**Research Paper**

# Assessment of radiation dose in adult chest and abdomen ct procedures using size-specific dose estimates in selected ct centers in rivers and delta states

**Eseka K[1*], Prof. Mokobia C E[2], Akpolile F. A[3], Dr. Illugo N.T[4], Egheneji A[5]**
[1*,4,5]Department of Physics, University of Delta, Agbor, Nigeria.
[2,3]Department of Physics, Delta State University, Abraka, Nigeria.

**Article Info**

***Article History:***
Received: 22 November 2024
Revised: 05 February 2025
Accepted: 13 February 2025
Published: 26 June 2025

***Keywords:***
Patient Demographics
Size-Specific Dose Estimation
CT Imaging
Radiation Dose
Dose Optimization

**ABSTRACT**

This study evaluates radiation dose levels in adult chest and abdomen CT procedures using Size-Specific Dose Estimates (SSDE) across selected CT centers in Rivers and Delta States. The data was analyzed using de-identified data from console records to ensure confidentiality. The study found that female patients had a more significant percentage of CT chest scans (54.30%) and abdominal scans (59.86%) than males. The patient group showed a wide age range (18 to 93 years). Adjustments in tube voltage and current intensity were indicated for patient size and imaging requirements. For chest scans, radiation exposure averaged 50.04 mGy (±11.34) and 523.2 mGy.cm (±112.33), while for abdomen scans, the average was 58.12 mGy (±19.58) and 725.81 mGy.cm (±114.07). ANOVA results revealed a significant association between age and dose-area product (DAP TRANS) for both chest and abdomen scans. Consistent scan settings remained constant across age categories, implying consistent scan settings irrespective of patient age. These findings emphasize the impact of patient demographics on CT scan parameters and radiation exposure, highlighting the need for individualized dose optimization strategies.

*Corresponding Author:*
Eseka K
Department of Physics, University of Delta, Agbor, Nigeria.
Email: kenneth.eseka@unidel.edu.ng

## 1. INTRODUCTION

Computed Tomography (CT) is an essential diagnostic instrument in medical imaging, yielding intricate cross-sectional images of the body. The elevated radiation doses linked to CT scans require stringent quality assurance (QA) and dosage optimization to guarantee patient safety [1], [2], [3]. Medical diagnostics extensively use Computed Tomography (CT) imaging; however, concerns about radiation dose exposure continue to be a significant issue. The Size-Specific Dose Estimate (SSDE) is a methodology established by the American Association of Physicists in Medicine (AAPM) Report No. 204 [4] to offer a more precise assessment of the radiation dose administered to a patient according to their size. In contrast to the CT Dose Index Volume (CTDIvol), which is based on a conventional phantom size, the Size-Specific Dose Estimate (SSDE) accounts for human body size, providing a tailored radiation dose assessment. Among the various strategies utilized for CT dose reduction, the implementation of diagnostic reference levels (DRLs) has become a common practice in medical facilities [5], [6] DRLs are employed to minimize the radiation doses administered to patients during CT scans. Setting up DRLs can help check radiation doses and enhance patient safety by encouraging lower dose levels while still keeping image quality and patient care high [7].

There is a surge in the use of DRLs in diagnosis for adult patients. The increase is due to its varying applications in medicine [8], [9], [10]. While CT scans offer invaluable diagnostic information regarding the appropriate patients, concerns have arisen regarding the radiation doses associated with the procedure. Several studies have shed light on the non-trivial radiological consequences associated with these doses [11], [12]. The National Radiological Protection Bureau (NPRB) submitted that high radiation levels characterize CT scans and constitute a significant portion of radiological examinations in the United Kingdom (UK) Quite recently, [13] indicated that this protocol (CT imaging) is the highest contributor of artificial sources of radiation to humans Table 1.

Table 1. % Contribution and Annual Dose Values for Varying Artificial Radiation Sources

| Source | % Contribution | Average Annual Dose (mSv) |
|---|---|---|
| Consumer products | 2 | 0.130 |
| Industrial | < 0.1 | 0.003 |
| Occupational | < 0.1 | 0.005 |
| Computed Tomography (CT) | 24 | 1.470 |

(Adapted from Mokobia, 2023)

CT technology will continue to change at a rapid pace, and radiologists, technologists, physicists, and department administrators will all need to reevaluate existing practice strategies and examination protocols to successfully integrate patient safety with complex CT scanners Table 2 into their practice [14]. This expected increase in utilization must be accompanied by awareness and understanding of radiation dose issues. In addition, as CT technology develops, the revision or updating of existing definitions, particularly with respect to CT dosimetry, may be required [15]. Computed tomography examinations of the chest and abdominopelvic (CAP) region are commonly employed to assess anatomical structures and diagnose malignancies in organs such as the lungs, liver, pelvic organs, lymph nodes, and bones [16]. The frequency of the latter has risen significantly, thanks to the widespread use of multi-detector row computed tomography scanner machines. Computed Tomography (CT) is an essential diagnostic instrument in contemporary medicine; however, it entails considerable radiation exposure, specifically 2225. 25 mGy·cm for abdominal CT scans, which exceeds international standards and highlights the necessity for protocol optimization [17], [18] in thoracic and abdominal imaging. Size-Specific Dose Estimates (SSDE) have been recommended to enhance the precision of patient radiation dose evaluations by considering individual body sizes [19].

