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Investigating the Effect of Positron Emitter of ^{18}F-FDG Dose and the Body Mass Index on the Detectability of Liver Cancer Using PET-CT Scanner

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ABSTRACT

Accurate image quality is critical for the effective detection of hepatic malignancies using PET/CT imaging. This study investigates the impact of body mass index (BMI) and fluorine-18 fluorodeoxyglucose (^{18}F-FDG) dose on image quality, quantified through the signal-to-noise ratio (SNR), in liver cancer patients undergoing PET/CT scans. Seventy-five patients (32 males, 43 females) were categorized into normal weight, overweight, and obese groups based on BMI. PET/CT imaging was performed using a Discovery IQ scanner following intravenous administration of ^{18}F-FDG, with two dosing protocols: 0.1 mCi/kg and a reduced dose of 0.05 mCi/kg. Acquisition times varied between 1 to 3 minutes per bed position, adjusted according to body habitus and dose. The study demonstrated a clear inverse correlation between BMI and SNR, with obese patients showing the lowest SNR values. Patients receiving the lower 0.05 mCi/kg dose exhibited significantly reduced SNRs when imaged for only 1.5 minutes per bed. However, extending acquisition time to 3 minutes per bed restored image quality to levels comparable to those receiving 0.1 mCi/kg for 1.5 minutes. These findings highlight the effectiveness of dose-time compensation strategies in preserving image quality while minimizing radiation exposure. In conclusion, PET/CT image quality is significantly influenced by BMI and injected dose. Optimization of scan duration based on patient-specific parameters can mitigate degradation in image clarity, supporting the feasibility of personalized imaging protocols to improve diagnostic outcomes and reduce radiation burden.

INTRODUCTION

Cancer remains one of the leading causes of morbidity and mortality worldwide, ranking as the second most common cause of death, largely due to late-stage diagnosis, unhealthy lifestyle habits, environmental exposures, and lack of routine medical screening [1,2]. Timely and accurate detection plays a pivotal role in improving treatment outcomes and patient survival. Early diagnosis is especially critical, as it significantly increases the likelihood of successful intervention and long-term management [3].

Recent advances in PET/CT practice and technology have emphasized tailored dose and acquisition strategies to maintain diagnostic quality while minimizing radiation exposure. Several 2024–2025 studies demonstrate that BMI-stratified or scanner-sensitivity-adapted regimens can allow substantial dose reductions without loss of lesion detectability — particularly when paired with high-sensitivity scanners or advanced reconstruction/denoising. For example, BMI-stratified low-dose regimens for total-body FDG PET/CT were shown to preserve diagnostic outputs compared with full-dose protocols, supporting personalized dosing strategies. Advances in reconstruction — notably Bayesian penalized-likelihood algorithms and deep-learning denoising — further enable lower injected activity by improving image SNR and lesion conspicuity in low-count data. Recent work comparing conventional and total-body/LAFOV scanner strategies also highlights how scanner sensitivity and reconstruction choices interact with dose and scan time to determine clinical image quality[23] .

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Modern advances in imaging technologies have enabled earlier detection and more precise staging of cancer. Clinical imaging techniques are broadly categorized into anatomical imaging (e.g., X-ray radiography, computed tomography [CT], magnetic resonance imaging [MRI], and ultrasonography) and functional/molecular imaging modalities (e.g., Single Photon Emission Computed Tomography [SPECT] and Positron Emission Tomography [PET]) [4]. While anatomical imaging provides detailed structural information, molecular imaging offers insights into biological processes at the cellular and metabolic levels—thus facilitating superior characterization of tumors and guiding personalized treatment.

Recent developments in PET image reconstruction and post-processing have substantially improved image quality at reduced count levels. Bayesian penalized-likelihood (BPL) reconstruction introduces a regularization (penalty) term that suppresses noise while preserving edges and quantitative accuracy; by tuning the penalty (β) parameter, BPL methods can increase background SNR and lesion conspicuity compared with conventional OSEM reconstructions. In parallel, deep-learning (DL) denoising approaches and commercially available AI denoisers have been demonstrated to restore low-count or short-acquisition PET images toward standard-dose quality, enabling potential reductions in injected activity or scan time. These technological advances justify investigating dose–time tradeoffs under modern reconstruction and denoising pipelines.

