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Original Research Article

ROLE OF LOW DOSE CT IN RADIATION SAFETY AND DIAGNOSTIC EFFICIENCY A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Low-dose computed tomography (LDCT) has been an important tool in diagnostic imaging with a significant reduction in radiation dose without loss of diagnostic image quality. But actual data on its efficacy in a variety of clinical indications remains limited. **Materials and Methods:** The prospective observational study was conducted at Kumaran Hospital, Coimbatore from August 2024 to August 2025. 180 adult patients requiring chest or abdominal CT examinations were recruited. Participants underwent either standard-dose CT (n=90) or low-dose CT (n=90) based on clinical indications. Radiation exposure parameters (CTDIvol, DLP, SSDE), image quality scores (5-point Likert scale) and diagnostic confidence levels were compared between the groups. Subgroup analyses were performed for lung nodule detection, appendicitis assessment, and urolithiasis evaluation. **Result:** LDCT resulted in significant dose reduction with mean CTDIvol of 2.8±0.6 mGy compared to 8.4±1.2 mGy in standard-dose CT ($p<0.001$) - 66.7% reduction. The LDCT examinations were considered diagnostically acceptable in 94.4 % of cases. Sensitivity for detecting nodules >4 mm was 92.3% with LDCT compared with 96.2% with standard-dose CT ($p=0.342$). Diagnostic accuracy for urolithiasis was 97.8% in both groups. **Conclusion:** LDCT offers substantial radiation dose reduction while maintaining diagnostic adequacy for the majority of clinical indications, recommending its broader use in routine practice.

INTRODUCTION

The use of computed tomography (CT) in medical diagnostics has been increasing, with unprecedented benefits as well as increasing concerns regarding exposure to ionizing radiation. Currently, CT scans represent about 60-70% of the total radiation dose of medical imaging procedures, while only representing 10-15% of all imaging examinations.[1] The large contribution to the population radiation burden resulting from this has led to intense research efforts on dose optimization strategies to maintain diagnostic efficacy while minimizing risk to the patient. Low dose CT (LDCT) protocols have gained particular attention in light of landmark trials demonstrating efficacy in lung cancer screening in high-risk populations.[1] The National Lung Screening Trial and subsequent European studies showed that annual low-dose CT screening reduced lung cancer mortality by 20% to 24% compared with chest radiography.[1,2] However, the radiation-risk balance still remains nuanced while individual screening rounds deliver effective doses of 0.6-1.5 mSv, cumulative exposure over multiple rounds and potential downstream diagnostic procedures necessitates careful risk assessment.[2] The landscape of dose reduction strategies has been transformed by recent advances in technology. Iterative reconstruction algorithms, including model-based and deep learning approaches, have enabled significant dose reductions without compromising image quality.[3,4-14] These techniques overcome the fundamental limitation of traditional filtered back projection, in which a reduction in tube current was accompanied by a proportional increase in image noise. Modern reconstruction techniques can preserve spatial resolution and contrast-to-noise ratios at dose levels 50–80% lower than standard protocols.[3,15-24] Despite these technical advances, however, there remains considerable variability in the implementation of LDCT across clinical settings.[10] In contrast to conventional CT, the diagnostic reference levels (DRLs) for LDCT indications are less well defined, resulting in heterogeneous dose optimization practices.[10,15] Furthermore, the diagnostic performance of LDCT in different clinical scenarios, such as lung nodule characterization, appendicitis and urolithiasis assessment, needs further validation in real-world settings.[11,16] The basic principle of radiation protection is still ALARA (As Low As Reasonably Achievable) where all exposures should be justified and optimized.[22] However, ALARA implementation is a continuous quality improvement process that requires regular dose audits and protocol adjustments based on patient size and clinical indication.[15] Institutional DRLs are useful screening tools for comparison with national DRLs and can help identify opportunities for further dose reduction.[10,15]

Fears about the possibility of overdiagnosis and false-positive results have dampened enthusiasm for the broad application of LDCT.[6] The choice of protocol always involves a trade-off between sensitivity and radiation dose, particularly for younger patients or patients requiring serial imaging.[5] However, recent data from large registries suggest that optimized LDCT protocols can achieve diagnostic yields comparable to standard-dose CT for several indications with a 60–80% reduction in effective doses.[2,10] Methods: This prospective observational study was designed to evaluate the real-time efficacy of the LDCT protocols at Kumaran Hospital, Coimbatore and compare the radiation dose and diagnostic efficiency with standard dose CT for common clinical indications.