A multitude of studies have assessed radiation levels from CT treatments throughout Nigeria. A research at Aminu Kano Teaching Hospital indicated a 75th percentile CTDIvol of 12 mGy and a Dose

Length Product (DLP) of unspecified value. In Rivers State, an evaluation of chest CT scans from three sites recommended Diagnostic Reference Levels (DRLs) of 10.6 mGy for CTDIvol and 414.70 mGy·cm for DLP. The observed levels were lower than the European Commission's Diagnostic Reference Levels, indicating a degree of optimization in the region [20], [21].

Conventional dose metrics such as CTDIvol and DLP fail to consider patient size, which may result in erroneous dosage evaluations. SSDE accounts for patient size, yielding a more personalized dose estimation. A study in Ghana indicated that the use of SSDE exposed underestimations of radiation doses by as much as 26% when depending exclusively on CTDIvol, underscoring the necessity of including SSDE into dose evaluations [21].

Research indicates considerable diversity in radiation exposures among various CT centers in Nigeria. A research in Lagos revealed significant disparities in organ doses among seven CT units, highlighting the absence of defined methods [22]. This heterogeneity underscores the necessity for standardized scanning techniques and routine dose assessments to guarantee patient safety. The evaluation of radiation doses in adult chest and abdominal CT procedures utilizing SSDE is essential for precise dose estimation and patient safety. Although several areas in Nigeria have advanced in refining CT techniques, considerable variability remains. Implementing SSDE and standardizing DRLs across CT centers, especially in Rivers and Delta States, are crucial measures for dose optimization and reducing radiation hazards to patients.

## Study Area

The research work was conducted in four out of the 16 identified scan centers that were contacted. These centers spread across the States of Rivers and Delta, Nigeria Figure 1 & Figure 2.

Figure 1. Map of Rivers State


Figure 2. Map of Delta State

## 2. RELATED WORK

Researchers from all over the world are working on finding out how much radiation is used in calculation tomography (CT) imaging, to ensure that patients are safe, while yet receiving acceptable clinical images. The size-specific dose estimate (SSDE) was introduced in 2001 by the American Association of Physicist in Medicine (AAPM), which takes into account the difference size in patients, making it more accurate to measure the dose. SSDE has been helpful in therapeutic settings for a wide range of patient groups, and its use has expanded gradually.

Setting up diagnostic reference levels (DRLs) is very important for keeping people safe from radiation in medical imaging. The European Commission's guidelines underline the significance of regular dose audits and optimisation efforts to maintain patient doses as low as possible. Recent research has focused on setting region-specific DRLs that consider the types of equipment available in that area and the types of patients living there. Regional studies in Sub-Saharan Africa have shown that CT dose practices may be very different, and the need for standardized protocols is essential. However, the use of SSDE calculations can make patient-specific dose estimations less accurate, and the need for standardized protocols is still a challenge in places with limited resources. The demographics of patients significantly impact the dose requirements and optimization measures for CT scans. Age-related factors, such as changes in body structure, affect radiation quality, and exposure settings need to be adjusted accordingly. Disparities in CT dose needs between men and women are also evident, with female patients often needing specific optimisation tactics due to their sensitivity to radiation. The size of a patient also plays a role in determining radiation dose, with automatic exposure control systems and size-specific techniques being crucial.

Modern CT technology has improved dose reduction while maintaining image quality, particularly in underdeveloped nations. Multi-detector row CT systems have made scans faster and safer, but the increasing frequency of exams necessitates attention to cumulative dosage effects and methods for justifying exams. Quality assurance and standardization in CT dose management have evolved, but standardization has been challenging in poor nations due to equipment and technical knowledge barriers. Current research on CT dosimetry in Sub-Saharan Africa is limited, with many studies focusing on rich countries with advanced healthcare systems. The current study fills these gaps by using the SSDE method for full dose evaluations at various CT centers in Nigeria, adding to the limited information on CT dosimetry in the region.

## 3. METHODOLOGY

Data were collected using data collection sheets designed to include all the variables of the study, including age, gender, tube voltage, tube current, rotation time, organ volume CT dose index, dose length product, and effective dose value.

### Research Design

This study was structured as a retrospective cross-sectional analysis focused on adult patients who were referred for CT scans of the chest and abdominopelvic regions. Notably, the research methodology ensured that the investigator did not interact directly or indirectly with patients during or after the study period.

### 3.1 Study Population

Data (clinical history, scan protocol and parameters, contrast administration where applicable, positioning instructions, radiation dose information, scan range and quality control checks) was collected for a total of five hundred and eighty patients (580) that comprised adult male and female who were referred for CT scan of the chest and abdominopelvic region from the console of the CT scanners Table 2 in the four centers that accepted for the work to be carried out in their centers. The centers were then identified with codes (A, B, C & D). The chest and pelvic examination were selected for this study because, during the examination, critical organs (the heart, liver, stomach, testes, ovaries and other vital organs) that contribute to effective dose are irradiated.