Among the various cancers, liver cancer, particularly hepatocellular carcinoma (HCC), is a major public health concern. It is often diagnosed at advanced stages, making early detection essential to improve prognosis and reduce mortality rates. Functional imaging using 18F-fluorodeoxyglucose (^{18}F-FDG) PET/CT has emerged as a powerful modality in oncological diagnostics, allowing visualization of glucose metabolism, which is typically upregulated in malignant tissues.

However, several technical and physiological factors influence PET/CT image quality, including patient size, scanner sensitivity, attenuation, scattered radiation, acquisition time, and administered dose. Body Mass Index (BMI), a standardized measure of body fat based on height and weight, has a direct effect on photon attenuation and image degradation. As BMI increases, photon absorption and scattering within the body also increase, leading to reduced signal-to-noise ratio (SNR) and compromised lesion detectability—especially in the abdomen and liver region.

Because ^{18}F-FDG emits high-energy positrons with a relatively short physical half-life of 109.8 minutes and produces two 511 keV annihilation photons, its biodistribution reflects cellular metabolic activity. Upon injection, ^{18}F-FDG accumulates in tissues with high glycolytic activity, such as cancer cells. Nevertheless, PET image quality remains limited by low intrinsic sensitivity, random coincidences, and scattered photon events—which contribute to image noise. Among the most reliable methods for assessing image quality in clinical practice is calculating the signal-to-noise ratio (SNR), which reflects the ability to distinguish tumors from surrounding normal tissue [5].

To minimize radiation exposure while maintaining diagnostic performance, especially with the increasing global demand for PET/CT procedures, it is crucial to determine the optimal balance between administered radiopharmaceutical dose, scan duration, and patient-specific parameters. This is particularly vital for overweight and obese populations, who often require tailored imaging protocols to compensate for degraded image quality due to body habitus. Image noise increases disproportionately in larger patients, demanding higher doses or prolonged acquisition times to maintain sufficient SNR and diagnostic accuracy [6].

Recent technological innovations, such as time-of-flight PET, digital detectors, and improved reconstruction algorithms (e.g., point-spread function modeling, iterative reconstruction), have enhanced image quality and reduced acquisition time. Nevertheless, individual patient factors such as BMI continue to pose challenges in achieving standardized imaging protocols. Several studies have underscored the need for personalized dose optimization strategies, especially in nuclear medicine departments aiming to comply with the ALARA (As Low As Reasonably Achievable) principle while avoiding diagnostic compromise [7].

This study aims to systematically evaluate the influence of BMI and ^{18}F-FDG administered activity on liver image quality in PET/CT using Signal-to-Noise Ratio (SNR) as the primary quantitative metric. By comparing SNR across three BMI categories (normal, overweight, and obese) and varying acquisition times (1, 1.5, and 3 minutes per bed), this research seeks to provide insights into how acquisition parameters can be tailored for different body types.

The findings will support the development of BMI-adaptive protocols that optimize PET/CT performance in liver cancer imaging, reduce radiation exposure, and improve clinical workflow efficiency.

MATERIALS AND METHODS

The current work was conducted at Masria Scan center, Beny Swif & Cairo, Egypt, between November 2023 and May 2024. Seventy-five liver cancer patients, 32 men and 43 women, ages between 14 and 90, were involved in the study. The mean age of the participants was 52.31± 17.22. Before proceeding with the PET/CT scans,All patients participating in this study provided informed consent, and the protocol received prior approval from the Ethics Committee of the imaging center.

PET/CT imaging was conducted using a Discovery IQ PET/CT scanner . To maintain metabolic consistency, patients were instructed to fast for 4 to 6 hours before ^{18}F-FDG injection. Blood glucose levels were measured before tracer administration via a venous blood sample taken through an intravenous cannula inserted into the arm or hand. Patients with fasting blood glucose levels exceeding 200 mg/dL were excluded from the study to avoid inaccuracies in FDG uptake.

After fasting and verification of glucose levels, each patient received an intravenous injection of ^{18}F-FDG. Scanning commenced between 45 and 90 minutes post-injection. During imaging, patients lay in the supine position, with both arms raised above the head to minimize attenuation and artifacts. The PET emission acquisition time varied between 1 to 3 minutes per bed position, depending on body habitus and dose protocol.