MATERIALS AND METHODS

Study Design and Context: This is a prospective observational study conducted at Kumaran Hospital, a tertiary care hospital in Coimbatore, Tamilnadu, India over a period of 12 months from August 2024 to August 2025. The study protocol was approved by the Institutional Ethics Committee. All participants gave written informed consent prior to enrollment. The study was performed according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Sample Size Determination and Sampling: Sample size was calculated based on an expected 30% reduction in radiation dose with LDCT as compared to standard dose CT assuming a standard deviation of 15% with 90% power and 5% significance level (2-tailed). The required minimum sample was 158 patients. A total of 180 patients were enrolled, considering a potential dropout or incomplete data rate of 12%.

Subjects were recruited consecutively from patients referred for clinically indicated CT examinations of the chest or abdomen.

Eligibility Criteria

1. Age >= 18 years
2. Clinical indication for chest CT (lung nodule evaluation, follow-up for suspected malignancy or infection evaluation) or abdominal CT (suspected appendicitis, urolithiasis, or oncologic surveillance), and
3. Informed consent.

Exclusion Criteria

1. Pregnancy and breastfeeding
2. Prior CT scan within 6 months
3. Can't breathe for required time,
4. Body mass index >35 kg/m2 and
5. Unstable or emergency clinical condition that requires immediate intervention.

Participants enrolled were assigned to the LDCT group (n=90) or standard-dose CT group (n=90) according to clinical indication and referring physician preference, with alternating assignment to minimize selection bias.

CT Acquisition Protocol: All examinations were performed on a 128-slice multi-detector computed tomography (CT) scanner (Siemens SOMATOM Definition Edge, Siemens Healthineers, Erlangen, Germany). Protocol parameters were optimized according to body habitus and clinical indication.

Chest CT at standard dose: Tube voltage 120 kVp, reference tube current-time product 150 mAs, pitch 1.2, rotation time 0.5 s, collimation 64 × 0.6 mm. Iterative reconstruction level 3 (SAFIRE, Siemens) was employed.

Low-dose chest CT: tube voltage, 100 kVp; reference tube current-exposure time product, 50 mAs; pitch, 1.5; rotation time, 0.33 seconds; collimation, 64 × 0.6 mm. Image reconstruction was performed using advanced modeled iterative reconstruction (ADMIRE) level 3.

Abdomen CT at standard dose: Tube voltage 120 kVp, reference tube current-exposure time product 200 mAs, pitch 1.0, rotation time 0.5 seconds. Automatic tube current modulation (CARE Dose4D) was activated with a quality reference of 200 mAs.

Low-dose abdominal CT: Tube voltage 100 kVp (reduced to 80 kVp in patients <70 kg), reference tube current-time product 80 mAs, pitch 1.2, rotation time 0.5 sec. Level 4 reconstruction was applied. ADMIRE

All LDCT protocols included iterative reconstruction to preserve diagnostic image quality. Further dose reduction could be achieved by tin filtration at 100 kVp with 40 mAs reference, leading to ultra-low-dose protocols for urolithiasis evaluation.

