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Evaluation of dosimetric indicators of routine CT scan examinations in adults in two health facilities in the city of Yaoundé, Cameroon: a retrospective study

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Abstract: Radiation protection aims at an appropriate level of protection for patients, staff, populations and the environment against the adverse effects of exposure to ionizing radiation without unnecessarily limiting desirable activities that can be associated with this exposure.

Objective: Evaluate the doses delivered to adult patients during routine cerebral, thoracic, abdominal and abdominopelvic computed tomography (CT) examinations performed in two health facilities in the city of Yaoundé.

Methods: This was a retrospective, descriptive, cross-sectional study conducted over six months, from March to August 2025, in two healthcare facilities in Yaoundé. The records of adult patients aged 18 years and older who underwent cerebral, thoracic, abdominal, or abdominopelvic CT scans, with or without contrast injection, were included. Sociodemographic, clinical, technical, and dosimetric data were collected from registries and patient records and then analyzed using SPSS version 20. The main dosimetric indicators studied were CTDIvol and the dose-length product (DLP).

Results: The sample comprised 111 examinations: 76 brain CT scans (68.5%), 16 chest CT scans (14.4%), 13 abdominal CT scans (11.7%), and 6 abdominopelvic CT scans (5.4%). Men represented 65.7% of the patients, with a male-to-female ratio of 1.9. The mean age was 45 years. The median CTDIvol was 24.75 mGy for brain CT, 11.2 mGy for chest CT, 13.6 mGy for abdominal CT, and 10.8 mGy for abdominopelvic CT. The 75th percentiles of CTDIvol were 42.15 mGy, 14.95 mGy, 37.56 mGy, and 25.22 mGy, respectively. The 75th percentiles of DLP were respectively 837, 15, 512, 65, 1808.9 and 1017.2 mGy·cm.

Conclusion: The observed dose levels varied depending on the type of examination and the imaging center. Cerebral values were lower than several international reference values, while thoracic, abdominal, and abdominopelvic values were higher according to the reference values considered. The establishment of national diagnostic reference levels, combined with regular audits and the optimization of acquisition protocols, appears necessary to strengthen patient radiation protection in Cameroon.

Keywords: *Dosimetry; computed tomography; CTDIvol; dose-length product; adult; Yaoundé.*

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Introduction

Computed tomography (CT) is a cross-sectional imaging technique based on measuring X-ray attenuation and enabling the reconstruction of two-dimensional and three-dimensional images. Its technological development and widespread availability have contributed to an increase in the number of examinations performed. CT thus constitutes a significant source of medical exposure to ionizing radiation and justifies particular attention to optimizing the doses delivered to patients (Moifo et al., 2017). Ionizing radiation can produce deleterious biological effects. In medical radiology, radiation protection is based in particular on the principles of justification and optimization; dose limitation does not apply to patients in the same way as to exposed workers and the public (International Commission on Radiological Protection [ICRP], 1991). In this context, diagnostic reference levels (DRLs) constitute an optimization tool that allows for the identification of practices with unusually high or low dose levels. In CT, CTDIvol and DLP are the main indicators used to characterize exposure levels, with the 75th percentile commonly used for establishing RDAs from dosimetric surveys (Schegerer et al., 2019). In Cameroon, previous work has shown variability in delivered doses depending on the facility and acquisition protocols, highlighting

the importance of having national reference values and strengthening the optimization of practices (Moifo et al., 2017). The present study therefore aimed to evaluate the doses delivered to adult patients during routine brain, thoracic, abdominal, and abdominopelvic CT examinations performed in two healthcare facilities in the city of Yaoundé.

Materials and Methods

This was a retrospective descriptive cross-sectional study conducted in two healthcare facilities in Yaoundé: the Yaoundé Military Hospital and the Centre Médical le Promoteur de la Bonne Santé (Medical Center Promoter of Good Health). The study period extended from March to August 2025, a total of six months. The two facilities had different CT scanners: a 120-slice Toshiba Aquilion at Centre Médical le Promoteur de la Bonne Santé, and a 32-slice Neusoft at the Yaoundé Military Hospital, which was commissioned in 2022. Included were records of brain, thoracic, abdominal, and abdominopelvic CT scans performed with or without contrast injection in patients aged 18 years or older, regardless of the indication, when the scan was performed in a single acquisition. Records were randomly selected. The study was authorized by the directors of both facilities. Sociodemographic and clinical data, including age, sex, and indication for the examination, were collected from patient records and files. Technical parameters, including tube voltage (kV), charge (mAs), acquisition length, pitch, and rotation time, as well as CTDIvol and DLP dosimetric indicators, were obtained from the dose reports displayed by the scanners. Records from the Centre Médical Le Promoteur de la Bonne Santé were coded C1 and those from the Yaoundé Military Hospital C2. The data were entered into an Excel spreadsheet and then analyzed using SPSS. Dosimetric values were compared to available national and international references, including those reported in Togo, Algeria, Germany, South Korea, and other international surveys.