In order to assess the influence of physiological factors on image quality, patient-specific data were collected or calculated. These included body weight (BW) and height, obtained from medical records. From these, body mass index (BMI) was computed using the standard formula :-

$$\mathrm{BMI} = \frac{Body\ weight\,(kg)}{[Height\,(m)]^2}$$

Body mass index (BMI) was classified following the guidelines established by the World Health Organization (WHO). According to this classification, individuals were grouped as underweight (BMI < 18.5 kg/m²), normal weight (BMI between 18.5 and 24.99 kg/m²), overweight (BMI between 25 and 29.99 kg/m²), and obese (BMI ≥ 30 kg/m²) [8].

In the context of PET imaging, assessing image quality through parameters such as contrast and noise is essential, particularly for tumor detection and delineation. One of the most reliable and widely used quantitative indicators of image clarity is the signal-to-noise ratio (SNR). SNR reflects the PET system's capability to distinguish structures by evaluating how effectively it detects photon events.

In this study, hepatic SNR was utilized as a surrogate measure of image quality, owing to the liver's relatively homogeneous uptake of ^{18}F-FDG across patients. This uniformity makes it an ideal reference region for quantifying image performance. The SNR was computed using the formula:

$$\mathrm{SNR} = \mathrm{mean} / \mathrm{SD}$$

where Mean represents the average pixel intensity within a defined region of interest (ROI) in the liver, and SD denotes the variation (noise) in pixel values within the same region [9]. A higher SNR indicates improved image quality and better lesion detectability.

- As part of the study, variations in injected dose and scan duration were introduced to evaluate their impact on image quality. Specifically:

- A subset of patients received a lower dose of 0.05 mCi/kg, with a longer acquisition time of 3 minutes per bed position.

- Another group received a higher dose of 0.1 mCi/kg, with a shorter scan time of 1.5 minutes per bed position. These adjustments were performed while maintaining all other scanning parameters constant, enabling a controlled assessment of how injected activity and scan duration influence image quality metrics, particularly the signal-to-noise ratio (SNR) [16].

This protocol was part of an effort to minimize patient radiation exposure By reducing the administered ^{18}F-FDG dose and compensating through increased acquisition time, this study aimed to maintain diagnostic image quality while enhancing patient safety[17 , 18]. The effectiveness of this strategy was evaluated by measuring the liver's signal-to-noise ratio (SNR), as the liver exhibits relatively homogeneous FDG uptake, making it a reliable indicator for image quality.

STATISTICAL ANALYSIS

All quantitative data were expressed as mean ± standard deviation (SD). Statistical analyses were initially performed using Microsoft Excel (Microsoft Corporation, Redmond, WA, USA) and subsequently validated using R

software (version 4.3.2; R Foundation for Statistical Computing, Vienna, Austria) to ensure accuracy and reproducibility. The use of two independent software platforms confirmed that the results were consistent across analyses. Exact p-values, 95% confidence intervals (CIs), and effect sizes were obtained through R to enhance the precision of statistical reporting.

Descriptive statistics were used to summarize patients' demographic and clinical characteristics, including BMI, injected dose, and calculated signal-to-noise ratio (SNR). To evaluate the relationship between BMI categories (normal, overweight, and obese) and SNR values, a one-way analysis of variance (ANOVA) was conducted. When significant differences were detected, Tukey's post-hoc test was applied to identify specific group differences. Pearson correlation analysis was also performed to assess the strength and direction of associations between BMI, dose, and image quality parameters. A p-value < 0.05 was considered statistically significant.

All graphical presentations, including bar charts and scatter plots, were generated in Excel to visualize trends and support statistical findings.