### 3.2 Sample Size

The sample size for establishing the Diagnostic Reference Levels (DRLs) in this research followed the European Commission's recommendation of a minimum of 10 standard-sized patients [23]. However, data from more than 10 patients per studied center were collected to broaden the study's base and enhance the statistical significance of the results.

### 3.3 Sampling Techniques

This study involved all adult patients who were referred for only chest, and abdominopelvic CT scans at the specified study centers.

### 3.4 Inclusion Criteria

Standard-sized adult male and female patients 18 years and above whose weights were within 70±10 kg were included in this study. In contrast, adult patients whose body weights were above or below the recommended standard size (70 ± 10 kg) were excluded [24].

### Data Analysis

Patient information (age, gender), tube voltage, tube current, rotation time(s), organ examined, CTDIvol, and dose length (DLP) were collected over time from the console of the CT imaging machine in each of the hospitals studied [25], [26]. To evaluate the Size-Specific Dose Estimates (SSDE) involved in this study, we relied on the conversion factor, which is based on the four different measurements of torso thickness to represent patient size [14]. By using digital

Table 3 calipers on the scanner console, the anteroposterior dimension (AP), the lateral dimension (LAT), the sum of the dimensions (AP + LAT), and the effective diameter (Deff) were obtained.

Effective Diameter ($D_{eff}$)

$$D_{eff} = \sqrt{AP + LAT} \quad 1$$

Where AP is the anteroposterior diameter, and LAT is the lateral diameter of the patient's torso

Water-Equivalent Diameter $D_w$

$$D_w = 2\sqrt{\frac{A_w}{\pi}} \quad 2$$

Where $A_w$ is the cross-sectional area of the patient in the CT scan, adjusted for tissue composition based on attenuation values (HU). AAPM Report 220. The $A_w$ is generated from the CT console.

Size-Specific Dose Estimate (SSDE):

$$SSDE = f_{size} \times CTDI_{vol} \quad 3$$

Where $f_{size}$ is the size-based conversion factor for the torso, and $CTDI_{vol}$ is the volume CT dose index. The conversion factor $f_{size}$ for the chest and abdomen for an adult CT patient whose AP diameter is 32 cm is put at 0.9 for any of the body regions [21].

## 4. RESULTS AND DISCUSSION

### Chest Results

Table 2. Technical Characteristics of the CT Scanners

| Center | Manufacturer | Model | Date Installed/Scan Mode | Slice |
|---|---|---|---|---|
| A | Siemens | Healthineers | 2019 Helical/Axial | 64 |
| B | Neusoft | Neu Viz | 2021Helical/Axial | 128 |

| | | | | |
|---|---|---|---|---|
| C | GE | Revolution Acts | 2019Helical/Axial | 8 |
| D | Toshiba | Aquillion | 2018 Helical/Axial | 64 |

Table 3. Monitor Calipers Quality Measurement Test

| Center | Calipers Measurement ± |
|---|---|
| A | + 0.4 |
| B | + 0.2 |
| C | + 0.3 |
| D | + 0.2 |

Table 4. Presents the Frequency and Percentage of Gender Distribution (N=221) for CT Chest Cases across Different Hospitals

| Variables | | Frequency | Percentage |
|---|---|---|---|
| Gender | F | 120 | 54.30 |
| | M | 101 | 45.70 |
| Hospitals | A | 58 | 26.24 |
| | B | 52 | 23.53 |
| | C | 54 | 24.43 |
| | D | 57 | 25.79 |

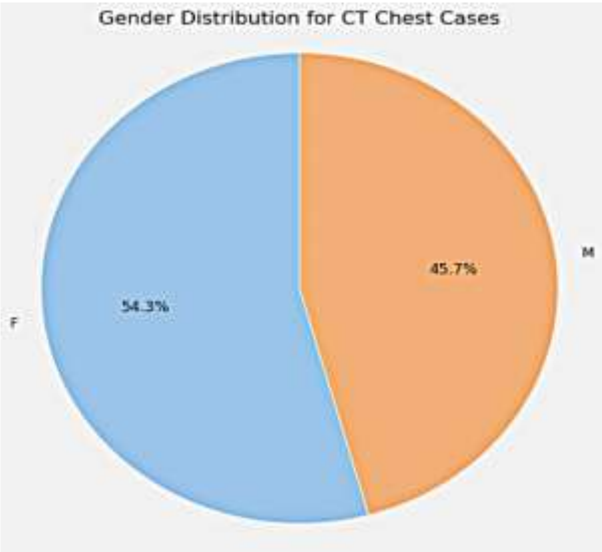


Figure 3. Frequency and Percentage of Gender Distribution

### Interpretation

**Gender Distribution**: Figure 3 the pie chart shows that 54.3% of the Table 4 CT Chest cases are female (F), while 45.7% are male (M). This indicates a slightly higher representation of females in the patient population for these cases.

**Hospital Distribution**: The second pie chart shows how the cases are spread out among four hospitals. Hospital A has the highest examples, with 26.24% of them, and the hospital is behind with 25.79%. Hospitals have the same percentage of B and C, with 23.53% and 24.43% of the total respectively. This distribution can help us understand how many patients in each hospital and how they are using their resources. These charts give a clear picture of the demographic and institutional distribution of whistle chest patients, which can help in planning and manage resources.