Results

A total of 111 records were included in the final sample, 39 from the Centre Médical Le Promoteur de la Bonne Santé and 72 from the Yaoundé Military Hospital. Patients ranged in age from 18 to 83 years and were divided into four age groups: 18–38 years, 38–58 years, 58–78 years, and ≥ 78 years. The average age was 45 years, and the 58–78 age group was the most represented. (34.24%). Males predominated with 73 patients (65.7%), representing a sex ratio of 1.9.

Brain CT scans were the most frequently performed examinations (68.5%), followed by thoracic CT scans (14.4%), abdominal CT scans (11.7%) and abdominopelvic CT scans (5.4%).

Table I. Distribution of examination types according to centers.

CT scan type	C1 n	C1%	C2 n	C2%	Total n	Total %
Cerebral	30	76.9	46	63.8	76	68.5
Thoracic	9	23.1	7	9.7	16	14.4
Abdominal	0	0	13	18.2	13	11.7
Abdomino-pelvic	0	0	6	8.3	6	5.4
Total	39	100	72	100	111	100

Technical parameters varied depending on the center and the anatomical region examined. At center C2, kV and mAs values were generally more variable, and the automatic dose modulation system was used for the majority of examinations. At center C1, some parameters, particularly kV and mAs, appeared more standardized. Abdominopelvic CT scans had the greatest average acquisition length (49.72 cm), with a maximum extent of 54.41 cm.

Table II. Distribution of the main technical parameters according to the center

Exam	Center	kV	mAs	Average length (cm)	Length range (cm)	Pitch	Rotation(s)
Cerebral	C1	120	75	26.67	14.06–41.34	0.75	0.50
Cerebral	C2	100-120	102.6–249.4	29.02	18.69–36.42	0.8	0.65
Thoracic	C1	120	75	32.92	36.04–43.62	0.5	1.65
Thoracic	C2	100-120	116.5–182.2	41.15	37.10–46.90	0.8–1	1.35
Abdominal	C2	100-120	24.8–175.3	48.50	15.55–58.64	0.8–1	1.75
Abdomino-pelvic	C2	100-120	20.8–148	49.72	33.51–54.41	0.8–1	1.75

Median CTDIvol values were generally lower at center C1 than at center C2. Cerebral CT showed a higher median value (24.75 mGy), while thoracic CT showed a value of 11.2 mGy. Median CTDIvol values were 13.6 mGy for abdominal CT and 10.8 mGy for abdominopelvic CT. The 75th percentiles were 42.15 mGy, 14.95 mGy, 37.56 mGy, and 25.22 mGy, respectively.

Table III. Distribution of CTDIvol at the 75th percentile according to the type of examination.

Exam type	50th percentile (mGy)	75th percentile (mGy)
Cerebral	24, 75	42.15
Thorax	11.2	14.95
Abdominal	13.6	37.56
Abdomino-pelvic	10.8	25.22

The dose-length product (DLP) assessment showed variations depending on the center and type of examination. The values in Table IV correspond to the median (50th percentile) and the 75th percentile. For cerebral examinations, the median was 671.15 mGy·cm and the 75th percentile was 837.15 mGy·cm. For thoracic examinations, these values were 432 and 512.65 mGy·cm, respectively. Abdominal examinations had the highest values, with a median of 1623 mGy·cm and a 75th percentile of 1808.9 mGy·cm. For abdominopelvic examinations, the median was 578.4 mGy·cm and the 75th percentile was 1017.2 mGy·cm.

Table IV. Distribution of DLP according to the type of examination.