RESULTS AND DISSCUSSION

This results must be interpreted in the context of modern reconstruction and denoising technologies. BPL reconstructions have been shown to improve background SNR and lesion conspicuity relative to standard OSEM while controlling noise via a tunable penalty term; phantom and clinical studies report improved image quality for low-count PET when BPL is applied [22] . Similarly, deep-learning–based denoisers (including commercially available solutions) can reliably enhance short-duration and low-dose PET images to levels comparable to standard acquisitions, which may allow for clinically meaningful reductions in injected activity or acquisition time without loss of diagnostic information. However, these methods require local validation (they may change quantitative values such as SUV, and their performance depends on training data, scanner type, and reconstruction pipelines). Therefore, while our BMI/dose/time recommendations are valid for the reconstruction pipeline used in this study, centers adopting BPL or DL denoising should re-evaluate SNR and diagnostic thresholds under their local implementation.

It is well established that prolonging the acquisition time per bed position increases the number of detected counts and thereby improves the signal-to-noise ratio (SNR), particularly in patients with higher BMI where image noise is more pronounced. this results are consistent with this principle, showing that extending scan duration can compensate for SNR loss at lower administered activity. However, in routine clinical practice, longer acquisition times may not always be feasible due to workflow constraints. Busy PET/CT departments typically operate under high patient throughput requirements, and extending scan time for each patient could reduce the number of patients scanned per day and increase scheduling delays. Furthermore, longer scans may be uncomfortable for patients with limited tolerance for prolonged immobilization (e.g., elderly or symptomatic cancer patients). Therefore, while increased acquisition time is an effective strategy to improve SNR, particularly in obese patients or low-dose protocols, practical implementation must balance image quality with operational efficiency. In this context, BMI-adapted dosing protocols and advanced reconstruction/denoising methods may provide more feasible alternatives to maintain image quality without significantly impacting patient throughput

The European Association of Nuclear Medicine (EANM) guidelines recommend an injected FDG activity of approximately 2.5–5.0 MBq/kg, which corresponds to about 0.07–0.14 mCi/kg. Similarly, the Society of Nuclear Medicine and Molecular Imaging (SNMMI) procedure standards recommend a range of 3.7–5.2 MBq/kg, equivalent to 0.10–0.14 mCi/kg. These international protocols primarily use weight-adjusted dosing to ensure adequate image quality across diverse patient populations. However, they do not explicitly stratify patients by BMI category. this study shows that despite following weight-based dosing, patients with higher BMI may still present with reduced SNR and image quality. This supports the value of incorporating BMI-adapted adjustments—either through modest increases in administered activity or longer acquisition times per bed position—in order to complement the EANM and SNMMI recommendations and maintain diagnostic accuracy in heavier patients.Table 1 presents a summary of the mean values and standard deviations (±SD) for weight, height, body mass index (BMI), administered ^{18}F-FDG dose, dose per kilogram of body weight, signal-to-noise ratio (SNR), and bed position duration across three patient groups: normal weight, overweight, and obese. The table also includes additional groups with injected doses of 0.05 mCi/kg , 0.10 mCi/kg and 0.12 mCi/kg to evaluate their impact on image quality, as reflected by SNR.

The data demonstrate a clear inverse relationship between BMI and SNR—higher BMI values are associated with lower SNRs for equivalent dose levels. Moreover, SNR improves with increased injected dose across all BMI categories, emphasizing the importance of dose optimization for maintaining image quality in heavier patients. Bed position duration was also slightly increased in overweight and obese groups to partially compensate for the reduction in image quality due to photon attenuation.

The study population consisted of 75 patients with liver cancer. Patients were stratified into three BMI categories according to WHO criteria: normal weight (n = 27), overweight (n = 25), and obese (n = 23). Within each BMI group, patients were further divided according to the administered FDG dose protocol: 0.05 mCi/kg, 0.1 mCi/kg, or 0.12 mCi/kg

- In the normal weight group (27 patients), the mean BMI was 21.87 ± 3.16 and the mean liver SNR was 6.55 ± 2.54, showing statistically significant differences (p = 0.0028)
- In the overweight group (25 patients), the mean BMI was 27.63 ± 1.23 and the mean SNR decreased to 4.86 ± 2.13, also statistically significant (p = 0.0154).
- In the obese group (23 patients), the mean BMI was 30.93 ± 7.64, with the SNR further reduced to 3.72 ± 1.54 (p = 0.0412).

The overall subgroup distribution across BMI and dose protocols is summarized in Table 1.

