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Radiation Dose Measurement (Ctdivol and Dlp) In Ct Thorax And Abdomen According To Patient's Body Weight And Gender

Deepak Katiyar*[1], Dr Vijay Kishor Chakravarti[2], Shubhanshi Rani[3], Ishant[4], Shivam Agarwal[5], Dr. Praveen Katiyar[6], Mishka Mustafa[7], Shubham Sharma[8]

*[1]Assistant Professor, Department of Radiological Imaging Techniques, Teerthanker Mahaveer University College of Paramedical Sciences, TMU, Moradabad, Uttar Pradesh, India-244001. Email ID: katiyardeepakbrit2156@gmail.com
[2]Demonstrator, Department of Radiological and Imaging Technology, Faculty of Paramedical Sciences, UPUMS, Saifai, Etawah, Uttar Pradesh, India. Email id - kishorvijay737@gmail.com
[3]Assistant Professor, Institute of Paramedical Sciences, GIMS, Greater Noida, Uttar Pradesh, India. Email ID-shubhanshikomal@gmail.com
[4]Assistant Professor, Department of Radiography and Imaging Technology, School of Health and Allied Sciences, Sanskaram University, Patauda, Haryana, India-124108. Email ID: ishant.allied@sanskaramuniversity.ac.in
[5]Ph.D. Scholar, School of Health Sciences, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India-208024. Email ID: shivamagarwal50283@gmail.com
[6]Associate Professor, School of Health Sciences, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India-208024. Email ID: dr.praveenkatiyar@gmail.com
[7]Assistant Professor, Radiological Imaging Techniques, T.S. Mishra University, Lucknow, Uttar Pradesh, India-226008. Email ID: sayyedamishka313@gmail.com
[8]Assistant Professor, Department of Radiological Imaging Techniques, Teerthanker Mahaveer University College of Paramedical Sciences, TMU, Moradabad, Uttar Pradesh, India-244001. Email ID: sh946645@gmail.com

Correspondence Author
Deepak Katiyar, Email ID: katiyardeepakbrit2156@gmail.com

ABSTRACT

Background: Computed Tomography (CT) utilizes differential x-ray absorption by tissues to produce cross-sectional images. Radiation dose in CT is commonly described using Computed Tomography Dose Index (CTDIvol) and Dose Length Product (DLP).This study carried out to evaluate the effect of patient body weight and gender on radiation dose indices (CTDIvol and DLP) in NCCT abdomen and thorax examinations.

Methods: This prospective observational study was conducted in the Radiology Department, Teerthanker Mahaveer Hospital and Research Centre, Moradabad, Uttar Pradesh, India, over one year. A total of 160 adult patients (≥18 years; 100 abdomen and 60 thorax) with body weight 50–75 kg were included. CTDIvol (mGy) and DLP (mGy/cm) values were recorded from routine NCCT abdomen and thorax examinations and analyzed according to body weight (50–60 kg, 61–70 kg, >70 kg) and gender using one-way ANOVA and independent t-test.

Results: In NCCT thorax, mean CTDIvol values were 16.40, 16.28, and 16.29 mGy, and mean DLP values were 732.92, 716.51, and 640.22 mGy/cm across the three weight groups, respectively. In NCCT abdomen, mean CTDIvol values were 16.95, 16.10, and 16.30 mGy, and mean DLP values were 821.87, 852.59, and 815.66 mGy/cm across the weight groups. According to gender, mean CTDIvol and DLP were 16.3 mGy and 696.2 mGy/cm in males, and 16.5 mGy and 759.7 mGy/cm in females for thorax; and 16.2 mGy and 842.9 mGy/cm in males, and 16.9 mGy and 819.7 mGy/cm in females for abdomen. Statistical analysis revealed no significant differences ($p > 0.05$) in CTDIvol or DLP with respect to weight or gender.

Conclusion: CT radiation doses in NCCT abdomen and thorax examinations among adults (50–75 kg) were not significantly influenced by body weight or gender. Standardized CT protocols provide consistent radiation exposure across patient subgroups, supporting radiation safety and adherence to diagnostic reference levels.

KEYWORDS: Computed Tomography (CT), CTDIvol, Dose Length Product (DLP), NCCT, Radiation Dose.

