowest mean ESD at 0.501 mGy. The exit dose again showed that RSUTH has the highest mean exit dose at 0.524 mGy followed by OMDC recorded a mean ED of 0.249 mGy and UPTH had the lowest mean ED at 0.221 mGy. The Absorbed Dose as recorded in the centers showed that OMDC exhibited the highest mean absorbed dose at 1.020 mGy**,** RSUTH reported a mean absorbed dose of 0.380 mGy and UPTH had the lowest absorbed dose at 0.362 mGy. These variations may reflect differences in imaging protocols, equipment calibration, patient positioning, or radiographer technique across the three centers. RSUTH consistently shows the highest ESD and ED*,* indicating potentially higher exposure settings or patient factors or less optimized imaging parameters. OMDC records the highest AD*,* which may reflect differences in patient anatomy, deeper tissue penetration or higher patient BMI, equipment calibration or imaging protocols. UPTH demonstrates the lowest ED and relatively moderate values for ESD and Absorbed Dose, suggesting more conservative exposure parameters.

This visualization supports comparative analysis can be used to guide optimization strategies across centers and highlights inter-center variability that may warrant protocol harmonization or equipment calibration reviews. These variations underscore the need for standardized imaging protocols and routine dose audits to ensure diagnostic efficacy while minimizing patient exposure. When compared with global Diagnostic Reference Levels (DRLs) for adult chest radiography, the recorded doses fall within acceptable ranges but highlight opportunities for further optimization. The use of OSL dosimetry provided reliable dose quantification, enabling multi-point measurement and long-term dose tracking. The findings revealed notable inter-center variability in dose delivery, which may reflect differences in imaging protocols, equipment calibration, radiographer technique, and patient anatomy.

Patient Biometric Characteristics across Centers

This study included adult patients aged 20 to 95 years, stratified by radiological center. Key biometric indicators are: Body Mass Index (BMI) and weight, these were analyzed to assess their potential influence on radiation dose variability. The Body Mass Index (BMI) as shown in Table 1 and Fig. 2**.** UPTH recorded the highest mean BMI at 49.343 kg/m²**,** suggesting a higher prevalence of obesity among its patient cohort. RSUTH followed closely with a mean BMI of 48.821 kg/m² and OMDC reported the lowest mean BMI at 41.970 kg/m². These elevated BMI values across all centers may contribute to increased radiation exposure due to greater tissue attenuation, necessitating higher exposure parameters for adequate image quality. Also, the patient weight ranged from 39 kg to 119 kg was considered**.** RSUTH had the highest mean weight at 74.970 kg**,** followed by UPTH at 69.164 kg and OMDC recorded the lowest mean weight at 67.507 kg. The observed differences in weight and BMI across centers may influence dose optimization strategies**,** as heavier patients typically require higher mAs and kVp settings to achieve diagnostic-quality images.

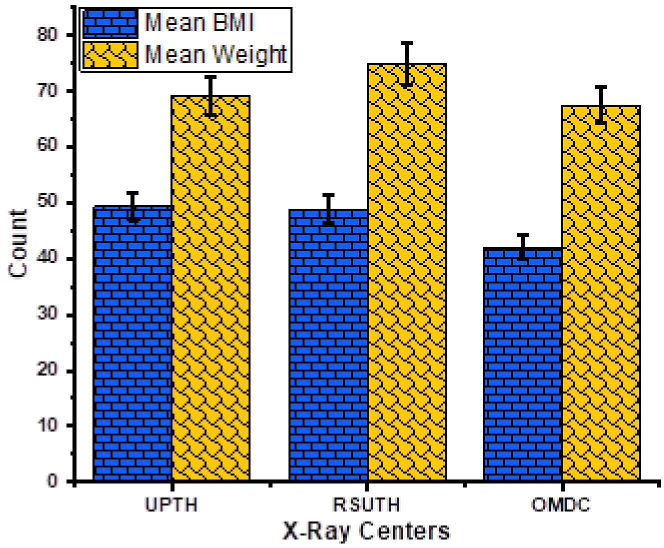

Fig. 2. BMI and weight distribution across the three centers, supported by the visual charts