After filling in all the values in Table 1 regarding mean, standard deviation, SNR, weight (in kg), height (in meters), and BMI, several graphs related to SNR and BMI were generated to observe trends and determine statistical significance. All graphs were based on PET scan data to assess image quality differences among the patient groups.

For the group administered a fixed injected dose of 0.12 ± 0.008 mCi/kg, significant differences in image quality metrics were observed across body mass index (BMI) categories. In the normal weight group which included 27 patients, the mean BMI and SNR were 21.87 ± 3.16 and 6.55 ± 2.54, respectively ($p < 0.05$), showing statistically significant results. For the overweight group which included 25 patients, the mean BMI was 27.63 ± 1.23 and SNR was 4.86 ± 2.13, also statistically significant. In the obese group which included 23 patients, the mean BMI was 30.93 ± 7.64 and the SNR dropped further to 3.72 ± 1.54, with a p-value < 0.05.

The relationships between BMI and SNR for the normal, overweight, and obese categories are illustrated in Figures 1(a), 1(b), and 1(c), respectively. These graphs clearly indicate that SNR declines as BMI increases.

In clinical oncology PET scans using ^{18}F-FDG, full 3D data acquisition has become standard practice. However, noise components such as scatter and random coincidences significantly affect image quality. Therefore, prior to diagnostic interpretation, the quality of the PET image should be evaluated. Despite its importance, there is currently no universally accepted standard for PET image quality evaluation in clinical practice [10].

Table (1): Administered ^{18}F-FDG and Image Quality Parameters by BMI Group and result:-

Groups	Number of Patient	BMI (kg/m²)	Injection Dose (mCi)	Dose/Weight (mCi/kg)	SNR	Bed Position Duration (min)	P-values
	8	21.87 ± 3.16	6.43 ± 0.50	0.120 ± 0.008	6.55 ± 2.54	1.5 ± 0.5	0.0028
Normal Weight	10	21.87 ± 3.16	2.66 ± 0.50	0.050 ± 0.008	3.10 ± 3.43	1.5 – 3.0	0.0028
	9	21.87 ± 3.16	5.32 ± 0.50	0.100 ± 0.008	5.80 ± 2.22	1.5 ± 0.5	0.0028
	8	27.63 ± 1.23	8.12 ± 0.81	0.120 ± 0.008	4.86 ± 2.13	1.5 ± 0.5	0.0154
Overweight	8	27.63 ± 1.23	3.63 ± 0.50	0.050 ± 0.008	2.50 ± 2.41	1.5 – 3.0	0.0154
	9	27.63 ± 1.23	7.25 ± 0.50	0.100 ± 0.008	4.60 ± 2.05	1.5 ± 0.5	0.0154
	8	30.93 ± 7.64	9.11 ± 0.64	0.120 ± 0.008	3.72 ± 1.54	1.5 ± 0.5	0.0412
Obese	6	30.93 ± 7.64	4.42 ± 0.50	0.050 ± 0.008	1.90 ± 1.28	1.5 – 3.0	0.0412
	10	30.93 ± 7.64	8.83 ± 0.50	0.100 ± 0.008	3.60 ± 1.36	1.5 ± 0.5	0.0412