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INTRODUCTION

Computed tomography (CT) is a widely used imaging modality that provides detailed cross-sectional visualization of internal organs and structures [1]. The technique involves absorption of x-rays by tissues of varying density, which are reconstructed into sectional images by computer algorithms [2]. With the increasing use of CT in clinical practice, concerns about radiation exposure have grown, as CT contributes significantly to the cumulative medical radiation dose received by patients worldwide [3]. Radiation exposure in CT is commonly quantified using standardized dose descriptors, namely the Computed Tomography Dose Index volume (CTDIvol) and the Dose Length Product (DLP) [4]. CTDIvol reflects the mean absorbed dose within the scanned volume, adjusted for the pitch factor, while DLP represents the total radiation dose delivered, calculated by multiplying CTDIvol with the scan length [5]. Both measures are routinely available on CT scanners and are recommended for monitoring patient dose levels and for establishing diagnostic reference levels (DRLs) [6]. Patient-related factors such as body weight, body mass index (BMI), and gender are known to influence image quality and may necessitate variation in scanning parameters [7]. However, the impact of these variables on CTDIvol and DLP in routine abdominal and thoracic CT examinations remains underexplored in Indian settings [8]. The present study was undertaken to evaluate radiation dose parameters (CTDIvol and DLP) in non-contrast CT (NCCT) thorax and abdomen examinations and to analyze their variation with respect to patient's body weight and gender.

MATERIALS & METHODS

This prospective, observational, clinical study was conducted in the Department of Radiology, Teerthanker Mahaveer Hospital and Research Centre, Moradabad, Uttar Pradesh, India, over a period of twelve months from March 2021 to March 2022, after obtaining ethical clearance from the Paramedical Research Committee (PRC) of Teerthanker Mahaveer University. A total of 160 patients (100 abdomen and 60 thorax) who were referred for non-contrast CT (NCCT) examinations and fulfilled the inclusion criteria were enrolled after informed consent. Patients with a history of prior radiation therapy, pregnancy, contrast allergy, or severe systemic illness were excluded. For each patient, body weight was measured using a calibrated weighing machine, and examinations were performed on departmental CT protocols. Radiation dose parameters, including CTDIvol (mGy) and DLP (mGy·cm), were obtained from the scanner-generated dose report. The recorded values were stratified according to patient body weight (50–60 kg, 61–70 kg, and >70 kg) and gender (male/female). Data were organized in Microsoft Excel and subjected to statistical analysis using one-way ANOVA to compare radiation doses across weight categories and Student's t-test to assess differences between genders, with $p < 0.05$ considered statistically significant.

RESULTS

Study population

A total of 160 patients were included in the study, comprising 100 abdomen (62.5%) and 60 thorax (37.5%) examinations. Among them, 106 were males (66.2%) and 54 were females (33.8%). The distribution of patient weight showed that 61 patients (38.1%) were in the 50–60 kg category, 73 (45.6%) in the 61–70 kg category, and 26 (16.2%) weighed >70 kg (Table 1, Table 2).

Table 1. Distribution of patients according to study group and gender (n = 160)

Variable	Category	Frequency	%
Group	Abdomen	100	62.5
	Thorax	60	37.5
Gender	Male	106	66.2
	Female	54	33.8

Table 2. Distribution of patients according to body weight (n = 160)

Weight (kg)	Frequency	%
50–60	61	38.1
61–70	73	45.6
>70	26	16.2

Radiation dose according to weight (overall population)

The mean CTDIvol and DLP values across the three weight groups are shown in Table 3. One-way ANOVA revealed no statistically significant differences in either CTDIvol or DLP according to body weight ($p > 0.05$).

Table 3. Mean CTDIvol and DLP values according to body weight (n = 160)

Weight (kg)	CTDIvol (mGy) Mean ± SD	DLP (mGy·cm) Mean ± SD
50–60	16.71 ± 2.88	782.50 ± 127.62
61–70	16.17 ± 0.99	802.26 ± 116.33
>70	16.29 ± 0.02	775.17 ± 93.28

ANOVA: F = 1.398 (CTDIvol), F = 0.728 (DLP); p = 0.250, 0.485

Radiation dose according to weight (abdomen group)

In the abdomen group (n = 100), the mean CTDIvol ranged from 16.10–16.95 mGy and DLP from 815.66–852.59 mGy·cm. Differences across weight categories were not statistically significant ($p > 0.05$) (Table 4).

Table 4. Mean CTDIvol and DLP values according to body weight in abdomen group (n = 100)

Weight (kg)	CTDIvol (mGy) Mean ± SD	DLP (mGy·cm) Mean ± SD
50–60	16.95 ± 3.82	821.87 ± 55.35
61–70	16.10 ± 1.24	852.59 ± 99.72
>70	16.30 ± 0.02	815.66 ± 56.50

ANOVA: F = 1.287 (CTDIvol), F = 2.195 (DLP); p = 0.281, 0.117

Radiation dose according to weight (thorax group)

In the thorax group (n = 60), the mean CTDIvol ranged from 16.28–16.40 mGy and DLP from 640.22–732.92 mGy·cm. One-way ANOVA showed no significant differences between weight groups ($p > 0.05$) (Table 5).