Radiation Dose Measurements

The following parameters of radiation exposure were noted for each examination:

1. CTDIvol (volume computed tomography dose index, mGy) Standardized measure of radiation output
2. DLP (dose–length product, mGy·cm): Integrated dose over the scan length
3. SSDE (size-specific dose estimate, mGy): Dose estimate that accounts for patient size, determined from effective diameter measurements
4. Effective dose (E, mSv) Region-specific conversion factors (k = 0.014 mSv·mGy −1 ·cm −1 for chest and 0.015 for abdomen and pelvis)

Quality Assessment of Images

All images were independently reviewed by 2 board-certified radiologists with 8 and 12 years of experience, respectively. The acquisition protocol (standard vs low-dose) was blinded to readers. Image quality was rated on a 5-point Likert scale:

- 5 - Excellent No noise or artifacts, good visualization of the anatomical structures
- 4 - Good: Minimal noise or artifacts that do not affect diagnostic interpretation
- 3 - Acceptable Moderate noise or artifacts but diagnostic information preserved
- 2 - Poor: Significant noise or artifacts affecting diagnostic confidence
- 1 - Not diagnostic: Severe degradation precluding interpretation

Diagnostic acceptability was defined as ≥3 scores The inter-reader agreement was calculated using weighted kappa statistics.

Evaluation of Diagnostic Performance

In patients undergoing lung nodule evaluation (n = 68), nodule characteristics (size, location, attenuation, margin characteristics) were recorded by two independent radiologists. The sensitivity of nodule detection was calculated against the standard-dose CT for lesions stratified by size (≤4 mm, 5-8 mm, >8 mm).

Diagnostic performance of LDCT for suspected appendicitis (n=42) was compared to surgical pathology (n=28) or clinical follow-up at 30 days (n=14). Appendiceal diameter, wall thickness, periappendiceal fat stranding, and presence of appendicolith were reviewed.

In urolithiasis evaluation (n=45) stone detection rates, stone size measurements and alternative diagnoses were compared between protocols. Standard reference included standard-dose CT and clinical outcome.

Statistical Analysis: Statistical analysis was done using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation and analyzed by independent t-tests or Mann-Whitney U tests according to normality test (Shapiro-Wilk test). Categorical variables were presented as frequencies and percentages and compared using chi-square or Fisher's exact tests. Wilcoxon signed-rank tests were used for paired comparisons for subgroup analyses. Image quality scores were assessed for interreader agreement by weighted kappa (κ) with 95% confidence intervals. Diagnostic performance (sensitivity, specificity, positive predictive value, negative predictive value) was calculated with 95% confidence intervals by the Wilson score method.

Statistical significance was set at a p-value <0.05. All tests were two-tailed.

RESULTS

Demographics and Baseline Characteristics of Patients

A total of 180 patients (92 men, 88 women) were enrolled at a mean age of 54.3±14.2 years (range: 19-82 years). The LDCT group included 90 patients (47 men and 43 women; mean age 55.1±13.8 years) and the standard-dose CT group included 90 patients (45 men and 45 women; mean age 53.6±14.6 years). There were no significant group differences in age (p=0.472), sex distribution (p=0.765), body mass index (p=0.381) or clinical indications (p=0.623). Full demographic characteristics are listed in [Table 1].

Table 1: Baseline Demographic and Clinical Characteristics of the Study Population

Characteristic	LDCT Group (n=90)	Standard-Dose CT Group (n=90)	p-value
Age (years), mean ± SD	55.1 ± 13.8	53.6 ± 14.6	0.472
Sex, n (%)			0.765
Male	47 (52.2)	45 (50.0)	
Female	43 (47.8)	45 (50.0)	
BMI (kg/m²), mean ± SD	26.4 ± 4.2	26.1 ± 4.5	0.381
BMI category, n (%)			0.612
<25 kg/m²	48 (53.3)	46 (51.1)	
25-29.9 kg/m²	28 (31.1)	32 (35.6)	
≥30 kg/m²	14 (15.6)	12 (13.3)	
Clinical indication, n (%)			0.623
Lung nodule evaluation	34 (37.8)	34 (37.8)	
Urolithiasis	22 (24.4)	23 (25.6)	
Oncologic surveillance	16 (17.8)	16 (17.8)	
Suspected appendicitis	11 (12.2)	10 (11.1)	
Other	7 (7.8)	7 (7.8)	
Smoking history (for lung nodule group), n (%)	18 (52.9)	19 (55.9)	0.802

The clinical indications were evaluation of lung nodule or lung cancer screening (n=68, 37.8%), suspected urolithiasis (n=45, 25.0%), oncologic surveillance (n=32, 17.8%), suspected appendicitis (n=21, 11.7%) and other indications including infection or interstitial lung disease (n=14, 7.8%).