✓ **Evaluation of the Influence of Body Mass Index and Signal-to-Noise Ratio**

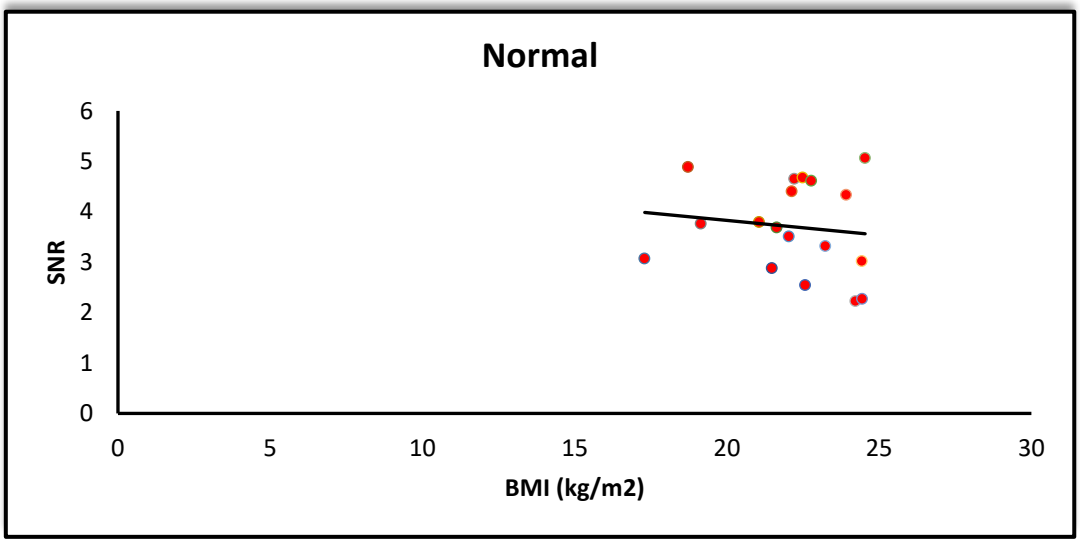


Fig. (1a): Relation between BMI (normal range) and SNR on the PET.

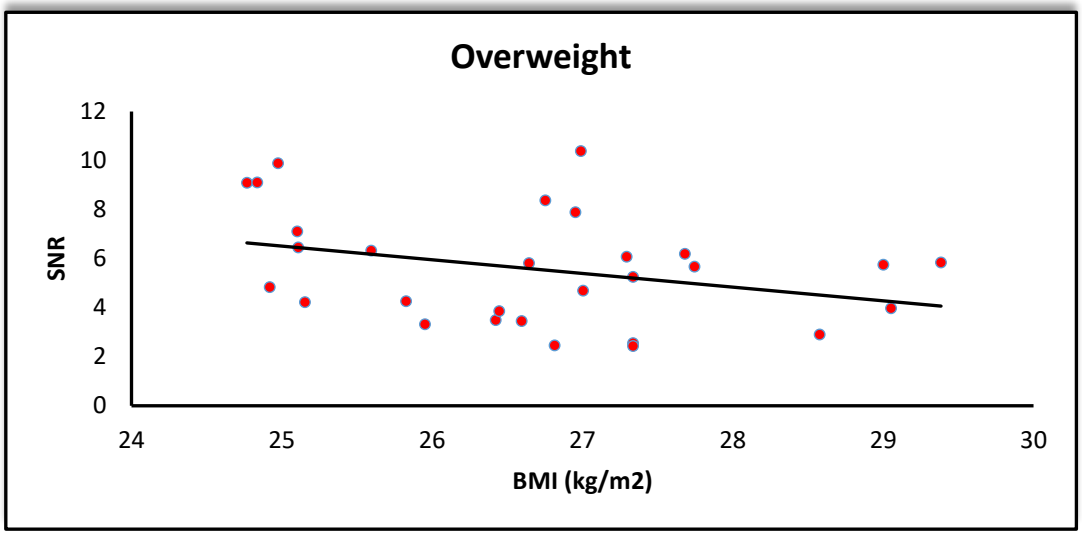


Fig. (1b): Relation between BMI (overweight range) and SNR on the PET.