Table 5. Mean CTDIvol and DLP values according to body weight in thorax group (n = 60)

Weight (kg)	CTDIvol (mGy) Mean ± SD	DLP (mGy·cm) Mean ± SD
50–60	16.40 ± 0.62	732.92 ± 170.64
61–70	16.28 ± 0.01	716.51 ± 90.27
>70	16.29 ± 0.01	640.22 ± 54.46

ANOVA: F = 0.624 (CTDIvol), F = 1.222 (DLP); p = 0.540, 0.302

Radiation dose according to gender

Independent *t*-test showed no statistically significant differences between males and females in either abdomen or thorax groups ($p > 0.05$). Results are summarized in Table 6.

Table 6. Mean CTDIvol and DLP values according to gender

Group	Parameter	Gender	Mean ± SD	t-value	*p*-value
Abdomen	CTDIvol (mGy)	Male	16.2 ± 1.0	-1.561	0.122
		Female	16.9 ± 3.8		
	DLP (mGy·cm)	Male	842.9 ± 90.0	1.384	0.169
		Female	819.7 ± 56.0		
Thorax	CTDIvol (mGy)	Male	16.3 ± 0.0	-1.508	0.137
		Female	16.5 ± 0.7		
	DLP (mGy·cm)	Male	696.2 ± 87.4	-1.767	0.083
		Female	759.7 ± 192.6		

DISCUSSION

This prospective cross-sectional study was conducted in the Department of Radiology, Teerthanker Mahaveer Hospital and Research Centre, Moradabad, during 2020–2022, with the objective of assessing radiation dose indices in NCCT abdomen and thorax examinations in adult patients. A total of 160 patients were enrolled (100 abdomen, 60 thorax) and stratified by body weight (50–60 kg, 61–70 kg, and >70 kg) and gender. Our findings indicate that in adults (≥18 years, 50–75 kg), radiation dose indices remain stable across weight and gender categories, suggesting effective protocol optimization. This contrasts with the study by **Ogbole et al. (2010)**, who reported significant increases in CTDIvol and DLP across weight groups in paediatric chest and abdominopelvic CT examinations. They observed CTDIvol values ranging from 1.2 to 5.8 mGy and DLP from 21.5 to 233 mGy·cm in children, underscoring weight-dependent variation. By contrast, our study in adults found no such differences, likely reflecting standardized protocol adjustments in adult imaging [9]. **Linet et al. (2009)** reported higher radiation doses in adults compared to children, with mean effective doses of 6.1 mSv in adults versus 3.9–4.4 mSv in paediatric and adolescent groups, highlighting age-related escalation. However, within our adult population, weight and gender did not significantly influence CTDIvol or DLP, suggesting that optimized adult CT protocols mitigate such variation [10]. **Hamd et al. (2025)** documented mean CTDIvol and DLP values (22.94 ± 5.64 mGy and 1493.80 ± 392.13 mGy·cm, respectively), substantially higher than those observed in our study (CTDIvol ≈ 16.1–16.9 mGy; DLP ≈ 640–852 mGy·cm). This difference may reflect institutional variations in acquisition protocols, scanner type, and radiation optimization practices [11]. The relatively lower values in our study highlight the effectiveness of dose management strategies and adherence to the ALARA principle. Overall, the present study demonstrates that radiation doses in NCCT abdomen and thorax examinations in adults remain consistent across weight and gender categories. In contrast to paediatric and international data, our findings suggest that protocol standardization contributes to dose stability and potentially reduces unnecessary radiation exposure. Regular dose monitoring and periodic comparison with diagnostic reference levels (DRLs) remain essential to maintain patient safety.

CONCLUSION

This study demonstrated that radiation dose indices (CTDIvol and DLP) in NCCT abdomen and thorax examinations of adult patients (≥18 years, 50–75 kg) showed no statistically significant variation according to body weight or gender. The findings suggest that standardized CT protocols ensure dose uniformity across patient subgroups, thereby supporting radiation safety practices. Compared with previously published international data, the relatively lower dose values observed in our setting highlight the importance of continuous protocol optimization and adherence to the ALARA principle. Routine monitoring of radiation dose and regular comparison with national and international DRLs are recommended to further enhance patient safety and minimize unnecessary exposure.

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