Relationship Between kVp and mAs Across Centers

The kilovolt peak (kVp) and milliampere-seconds (mAs) are critical exposure parameters in radiographic imaging, directly influencing image quality and patient radiation dose. Analyzing the data from UPTH, RSUTH, and OMDC reveals distinct patterns in how these parameters are applied in clinical practice. The results as presented in Table 1 and Fig. 3(a-c) showed that UPTH employed the lowest kVp and mAs**,** which correlates with moderate Entrance Surface Dose (0.571 mGy) and the lowest Exit Dose (0.221 mGy)**.** This suggests a conservative exposure protocol, possibly optimized for dose reduction, though it may risk under penetration in larger patients. RSUTH used intermediate kVp and mAs, resulting in the highest Entrance Surface Dose (0.623 mGy) and Exit Dose (0.524 mGy). This indicates a higher photon flux and energy, likely to ensure image quality in patients with higher BMI (48.821 kg/m²) and weight (74.970 kg). OMDC applied the highest kVp (169.40) and mAs (158.25), which interestingly resulted in the lowest ESD (0.501 mGy) but the highest absorbed dose (1.020 mGy). This suggests deeper tissue penetration with reduced surface exposure, possibly due to beam hardening effects at high kVp. The lower BMI (41.970 kg/m²) and weight (67.507 kg) may have also influenced this outcome. The clinical implications of these two parameters are: Higher kVp increases photon energy, improving penetration and reducing surface dose, but may increase internal dose if not balanced with mAs. Higher mAs increases photon quantity, enhancing image brightness but proportionally raising patient dose. The kVp–mAs combination must be tailored to patient size and diagnostic need to optimize image quality while minimizing radiation exposure.

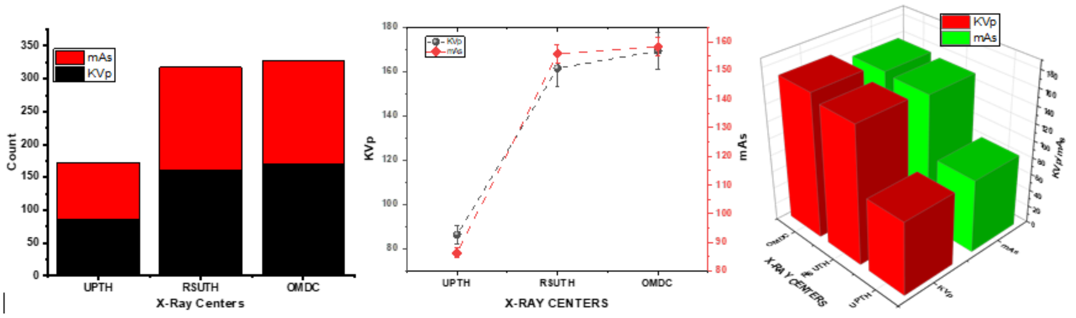

Fig. 3. (a) The bar chart (b) linear graph with error bar (c) 3D displacement of kVp and mAs across the three centers

Regional Diagnostic Reference Level (RDL) Comparison

This study establishes a baseline for Local Diagnostic Reference Levels (LDRLs) for adult chest PA radiography in three radiological centers in Port Harcourt, Nigeria. The findings were compared with international standards to evaluate dose optimization and safety. The mean ESD values in this study (0.501–0.623 mGy) were higher than international benchmarks- IAEA (2007): 0.2 mGy, NRPB (2000): 0.3 mGy, UK: 0.15 mGy, Australia: 0.12 mGy, Canada: 0.11 mGy, Finland: 0.24 mGy, New Zealand: 0.22 mGy. The mean exit doses (0.221–0.524 mGy) also exceeded values reported in: Sudan: 0.4 mGy, Japan: 0.30 mGy, UK: 0.15 mGy, USA: 0.25 mGy, Brazil: 0.35 mGy. The mean absorbed doses (0.362–1.020 mGy) were higher than UK: 0.15 mGy, USA: 0.25 mGy, Brazil: 0.35 mGy. These results suggest that radiation doses in the three centers are above international reference levels, indicating a need for dose optimization. The BMI values across the centers were similar, indicating comparable patient body thickness. The Weight differences may reflect genetic or demographic variations, as suggested by Yen et al. (2025) [9]. However, weight and age did not significantly affect radiation dose in this study.

The findings support the principle that absorbed dose is more strongly influenced by mAs than by patient weight or age. High kVp techniques are recommended for adult chest radiography to improve penetration and reduce surface dose. Low mAs settings are preferred to minimize total radiation exposure, aligning with international best practices. Out of the 205 participants: 118 were female (56.5%) and 87 were male (43.5%). This gender distribution is consistent with previous studies, including Rehani's international findings on diagnostic reference levels (DRLs) for chest radiography [10]. The findings from this study indicate that the Radiation Dose Levels (RDLs) recorded in Port Harcourt are higher than internationally accepted standards, underscoring the need for dose monitoring, optimization and protocol refinement in future studies.