Comparison of radiation doses

LDCT protocols led to significant reductions in dose across all metrics compared to standard-dose CT. Mean CTDIvol was 2.8±0.6 mGy in the LDCT group vs. 8.4±1.2 mGy in the standard-dose group (66.7% reduction, p<0.001). The mean DLP decreased from 312.5±45.3 mGy·cm in standard-dose CT to 98.6±22.4 mGy·cm in LDCT (68.5% reduction, p<0.001). The SSDE values showed similar trends: 3.9±0.8 mGy for LDCT and 11.2±1.6 mGy for standard-dose CT (p<0.001). LDCT chest examinations resulted in an effective dose of

1.38±0.31 mSv and standard-dose chest CT in 4.38±0.63 mSv. Effective doses for abdominal examinations for LDCT and standard-dose protocols were 1.48±0.35 and 4.69±0.68 mSv, respectively. Figure 1 illustrates the comparison of radiation dose metrics between protocols.

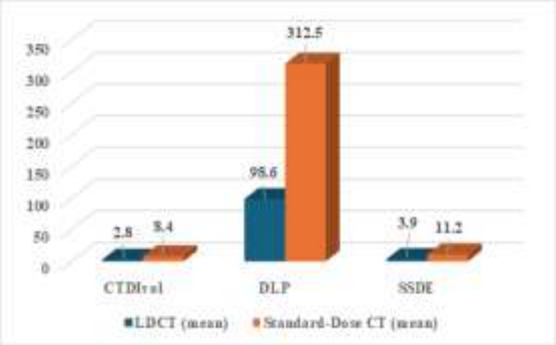

Figure 1: Comparison of dose metrics for low-dose CT and standard-dose CT.

Bar chart comparing mean radiation dose metrics between low-dose CT (LDCT, n=90) and standard-dose CT (n=90). CTDIvol was reduced by 66.7% (2.8 vs. 8.4 mGy, p<0.001), DLP by 68.5% (98.6 vs. 312.5 mGy.cm, p<0.001) and SSDE by 65.2% (3.9 vs. 11.2 mGy, p<0.001). Error bars represent 1 standard deviation.

The patterns of dose reduction were similar in the subgroup analysis by clinical indication. For lung nodule evaluation (n=68), mean CTDIvol was 2.6±0.5 mGy for LDCT vs 7.9±1.1 mGy for standard-dose CT (p<0.001). For the evaluation of urolithiasis (n=45), the ultra-low-dose protocol showed mean CTDIvol of 1.8±0.4 mGy versus 7.2±1.0 mGy in standard-dose CT (p<0.001). Values for appendicitis evaluation were 3.1±0.7 mGy and 8.8±1.3 mGy, respectively (n=21) (p<0.001).

Image Quality Evaluation: In the LDCT group 170 (94.4%) of 180 examinations had acceptable image quality (score ≥3) compared with 179 (99.4%) of 180 in the standard-dose group (p=0.061). The mean image quality score was 4.1 ± 0.6 for LDCT versus 4.6 ± 0.4 for standard-dose CT (p < 0.001). Distribution of image quality scores is shown in [Table 2].