Table 5. Presents Descriptive Statistics for All CT Chest Patients.

| Variables | Min | Max | Mean | Standard Deviation. |
|---|---|---|---|---|
| Age | 18 | 89 | 48.65 | 15.03 |
| Kv | 120 | 150 | 131.24 | 3.56 |
| ma | 75 | 450 | 154.32 | 5.71 |
| Rotation time (s) | 0.73 | 0.85 | 0.78 | 0.043 |
| CTDIvol | 48.72 | 68.0 | 50.04 | 11.34 |
| DLP | 504.0 | 574.6 | 523.2 | 12.33 |
| DAP TRANS | 16.05 | 43.74 | 29.81 | 7.42 |
| $D_w$ | 24.84 | 33.12 | 28.60 | 4.39 |
| DLAT | 17.55 | 51.43 | 32.41 | 9.87 |
| $D_{eff}$ | 16.43 | 41.62 | 28.78 | 8.61 |
| SSDE | 6.55 | 7.47 | 6.80 | 5.67 |

Table 6. Analysis of Variance between the Patient's Age and the Measurement Parameters for all Patients from CT Chest

| | | The Sum of Squares | Df | Mean Square | F | P-Value |
|---|---|---|---|---|---|---|
| DAP TRANS | within groups<br>Between groups<br>Total | 52.06 | 11<br>387.12 | 8.53<br>28<br>439.18 | 2.92<br>15.14 | 0.0323 |
| DLAT | within groups<br>Between groups<br>Total | 136.75 | 18<br>531.84 | 16.93<br>41<br>668.59 | 1.71<br>21.22 | 0.1106 |
| $D_{eff}$ | within groups<br>Between groups<br>Total | 48.69 | 12<br>394.24 | 9.76<br>43<br>44.93 | 2.26<br>13.05 | 0.0638 |
| SSDE | within groups<br>Between groups<br>Total | 48.69 | 12<br>394.24 | 9.76<br>43<br>44.93 | 2.26<br>13.05 | 0.0638 |

With 120 women (54.30%) and 101 men (45.70%), the 221 individuals in the study show a somewhat more significant percentage of female patients having CT scans. With relatively equal distribution among the hospitals, patients are spread throughout four hospitals: Hospital A (26.24%), Hospital B (23.53%), Hospital C (24.43%), and Hospital D (25.79%). Though Hospital B has the fewest patients, Hospital A has the most; nonetheless, the differences in hospital patient counts are minor. Table 5 shows that CT chest patients' ages range from 18 to 89 years, with an average of 48.65 years (±15.03) representing differences in patient size. The tube voltage (kV) ranges from 120 to 150 kV, averaging 131.24 kV (±3.56), and the current intensity (mA) from 75 to 450 mA, averaging 154.32 mA (±5.71) reflecting variations in exposure based on patient size. The Computed Tomography Dose Index Volume (CTDIvol) estimates radiation exposure and ranges from 48.72 to 68.0 mGy, with an average of 50.04 mGy (±11.34).

Water-Equivalent Diameter (Dw), Lateral Diameter (DLAT), and Effective Diameter (Deff) differ among individuals, averaging 28.60 cm (±4.39), 32.41 cm (±9.87), and 28.78 cm (±8.61), respectively. Ranging from 6.55 to 7.47 mGy, the Size-Specific dosage Estimate (SSDE) averages 6.80 mGy (±5.67), thereby changing dosage projections depending on patient size.

The ANOVA results Table 6 reveal that DAP TRANS has a statistically significant relationship with age ($F = 2.92$, $p = 0.0323$), suggesting that age influences dose distribution. However, DLAT, Deff, and SSDE do not show statistically significant associations with age ($p>0.05$), indicating that age does not strongly impact these parameters in CT chest scans.

## Abdomen Results

Table 7. Presents the Frequency and Percentage of Gender Distribution (N=147) For CT Abdomen Cases across Different Hospitals.

| Variables | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| F | 88 | 59.86 |
| M | 59 | 40.14 |
| **Hospitals** | | |
| A | 39 | 26.53 |
| B | 41 | 27.89 |
| C | 35 | 23.81 |
| D | 32 | 21.77 |

Table 8. Descriptive Statistics for All CT Abdomen Patients.

| Variables | Min | Max | Mean | Standard Deviation. |
|---|---|---|---|---|
| Age | 18 | 93 | 52.48 | 19.41 |
| Kv | 125 | 160 | 130.05 | 4.16 |
| ma | 75 | 430 | 125.66 | 3.89 |
| Rotation time (s) | 0.70 | 0.88 | 0.79 | 0.023 |
| CTDIvol | 56.34 | 85.31 | 58.12 | 9.58 |
| DLP | 620.20 | 858.90 | 725.81 | 14.07 |
| DAP TRANS | 15.41 | 39.65 | 26.04 | 6.52 |
| $D_w$ | 26.07 | 34.96 | 31.54 | 5.31 |
| DLAT | 19.23 | 61.51 | 42 .08 | 16.41 |
| $D_{eff}$ | 15.49 | 38.11 | 25.00 | 7.49 |
| SSDE | 8.06 | 11.17 | 9.44 | 3.98 |