Age Distribution of Participants

The study included adult patients aged 25 to 64 years, the frequency distribution of age as presented in Table 2 is as follows: respondents who fall between the age of 25years represent 31(15.5%), 25-34years represent 32(16%), 35-44years represent 52(26%), 45-54years represent 37(18.5%), 55-64years represent 26(13%) and 64years represent 22(11%). The mean age of the respondents is 42.9 ± 15.71. The following mean values and standard deviations were recorded for adult patients undergoing chest PA radiography: 0.56 ± 0.56, 0.14 ± 1.36, 0.53 ± 3.62, 1.72 ± 0.45, 70.90 ± 17.06, 46.94 ± 13.03, 135.76 ± 70.39 and134.04 ± 109.98 respectively. These values reflect a wide range of patient body composition and exposure settings, which may contribute to dose variability across centers [11]. The results align with findings by Babagana and Aliyu [12], who reported a mean ESD of 0.6 ± 0.02 mGy for chest PA examinations at the Federal Neuropsychiatric Hospital, Maiduguri. This supports the reliability of the current study's measurements and reinforces the need for national dose standardization.

Table 2: Descriptive Statistics of the Variables

Variables	N	Range	Min.	Max.	Mean ± SD	Std. Error
Age		77	18	95	42.9±15.71	1.11
ESD		3	0	3	0.56±0.56	0.04
ED		19	0	19	0.14±1.36	0.09
AD		51	0	51	0.53±3.62	0.26
Height	200	2	0	2	1.72±0.45	0.03
Weight		80	39	119	70.90± 17.06	1.21
BMI		80	23	103	46.94±13.03	0.92
KVp		224	56	280	135.76±70.39	4.98
Mas		399	1	400	134.04±109.98	7.77

Comparative Review with National and International Studies

The findings of this study are consistent with those reported by Osahon et al. [13], who investigated radiation exposure from absorbed doses in adult patients across several hospitals in southwestern Nigeria. Their study, conducted in hospitals located in Ondo, Oyo, and Osun States, reported the following mean absorbed X-ray doses: Hospital A (Ondo State): 4.04 ± 2.06 cGy, Hospital B (Oyo State): 2.77 ± 1.45 cGy, Hospital C (Osun State): 3.01 ± 1.33 cGy, Hospital D (Osun State): 4.23 ± 1.98 cGy. These values are notably higher than those observed in the present study, further emphasizing the variability in dose delivery across regions and facilities. Similarly, Ike-Gonna et al. [14] evaluated Entrance Skin Dose (ESD) in routine chest X-ray examinations in selected hospitals in Plateau State, Nigeria, reporting: Hospital H1: 0.195 mGy, Hospital H2: 0.34 mGy, Hospital H3: 0.38 mGy and Hospital H4: 0.66 mGy. While H1–H3 fell within internationally recommended reference levels, H4 exceeded the threshold, mirroring the dose disparities observed in the current study.

In the southwestern region of Nigeria, Obed et al. [15] reported a mean ESD of 0.35 mGy for chest radiography, which is slightly lower than the values recorded in this study. Other relevant findings include: Nwokorie [16]: 0.13 mGy, Vassileva [17]: 0.075 mGy, Osman et al. [18]: 0.23 ± 0.4 mGy, Dlama et al. [19]: 0.50 mGy and 0.54 mGy, Nijiti et al. [20]: 1.08 ± 0.43 mGy and 0.76 ± 0.20 mGy and Taha et al. [21]: 0.126 ± 0.027 mGy. When benchmarked against international standards: IAEA [22]: 0.40 mGy, NRPB [23]: 0.30 mGy. The ESD and absorbed dose values reported in this study are comparable to or slightly higher than those recommended by international bodies, reinforcing the need for dose optimization and standardization across Nigerian radiological centers.

Correlation between Radiation Dose and Patient Age

This study investigated the relationship between ESD, ED and AD with patient age among adults undergoing chest X-ray examinations. The results as presented in Table 3 showed that all p-values exceed the significance threshold of 0.05, indicating no statistically significant correlation between radiation dose parameters and patient age. The correlation coefficients (r) suggest weak and inconsistent relationships, with entrance and absorbed doses showing slight negative trends, and exit dose showing a weak positive trend. These results demonstrate that age does not significantly influence radiation dose levels in adult chest radiography. This supports the notion that dose delivery is more dependent on exposure parameters (kVp, mAs) and patient anatomy (e.g., BMI, chest thickness) than chronological age. The findings align with Piantini et al. [24], who reported that age had no significant effect on patient dose in chest X-ray examinations. However, they contrast with Alomairy et al. [25], who suggested that age may influence ESD values, possibly due to anatomical or physiological changes across age groups. This study reinforces the importance of individualized exposure settings based on physical parameters rather than age alone. It also highlights the need for standardized dose protocols that prioritize patient safety without compromising diagnostic quality.