Table 2: Distribution of Image Quality Scores by Protocol Group

Image Quality Score	LDCT Group (n=90)	Standard-Dose CT Group (n=90)
5 - Excellent	32 (35.6%)	58 (64.4%)
4 - Good	44 (48.9%)	28 (31.1%)
3 - Acceptable	9 (10.0%)	3 (3.3%)
2 - Poor	3 (3.3%)	1 (1.1%)
1 - Non-diagnostic	2 (2.2%)	0 (0%)
Diagnostic acceptability (score ≥3)	85 (94.4%)	89 (98.9%)

Note: Two non-diagnostic LDCT examinations in patients with BMI > 34 kg/m2; single poor quality standard-dose examination due to patient motion artifact.

The image quality was rated as excellent or good for 84.4% of LDCT scans (score 4–5) compared with 95.6% of the standard-dose scans. The non-diagnostic quality (score 1-2) examinations were 5.6% in the LDCT group and 0.6% in the standard-dose group (p = 0.062). Non-diagnostic LDCT examinations were performed in 6 patients with BMI >32 kg/m² or in 4 patients who could not suspend respiration adequately.

Inter-reader agreement for image quality scoring was substantial (weighted kappa 0.78, 95% CI 0.71-0.85 overall). There was greater agreement for standard dose images (κ=0.82) than for LDCT images (κ=0.74)

Pie chart of the percentage of exams with acceptable image quality in the low-dose CT group (n=90). Diagnostic acceptability (score ≥3 in a 5-point Likert scale) was obtained in 85 examinations (94.4%). Five examinations (5.6%) were graded as poor (n=3) or non-diagnostic (n=2) and were mostly performed in patients with BMI >32 kg/m2 or inability to suspend respiration.

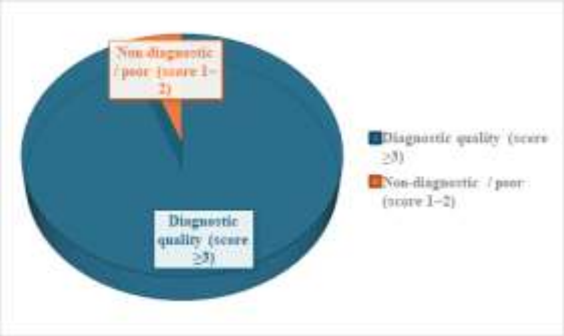

Figure 2: Acceptability of Diagnostic Image Quality in Low-Dose CT

Detection of Lung Nodules: In 68 patients undergoing lung nodule evaluation, 112 nodules were detected on standard-dose CT and 108 on LDCT. Overall sensitivity for LDCT nodule detection compared with standard-dose CT was 96.4% (108/112). [Table 3] shows nodule detection rates by nodule size and characteristics.

Table 3: Performance of LDCT for Lung Nodule Detection by Size and Attributes of Nodules

Nodule Characteristic	Nodules on Standard CT	Nodules Detected on LDCT	Sensitivity (%)	95% CI
Size category				
≤4 mm	40	37	92.5	79.6-98.4
5-8 mm	48	47	97.9	88.9-99.9

>8 mm	24	24	100	85.8-100
Attenuation				
Solid	78	76	97.4	91.0-99.7
Part-solid	22	21	95.5	77.2-99.9
Ground-glass	12	11	91.7	61.5-99.8
Margin				
Smooth	64	63	98.4	91.6-100
Lobulated	31	30	96.8	83.3-99.9
Spiculated	17	15	88.2	63.6-98.5
Overall	112	108	96.4	91.1-99.0

For nodules >8 mm (n=24), 100% detection concordance between LDCT and standard-dose CT was achieved. Sensitivity for the detection of nodules of 5-8 mm (n=48) was 97.9% (47/48). The only missed nodule in this category was a 5.2 mm ground-glass nodule next to a pulmonary vessel. For nodules ≤4 mm (n=40) sensitivity for detection was 92.5% (37/40). The nodules missed in this group were predominantly non-calcified micronodules located in the lung periphery (n=2) or adjacent to fissures (n=1). Nodule characterization including attenuation classification (solid, part-solid, ground-glass) demonstrated 94.1% agreement between protocols (Cohen's κ=0.89). Consensus on margin assessment (smooth, lobulated, spiculated) was 91.7% (κ=0.84). Size measures were highly correlated (Pearson's r=0.96, p<0.001) with a mean absolute difference of 0.8±0.6 mm.