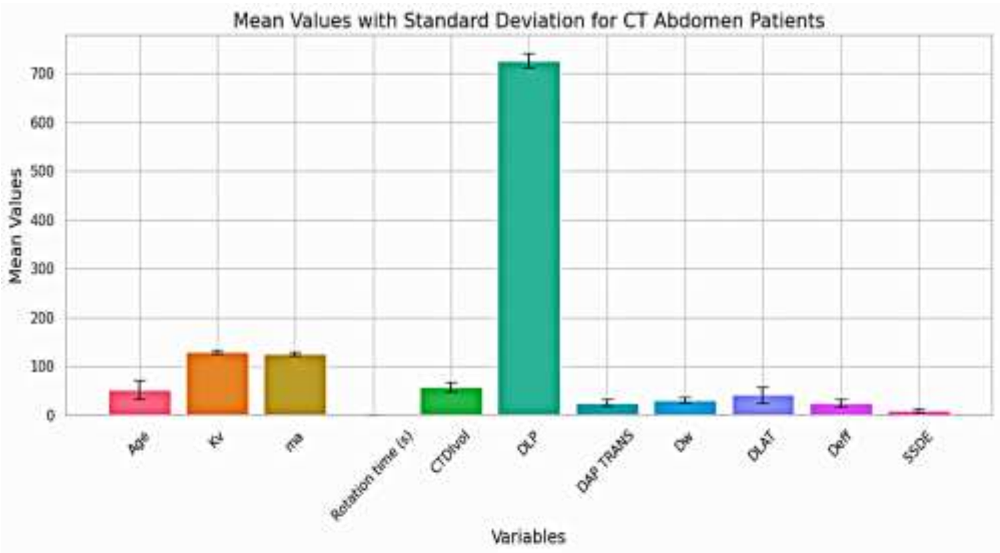


Figure 4. Descriptive Statistics for All CT Abdomen Patients

The histogram shows the average values for each variable, and the error bars show the standard deviation Figure 4. DLP (Dose-Length Product) and CTDIvol (Computed Tomography Dose Index volume) are two variables that have larger mean values, which means that the levels of exposure are higher. The Age variable has a mean of about 52.48 years, which is typical for the patient group. The Rotation time is very short, which means that the scanning procedure is swift, which is important for patient comfort and efficiency. The standard deviations illustrate how much each measurement can change.

For example, DLAT (Lateral Dose) has a higher range of values than other variables. This visualisation makes it easier to see how critical parameters in CT abdomen imaging are spread out and how much they can change. This is important for making sure patients are safe and getting the best imaging results.

Table 9. Analysis of Variance between the Patient's Age and the Measurement Parameters for all Patients from CT Chest.

| | | **The Sum of Squares** | **Df** | **Mean Square** | **F** | **P-Value** |
|---|---|---|---|---|---|---|
| DAP TRANS | within groups Between groups Total | 34.12 293.54 327.66 | 12 26 | 7.08 16.31 | 3.97 | 0.0078 |
| DLAT | within groups Between groups Total | 144.27 489.11 633.38 | 17 36 | 14.22 22.46 | 1.60 | 0.1503 |
| $D_{eff}$ | within groups Between groups Total | 53.48 357.19 410.67 | 12 43 | 9.76 13.05 | 1.86 | 0.8729 |
| SSDE | within groups Between groups Total | 157.32 334.06 491.38 | 12 | 14.51 41 | 0.62 17.53 | 0.8729 |

The gender distribution for CT abdominal cases Table 7 includes 147 patients, including 88 females (59.86%) and 59 males (40.14%), which perform a higher proportion of female patients receiving CT abdominal scans. The distribution of patients among hospitals is as follows: Hospital A accounts for 22.53%, Hospital B for 27.89%, Hospital C for 23.81% and Hospital D for 21.77%. The delivery is balanced, with the highest percentage of patients in hospital B and the lowest in hospital D.

Table 8, provides descriptive data for abdominal patients, showing the age limit of 18 to 93 years, the average which is 52.48 years (±19.41) reflecting an asymmetrical patient population. The tube voltage (kV) varies from 125 to 160, with a mean of 130.05 kV (± 4.16). Current intensity (mA) ranges from 75 to 430, with an average of 125.66 mA (± 3.89). The CTDIvol ranges from 56.34 to 85.31 mGy, with an average of 58.12 mGy (±9.58), estimating radiation exposure. The Dose-Length Product (DLP) spans 620.20 to 858.90 mGy·cm, averaging 725.81 mGy·cm (±14.07). The Water-Equivalent Diameter (Dw) averages 31.54 cm (±5.31), reflecting patient size variations, while the Size-Specific Dose Estimate (SSDE) ranges from 8.06 to 11.17 mGy, with a mean of 9.44 mGy (±3.98). Table 9 presents ANOVA results, where DAP TRANS shows a statistically significant association with age ($F = 3.97$, $p = 0.0078$), suggesting that age impacts dose distribution. However, DLAT ($p = 0.1503$), Deff ($p = 0.8729$), and SSDE ($p = 0.8729$) do not show significant associations with age, indicating that these parameters remain relatively unaffected by patient age in CT abdomen scans.