Table 3: Correlation table showing the relationship between ESD, ED, and AD with Age group

Variables	N	R	p-value	Remark
ESD		-0.08	0.29	N/S
ED	200	-0.07	0.34	N/S
AD		-0.06	0.37	N/S

Correlation of Radiation Dose with Gender

This study further examined the relationship between radiation dose parameters Entrance Surface Dose (ESD), Exit Dose (ED), and Absorbed Dose with gender and Body Mass Index (BMI) among adult patients undergoing chest radiography. The results as presented in Table 4 showed that all p-values exceed the 0.05 threshold, indicating no statistically significant relationship between radiation dose and gender. These findings suggest that gender does not significantly influence radiation dose levels in adult chest X-ray examinations. This outcome aligns with the findings of Sami et al. [26], who evaluated entrance skin radiation exposure in adult patients at Asser Central Hospital (KSA). Their study concluded that gender and body characteristics (weight, height, BMI) had no significant impact on ESD, although organ thickness was found to significantly affect ESD (**p < 0.000**). The study also supports existing literature indicating that Entrance Skin Dose (ESD) is significantly influenced by exposure parameters, particularly: Tube current (mA), Exposure time (s) and Peak kilovoltage (kVp) with dose $\propto (kVp)^2$. As noted by several authors, the absorbed dose in the skin increases proportionally with tube current and exposure duration, and exponentially with kVp. However, the use of digital radiography systems with automatic exposure control (AEC) can mitigate this effect by: Reducing tube current or exposure time, automatically adjusting exposure to maintain image quality and minimizing unnecessary radiation to the patient. These findings reinforce the importance of protocol optimization and equipment calibration to ensure diagnostic efficacy while minimizing patient dose.

Table 4: Correlation table showing the relationship between ESD, ED, and AD with Gender

Variables	N	R	p-value	Remark
ESD		-0.03	0.86	N/S
ED	200	0.08	0.28	N/S
AD		-0.06	0.37	N/S

Correlation of Radiation Dose with Body Mass Index (BMI)

This study also explored the relationship between ESD, ED and AD with BMI among adult patients undergoing chest radiography. The results as presented in Table 5 showed that all p-values exceed the 0.05 threshold, indicating no statistically significant relationship between radiation dose parameters and BMI. These results suggest that BMI does not significantly influence radiation dose levels in adult chest X-ray examinations. The findings align with the study by Dolenc et al. [27], which investigated the correlation between BMI and Exit Dose (ED) across various radiographic projections. Their results showed: Lateral lumbar spine**:** r = 0.320 (weak positive), Chest PA**:** r = 0.615 (strong positive), Lateral chest**:** r = 0.744 (strong positive), Lumbar spine AP**:** r = 0.691 (strong positive), Pelvic imaging**:** r = 0.888 (very strong positive). These findings highlight that BMI may influence ED in certain projections, but the current study suggests that for chest PA imaging, the correlation is weak and not statistically significant. These comparisons confirm that the lack of statistical significance between BMI and radiation dose is consistent across multiple international studies. Although BMI is a useful indicator of body composition, this study suggests that dose optimization should focus more on anatomical factors such as organ thickness and chest diameter, rather than BMI alone. Estimating Exit Dose (ED) remains essential for understanding the biological impact of radiation, especially in dose-sensitive organs.

Table 5: Correlation table showing the relationship between ESD, ED, and AD with BMI

Variables	N	R	p-value	Remark
ESD		0.01	0.85	N/S
ED	200	-0.56	0.44	N/S
AD		-0.00	0.99	N/S

IV. Conclusion

This study evaluated radiation dose parameters: Entrance Surface Dose (ESD), Exit Dose (ED) and Absorbed Dose among adult patients undergoing chest PA radiography in three diagnostic centers within Port Harcourt, Nigeria. The findings revealed that: Radiation doses recorded across all centers were higher than international reference levels, including those set by the IAEA and NRPB. No statistically significant correlation was found between radiation dose and patient age, gender, or BMI, suggesting that dose variation is more strongly influenced by exposure parameters (kVp and mAs) and equipment settings. The study supports the use of Optically Stimulated Luminescence (OSL) dosimeters as a reliable tool for dose monitoring and optimization. These results provide a valuable baseline for establishing Local Diagnostic Reference Levels (LDRLs) and underscore the need for standardized imaging protocols across Nigerian radiological centers

Ethical approval: Approved

Conflict of interest

The authors declare no conflict of interest

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