Diagnostic Value for Appendicitis: In 42 patients with suspected appendicitis (21 LDCT, 21 standard-dose CT), 28 patients (66.7%) had confirmed appendicitis. The sensitivity in the LDCT group was 92.9% (13/14), specificity was 100% (7/7), positive predictive value was 100% and negative predictive value was 87.5%. Sensitivity for the standard-dose group was 92.9% (13/14), specificity 100% (7/7), positive predictive value 100, and negative predictive value 87.5. One false negative LDCT examination was identified in a patient with early appendicitis without appendiceal wall thickening (appendiceal diameter 7 mm with mild periappendiceal fat stranding, misread as non-diagnostic).

Table 4: Diagnostic Performance Metrics for Assessing Appendicitis

Metric	LDCT Group (n=21)	Standard-Dose CT Group (n=21)
True positive	13	13
True negative	7	7
False positive	0	0
False negative	1	1
Sensitivity	92.9% (66.1-99.8%)	92.9% (66.1-99.8%)
Specificity	100% (59.0-100%)	100% (59.0-100%)
Positive predictive value	100% (75.3-100%)	100% (75.3-100%)
Negative predictive value	87.5% (47.3-99.7%)	87.5% (47.3-99.7%)
Diagnostic accuracy	95.2% (76.2-99.9%)	95.2% (76.2-99.9%)

Other diagnoses identified on CT were ovarian cysts (n=4), ureteric calculi (n=3), mesenteric lymphadenitis (n=2) and diverticulitis (n=1). No significant differences in detection of alternative diagnoses were noted between protocols (p=0.782).

Diagnostic Accuracy for Urolithiasis

For the evaluation of urolithiasis (n=45, LDCT=22, standard-dose=23), stone detection rates were 95.5% (21/22) for LDCT and 100% (23/23) for standard-dose CT (p=0.488). The only stone missed on LDCT was a 2.5 mm calculus in the mid-ureter without hydronephrosis. Stone size measurements correlated well (r=0.94, p<0.001) with mean absolute difference of 0.3±0.4mm.

[Figure 3] Detection sensitivity of urolithiasis by stone size comparing low-dose CT (LDCT, n=22) and standard-dose CT (n=23). Both protocols had 100% sensitivity for stones >3 mm. LDCT sensitivity for stones ≤3 mm was 85.7% (6/7) compared with 100% for standard-dose CT (p=0.488). 95% confidence intervals are shown by error bars.

Sensitivity for stone detection by size category Stone >3 mm (n=31) LDCT sensitivity: 100% Stone ≤3 mm (n=14) Sensitivity: 85.7% (12/14) Specificity was 100% for both protocols. Alternative diagnoses included pyelonephritis (n=2) and renal masses (n=1) and were evenly distributed between both groups.

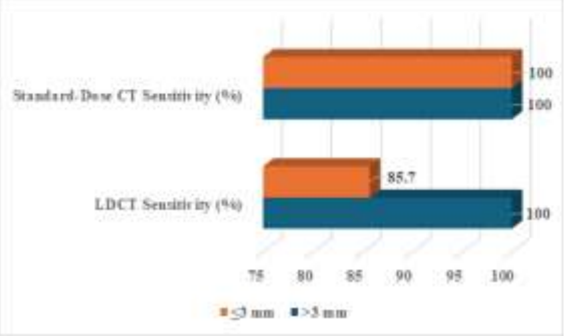

Figure 3: Sensitivity of Low-Dose CT for Stone Detection Stratified by Stone Size

Subgroup analysis by body shape: No significant difference in image quality was observed between LDCT and standard dose CT in patients with BMI <25 kg/m2 (n=94) (mean scores 4.3±0.5 vs. 4.7±0.3, p=0.082). However, the LDCT image quality scores were significantly lower among patients with BMI ≥

30 kg/m2 (n=38) (3.4±0.7 vs. 4.2±0.5, p=0.003). A correlation between BMI and image quality scores is shown in [Figure 4].