The study shows a slightly higher proportion of female patients (54.30%) undergoing CT scans of the chest compared to males (45.70%), with a relatively balanced distribution across hospitals. The age range of patients is diverse (18 to 89 years), with a mean of 48.65 years (±15.03). Variations in tube voltage (120 to 150 kV) and current intensity (75 to 450 mA) suggest adjustments based on patient size and imaging needs. Radiation exposure levels, measured through CTDIvol (50.04 mGy ±11.34) and DLP (523.2 mGy·cm ±12.33), vary among patients. Differences in water-equivalent diameter (Dw), lateral diameter (DLAT), and effective diameter (Deff) reflect patient size variations. The ANOVA analysis indicates that age significantly impacts DAP TRANS ($p = 0.0323$). Still, DLAT, Deff, and SSDE show no significant age-related differences, suggesting that overall scan settings for CT chest remain consistent across different age groups. The study equally shows a higher proportion of female patients (59.86%) undergoing CT abdomen scans compared to males (40.14%), consistent with CT chest scan trends. The distribution of patients in hospitals is very similar, with slight anomalies, with the hospital with the highest percentage at 27.89% with B and the lowest at the hospital at 21.77%. The comprehensive age limit (18 to 93 years) with an average of 52.48 years (±19.41) underlines an odd patient population. The amendment of tube voltage (125 to 160 kV) and current intensity (75 to 430 mA) indicates that the scan parameter is sewn according to specific patient characteristics, including size and imaging requirements. Radiation exposure levels differ among patients, with a CTDIvol mean of 58.12 mGy (±9.58) and a DLP mean of 725.81 mGy·cm (±14.07).

The water-equivalent diameter (Dw) (31.54 cm ±5.31) and SSDE (9.44 mGy ±3.98) reflect patient size differences and dose adjustments. ANOVA results indicate a significant association between age and DAP TRANS ($p = 0.0078$), suggesting that age affects dose distribution. However, DLAT, Deff, and SSDE do not show significant relationships with age ($p > 0.05$), indicating that these parameters remain stable across different age groups.

## 5. CONCLUSION

This study evaluated radiation dose levels in adult chest and abdomen CT procedures using Size-Specific Dose Estimates (SSDE) across selected CT centers in Rivers and Delta States. The results indicate a slightly higher proportion of female patients undergoing these scans, with a relatively even distribution across hospitals, suggesting equitable access to CT imaging. The broad age range of patients highlights the diverse demographics of individuals undergoing these examinations. Variations in tube voltage and current intensity reflect tailored scan settings based on patient size and imaging requirements, ensuring optimized radiation exposure.

The analysis of radiation dose parameters, including CTDIvol, DLP, and SSDE, reveals variations corresponding to differences in body size and scan protocols. ANOVA findings show a significant association between age and DAP TRANS, indicating that age influences radiation dose distribution. However, the lack of significant relationships between age and DLAT, Deff, and SSDE suggests that scan settings remain stable across different age groups. These findings emphasize the importance of patient-specific dose optimization to balance diagnostic accuracy and radiation safety. Continuous evaluation and refinement of CT protocols are essential to maintaining adherence to radiation safety standards and ensuring optimal dose management based on patient size.


### Acknowledgments

The authors deeply appreciate the management, staff and personnel of all the radiological centers where the research took place, the Lagos State University radiation monitoring unit (LURMU), and the management and staff of Lily Hospital Warri.

### Funding Information

No funding


### Author Contributions Statement

| Name of Author | C | M | So | Va | Fo | I | R | D | O | E | Vi | Su | P | Fu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eseka K | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ | ✓ | ✓ |  | ✓ |  |  |
| Prof. Mokobia C E |  | ✓ |  |  | ✓ |  | ✓ | ✓ | ✓ | ✓ | ✓ |  |  |  |
| Anita F.A | ✓ |  | ✓ | ✓ |  | ✓ |  | ✓ |  | ✓ |  | ✓ |  |  |
| Illugo N.T |  |  |  | ✓ |  |  |  | ✓ |  |  | ✓ |  |  |  |
| Egheneji A |  |  |  |  |  |  |  |  |  | ✓ |  |  |  | ✓ |

C : **C**onceptualization
M : **M**ethodology
I : **I**nvestigation
R : **R**esources
Vi : **Vi**sualization
Su : **Su**pervision

| | | |
|---|---|---|
| So : **So**ftware | D : **D**ata Curation | P : **P**roject administration |
| Va : **Va**lidation | O : Writing - **O**riginal Draft | Fu : **Fu**nding acquisition |
| Fo : **Fo**rmal analysis | E : Writing - Review & **E**diting | |

## Conflicts of Interest

The authors declare no conflicts of interest.

## Ethical Approval

Ethical clearance for this study was obtained from Lily Hospital Ltd Warri, Delta State and other selected CT centers before the commencement of the research. Additionally, permission to access the necessary data from the consoles of the various CT scan machines was equally obtained from the management of these respective hospitals.