Exam type	50th percentile (mGy·cm)	75th percentile (mGy·cm)
Cerebral	671.15	837.15
Thoracic	432	512.65
Abdominal	1623	1808.9
Abdomino-pelvic	578.4	1017.2

Discussion

The aim of this study was to evaluate the radiation doses delivered to adult patients during routine cerebral, thoracic, abdominal, and abdominopelvic computed tomography (CT) scans performed at two healthcare facilities in Yaoundé. A total of 111 scans were analyzed, with a clear predominance of cerebral scans (68.5%). This predominance is comparable to that reported in several dosimetric surveys, although the distribution of scans may vary depending on the populations studied, the clinical indications, and the organization of the imaging departments (Adambounou et al., 2021; Moifo et al., 2017). The mean age was 45 years, a value close to that reported in a study conducted in Algeria in 2024 (Aksoum El Mehdi, 2024). The male predominance observed in our series could be related to the characteristics of the population attending the two institutions studied. For brain scans, the median CTDIvol value was 24.75 mGy, while the 75th percentile reached 42.15 mGy. This latter value was lower than that reported in the 2019 German series (60.41 mGy) and in the 2021 Togolese series (Adambounou et al., 2021), but higher than that reported in the 2024 Algerian series, namely 39.44 mGy (Aksoum El Mehdi, 2024). These differences can be explained by the variability in acquisition protocols, technical parameters, scanner characteristics, and optimization practices between the different institutions. In our series, the median cerebral DLP value was 671.15 mGy·cm. Regarding thoracic examinations, the median CTDIvol value was 11.20 mGy, while the 75th percentile was 14.95 mGy. This latter value was lower than that reported in Algeria, namely 19.64 mGy, but higher than some values reported in South Korea in 2022 (7.6 mGy) and in Switzerland, where values of 9.3 and 13 mGy had been reported (Treier et al., 2010). A similar trend was observed for thoracic DLP, with a median value of 432 mGy·cm and a 75th percentile of 512.65 mGy·cm, compared to 324.2 mGy·cm reported in South Korea in 2022. For abdominal examinations, the median CTDIvol value was 13.60 mGy, while the 75th percentile reached 37.56 mGy. This latter value was higher than that reported in Algeria in 2024 (30.39 mGy) and that observed in South Korea in 2022 (8.9 mGy). Regarding abdominal DLP, the median value was 1623 mGy·cm, while the 75th percentile was 1808.90 mGy·cm, a value also higher than that reported in South Korea (437.7 mGy·cm). These discrepancies could be related to differences in acquisition protocols, the length of the region examined, and the technical parameters used. For abdominopelvic examinations, the median CTDIvol value was 10.80 mGy, compared to 15 mGy in the 2006 British series (Shrimpton et al.,2006). The 75th percentile was 25.22 mGy, a value higher than the 10.69 mGy reported in the Togolese series. Regarding abdominopelvic DLP, the median value was 578.40 mGy·cm, while the 75th percentile reached 1017.20 mGy·cm, compared to 745 mGy·cm reported in England. Overall, the differences observed between our series and data published in other countries can be explained by several factors, including the technical characteristics of the scanners, acquisition protocols, clinical indications, the length explored, and the automatic current modulation methods. They may also be influenced by the morphological characteristics of the patients and by the practices

specific to each institution. These results highlight the importance of regular evaluation of dosimetric practices in CT. The use of CTDIvol and DLP allows for monitoring exposure levels associated with different protocols and identifying situations where optimization might be necessary. Comparing the values obtained with available diagnostic reference levels is therefore a relevant tool for contributing to improved radiation protection for patients in Cameroonian hospitals.

Boundaries

This study has some limitations. First, the number of examinations analyzed was relatively small, which may limit the generalizability of the results. Second, abdominal and abdominopelvic examinations were only performed at one center, which may introduce bias related to the practices specific to that institution. Furthermore, the retrospective nature of the study is another limitation. In addition, the available information did not allow for a systematic distinction between protocols performed with or without contrast injection, nor for systematic control of patient weight or body shape. These factors are likely to influence acquisition parameters and, consequently, the dosimetric indicators obtained.

Conclusion

Our study highlights the variability of dosimetric indicators depending on the type of CT scan and the international comparative series. Certain 75th percentile values, particularly for abdominal and abdominopelvic scans, appear relatively high compared to some published data. These observations support the need for enhanced dosimetric monitoring, the establishment of local diagnostic reference levels, and the continuous optimization of CT scan protocols in the studied institutions.

Conflict of interest

On behalf of all authors the corresponding author declares no conflicts of interest

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