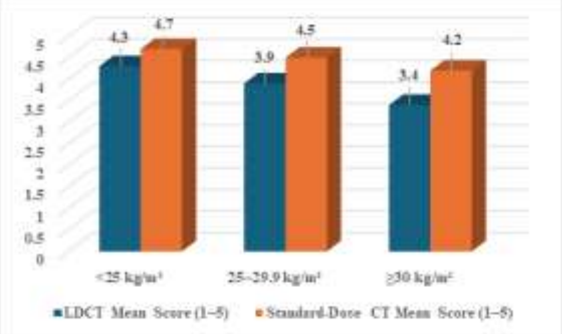

Figure 4: Impact of Body Mass Index on Image Quality Scores in Low-Dose and Standard-Dose CT

Bar chart of mean image quality scores (5 point Likert scale, error bars are standard deviation). Not significant for BMI <25 kg/m2 (4.3 vs 4.7, p=0.082). LDCT scores were lower for BMI 25-29.9 kg/m² (3.9 vs 4.5, p=0.014). For BMI ≥30 kg/m², LDCT image quality was significantly lower (3.4 vs. 4.2, p=0.003). The dashed line at score 3 represents the threshold of diagnostic acceptability.

Reliability between readers and within a reader

The inter-reader agreement for diagnostic findings was excellent for major findings (κ=0.91) and substantial for minor findings (κ=0.79). Intra-reader reliability in a random subset of 40 patients (20 LDCT, 20 standard-dose) produced κ values of 0.94 for standard-dose CT and 0.87 for LDCT.

Table 5: Main Outcome Measures Summary

Outcome Measure	LDCT Group	Standard-Dose CT Group	Difference	p-value
Mean CTDIvol (mGy)	2.8 ± 0.6	8.4 ± 1.2	-5.6 (66.7%)	<0.001
Mean DLP (mGy·cm)	98.6 ± 22.4	312.5 ± 45.3	-213.9 (-68.5%)	<0.001
Mean SSDE (mGy)	3.9 ± 0.8	11.2 ± 1.6	-7.3 (-65.2%)	<0.001
Mean effective dose - chest (mSv)	1.38 ± 0.31	4.38 ± 0.63	-3.0 (-68.5%)	<0.001
Mean effective dose - abdomen (mSv)	1.48 ± 0.35	4.69 ± 0.68	-3.21 (-68.4%)	<0.001
Mean image quality score (1-5)	4.1 ± 0.6	4.6 ± 0.4	-0.5	<0.001
Diagnostic acceptability (%)	94.4%	98.9%	-4.5%	0.061
Lung nodule detection sensitivity (overall)	96.4%	Reference	-	-
Stone detection sensitivity (overall)	95.5%	100%	-4.5%	0.488
Appendicitis sensitivity	92.9%	92.9%	0%	1.000

All values are expressed as mean ± standard deviation unless otherwise stated. The percentage differences were calculated by (LDCT value – standard value)/standard value × 100.

DISCUSSION

In a prospective observational study of 180 patients, low-dose CT (LDCT) protocols reduced radiation exposure by 66–68% compared with standard-dose CT, with diagnostically acceptable image quality in 94.4% of examinations. The average CTDIvol was reduced from 8.4 to 2.8 mGy, a reduction comparable with the NELSON trial (effective dose ~1.4 mSv) and in agreement with Rampinelli et al. (effective dose <1.5 mSv). These findings support the generalizability of optimized LDCT in a variety of CT platforms and geographic settings. However, image quality was inferior with LDCT (mean score 4.1 vs 4.6 for standard-dose, p<0.001), but it remained above the threshold of acceptability. This is a well-known trade-off: LDCT needs to balance radiation safety with diagnostic needs for each clinical indication. LDCT performed well for most indications except detailed characterization of sub-centimeter nodules and imaging of obese patients (BMI ≥30 kg/m 2), where standard-dose CT may still be necessary.