## Informed Consent Statement

Taking part in this study was completely up to the person. Before gathering data, all of the radiological centres and patients who took part were told what the study was about, what kind of data would be collected, and what steps would be taken to protect their privacy and keep their identities secret. To keep participants' privacy safe, the analysis did not use any personal information. We only looked at patients' medical and imaging data to see how much radiation was used in adult chest and abdominal CT scans using Size-Specific Dose Estimates (SSDE). All procedures followed the ethical criteria set by the relevant institutional review boards and the Declaration of Helsinki. Participants gave their consent in line with ethical standards, and they could leave at any time without affecting their medical care.

## Data Availability Statement

The raw data underlying the findings of this study are available from the corresponding author, Eseka K, upon reasonable request. Due to confidentiality and data protection policies related to patient information, the data are not publicly accessible. Researchers interested in accessing the data for verification or further analysis should contact the corresponding author at kenneth.eseka@unidel.edu.ng.

## REFERENCES

[1] K. M. Kanal, P. F. Butler, D. Sengupta, M. Bhargavan-Chatfield, L. P. Coombs, R. L. Morin, & J. A. Seibert. (2017). U.S. diagnostic reference levels and achievable doses for 10 adult CT examinations. Radiology, 284(1), 120–133. doi.org/10.1148/radiol.2017161911

[2] C. Jenkens, H. Boere, B. Wagemans, P. Nelemans, E. Nijssen, R. Smith-Bindman, J. Wildberger, & A. Sailer. (2021). Probability of receiving a high cumulative radiation dose and primary clinical indication of CT examinations: A 5-year observational cohort study. BMJ Open, 11. doi.org/10.1136/bmjopen-2020-041883

[3] C. O. Molua. (2021). Impact of natural disasters on mental health and behavioral changes. Journal of Mental Health Issues and Behavior, 1(02), 21-33. doi.org/10.55529/Jmhib.12.21.33

[4] American Association of Physicists in Medicine. (2012). Size-specific dose estimates in pediatric and adult CT examinations (AAPM Report No. 204). ISBN: 978-1-936366-08-8

[5] K. Eseka, C. Molua, A. O. Ukpene, & A. Egheneji. (2022). Investigating the protective effectiveness of the shielding parameters for diagnostic X-ray rooms in some selected hospitals in Agbor Metropolis - Delta State. FUDMA Journal of Sciences, 6(2), 116-119. doi.org/10.33003/fjs-2022-0602-914

[6] P. Shrimpton, J. Jansen, & J. Harrison. (2016). Updated estimates of typical effective doses for common CT examinations in the UK following the 2011 national review. The British Journal of Radiology, 89(1057), 20150346. doi.org/10.1259/bjr.20150346

[7] J. Damilakis, G. Frija, B. Brkljačić, E. Vano, R. Loose, G. Paulo, H. Brat, & V. Tsapaki. (2023). How to establish and use local diagnostic reference levels: An ESR EuroSafe Imaging expert statement. Insights into Imaging, 14(1), 27. doi.org/10.1186/s13244-023-01369-x
[8] E. Hall. (2000). CT scanning: Risk versus benefit. Journal of Radiological Protection, 20, 347-348. doi.org/10.1088/0952-4746/20/4/001
[9] C. O. Molua, K. Eseka, & A. O. Ukpene. (2022). Investigating background ionizing radiation in some selected locations in Agbor Metropolis. Journal of Energy Engineering and Thermodynamics, 2(4). http://journal.hmjournals.com/index.php/JEE
[10] K. Eseka, O. C. Molua, & O. A. Upkene. (2018). Determination of annual gonnadal dose equivalent arising from natural radioactivity in soil of Ika North East Local Government Area of Delta State, Nigeria. International Journal of Basic Science and Technology, 3(1), 1.
[11] C. O. Molua, & U. O. Anthony. (2024). Effects of GSM phone radiation on sleep quality. Journal Healthcare Treatment Development, 4(03), 1-14. doi.org/10.55529/jhtd.43.1.14
[12] A. Saravanakumar, K. Vaideki, K. N. Govindarajan, S. Jayakumar, & B. Devanand. (2013). Establishment of diagnostic reference levels in CT for selected procedures in Pudhuchery. Indian Journal of Medical Physics, 39, 50-55.
[13] C. E. Mokobia. (2023). My three arrows: A victory over cyberphobia (100th inaugural lecture). Delta State University.
[14] A. Amer, W. Ahmed, A. Hussein, A. Mehta, A. Khalif, & M. Abdullah. (2023). Estimation of radiation dose in CT chest and abdomen examinations using size-specific dose estimates. Open Access Library Journal, 10, e9843. doi.org/10.4236/oalib.1109843
[15] American College of Radiology. (2018). ACR practice parameter for diagnostic reference levels and achievable doses in medical X-ray imaging. ACR.
[16] A. M. Nor, K. Zunaide, A. H. Hasyma, H. D. W. Jeannie, H. N. Kwan, & K. A. K. Muhammad. (2021). Evaluation of organ dose and image quality metric of pediatric CT chest-abdomen-pelvis (CAP) examination: An anthropomorphic phantom study.
[17] M. Abba, M. A. Umar, & M. Sadiq. (2018). Assessment of patient radiation dose in CT examination in Aminu Kano Teaching Hospital, Kano, Nigeria. Bayero Journal of Pure and Applied Sciences, 11(1), 121-125. https://www.ajol.info/index.php/bajopas/article/view/185871
[18] O. C. Molua. (2023). Studying the radioactive isotopes present in drinking water sources and evaluating their health risks. Innovations, 73(2), 218-226.
[19] M. K. Kalra, A. D. Sodickson, & W. W. Mayo-Smith. (2014). Size-specific dose estimates in pediatric and adult body CT: Introduction and practical guide. Radiology, 265(1), 158–172.
[20] E. S. Amadi, & E. E. Esien. (2023). Assessment of patients' radiation doses during computed tomography chest imaging examination: Proposed diagnostic reference level. Herald Open Access. https://www.heraldopenaccess.us/openaccess/assessment-of-patients-radiation-doses-during-computed-tomography-chest-imaging-examination-propose-diagnostic-reference-level
[21] C. O. Molua. (2022). The environmental impact of exposure to electromagnetic fields (EMF) on health. Journal of Environmental Impact and Management Policy, 4(3), 22-34.
[22] J. A. Ademola, & O. I. Fawole. (2019). Organ dose evaluation and effective dose estimation in adult CT examinations in Lagos, Nigeria. European Journal of Medical and Health Sciences, 1(3), 45-52.
[23] European Commission. (2019). Guidance on diagnostic reference levels (DRLs) for medical exposures (Radiation Protection No. 109). European Commission.
[24] J. Moreland, F. Gleeson, & B. Nicholson. (2020). Negotiating the risks of computed tomography in primary care. The British Journal of General Practice, 70(691), 86-87. doi.org/10.3399/bjgp20X708029
[25] L. Noferini, C. Fulcheri, A. Taddeucci, M. Bartolini, & C. Gori. (2014). Considerations on the practical application of the size-specific dose estimation (SSDE) method of AAPM Report 204. Radiological Physics and Technology, 7, 296-302. doi.org/10.1007/s12194-014-0265-2
[26] J. M. Boone, K. J. Strauss, D. D. Cody, C. H. McCollough, & M. F. McNitt-Gray. (2012). Size-specific dose estimates (SSDE) in pediatric and adult body CT examinations (AAPM Report No. 204). AAPM.

**How to Cite:** Eseka K, Prof Mokobia C E, Akpolile F. A, Dr. Illugo N.T, Egheneji A. (2025). Assessment of radiation dose in adult chest and abdomen ct procedures using size-specific dose estimates in selected ct centers in rivers and delta states. Journal Healthcare Treatment Development (JHTD), 5(1), 13–26. https://doi.org/10.55529/jhtd.51.13.26

**BIOGRAPHIES OF AUTHORS**

| | |
|---|---|
|  | **Eseka K** Area of Specialization: Radiation and Health Physics Department of Physics My qualifications are NCE, B.Sc Ed, M.Sc, and PhD (awaiting). I attended Delta State University, Abraka. Currently, I am PhD student (Radiation and Health Physics) in the Department of Physics Abraka. My interest is centred on radiation protection and measurement. I hail from Aliokpu in Ika South Local Government Area of Delta State. Email: kenneth.eseka@unidel.edu.ng |
|  | **Prof Mokobia C E** Area of Specialization: Radiation and Health Physics Department of Physics I am a professor of Radiation and Health Physics. My qualifications are NCE, B.Sc Ed, M.Sc, M.Phil and PhD. I attended Ahmadu Bello University (ABU), Zaria and Obafemi Awolowo, University (OAU), Ile-Ife. Currently, I am holding a professorial chair (Radiation and Health Physics) in the Department of Physics. My interest has centred on radiation protection and my research work has mainly been on natural radioactivity in different matrixes, investigation of the radiation dosimetric capabilities of certain natural materials and background ionization radiation (BIR) measurements in the environment. My latest interest is 'radon in the environment'. I hail from Ubulu-Uno in Aniocha South Local Government Area of Delta State. Email: mokobia@delsu.edu.ng |
|  | **Akpolile F. A** Area of Specialization: Radiation and Health Physics Department of Physics. Currently, I am a lecturer at the Delta state university, Abraka in the department of Physics. I hold a B.Sc degree in physics, M.Sc in environmental and health physics and a P.hd degree in radiation and health physics. Email: akpolileaf@delsu.edu.ng |
|  | **Dr. Illugo N.T** A lecturer at the University of Delta, Agbor, with a specialization in Environmental and Radiation Physics. I strive to create an engaging and inclusive learning environment where every student feels valued and motivated to participate. Currently, I am a lecturer at the University of Delta in the department of Physics Email: nwanne.ilugo@unidel.edu.ng |

| | |
|---|---|
|  | **Egheneji A** I am a Lecturer at the University of Delta Agbor. I hold B.Sc and M.Sc degree from Delsu Abraka. I am at an advance stage of my PhD program (Radiation and Health Physics). My interest is centred on radiation protection and measurement. I hail from Abraka in Ethiope East Local Government Area of Delta State. Email: anthony.egheneji@unidel.edu.ng |