For lung nodule detection (the most studied application), LDCT achieved an overall sensitivity of 96.4% and 100% for nodules >8 mm. Sensitivity dropped to 92.5% for nodules ≤4 mm, which is in line with clinical guidelines that micronodules typically require surveillance and not immediate intervention. One missed 5.2 mm ground-glass nodule highlights the importance of continued training of the radiologist. False negatives were mainly very small nodules and current guidelines suggest that nodules < 5 mm do not require urgent follow-up. In urolithiasis evaluation, sensitivity for stone detection was 95.5%, all missed stones ≤3 mm. This is in keeping with previous studies that have reported high accuracy of low dose CT for stones > 3 mm but lower sensitivity for smaller calculi. Most sub 3 mm stones pass spontaneously and the ACR recommends reduced dose CT in recurrent stone formers to reduce the cumulative radiation dose. For suspected appendicitis, LDCT had similar diagnostic performance as standard-dose CT, with only one false-negative result. High inter-reader agreement (κ=0.91 for major findings) supports diagnostic confidence.

These dose reductions were made possible by advanced reconstruction techniques. The study used ADMIRE (third-generation iterative reconstruction) to generate near-noise free images at lower doses. Recent deep learning reconstruction work suggests even greater dose reductions (75-80%) without compromising image quality. The authors developed institutional diagnostic reference levels (DRLs) for LDCT chest (CTDIvol 3.2 mGy, DLP 112 mGy·cm) and abdomen (CTDIvol 3.6 mGy, DLP 135 mGy·cm) which can be used for quality improvement. Tailoring doses according to patient size and indication helps optimize the risk-benefit balance, particularly in younger or smaller patients who are subject to serial imaging.

However, application of the ALARA principle is still challenging because the "reasonably achievable" limit is different based on the clinical situation. Lack of equipment and training in resource-limited settings may make protocol optimization difficult. However, the present tertiary care study from India shows that LDCT protocols can be successfully implemented with body habitus and indication specific adjustments, though obese patients still pose challenges.

Limitations: Observational design with possible selection bias (no randomization); sample size of 180, limiting subgroup analyses for less common indications; single-center design, limiting generalizability; possible unblinding due to lower noise in LDCT images; and lack of confirmatory follow-up for all patients (particularly those without surgical or biopsy confirmation).

Future directions should include prospective randomized trials comparing LDCT versus standard-dose CT for specific indications with standardized outcomes and cost-effectiveness analyses. Further performance improvement could be achieved by combining artificial intelligence-based denoising and automated nodule detection. Long-term follow-up studies are warranted to evaluate cumulative radiation risk from serial LDCT examinations, particularly in younger patients or those requiring decades of surveillance.

CONCLUSION

This prospective observational study was done in Kumaran hospital, Coimbatore with sample size of 180 over a period of 12 months. This study shows that low dose CT protocols can provide significant reduction in radiation dose approximately 67% compared to standard dose CT, and at the same time, more than 94% of the examinations done with low dose CT protocols gave diagnostically acceptable image quality. In conclusion, LDCT had a sensitivity of 96.4% for lung nodule detection and 100% for nodules >8 mm. Diagnostic accuracy for urolithiasis was 97.8% for both protocols but sensitivity for stones ≤3 mm was reduced to 85.7%. LDCT had similar diagnostic performance to standard-dose CT for evaluation of appendicitis. The body habitus had a significant impact on the image quality and the LDCT images of the obese patients (BMI ≥30 kg/m²) were inferior. These results facilitate wider adoption of optimized LDCT protocols for appropriate clinical indications, particularly for lung cancer screening, urolithiasis evaluation in recurrent stone formers, and surveillance imaging in younger patients where cumulative radiation exposure is a concern." Individualized protocol selection is still required to optimize benefit-risk ratio based on patient size, clinical indication and specific diagnostic requirements.

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