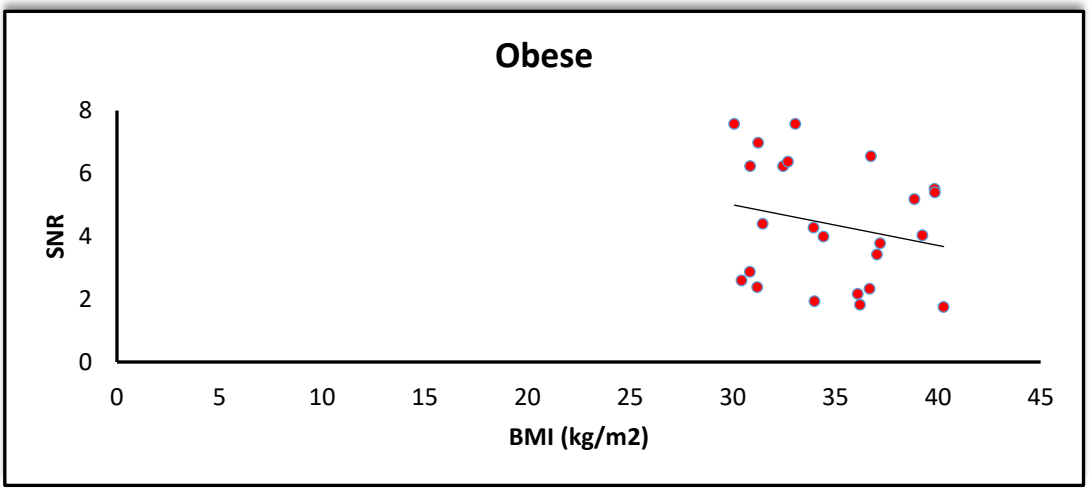
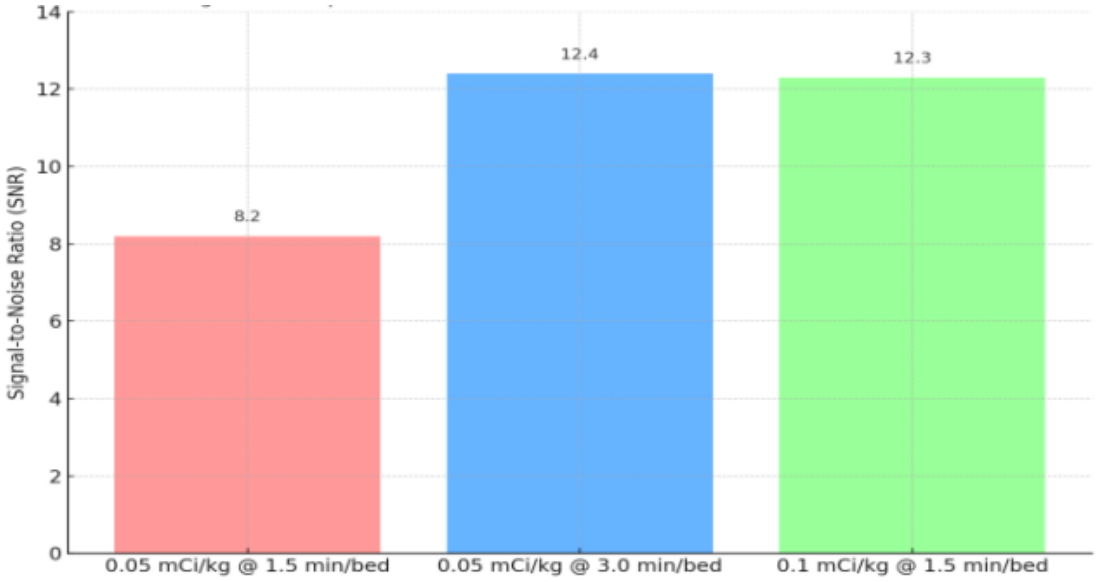


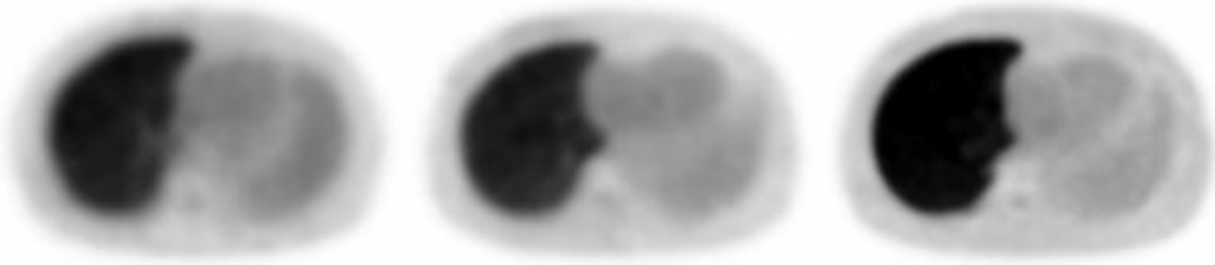
Fig. (1c): Relation between BMI (obese) and SNR on the PET.

Figure (1d) showing the relationship between bed position duration and SNR across different BMI groups, assuming variable injected doses. As shown:

- For all BMI groups, increasing the bed position duration leads to improved SNR.
- Obese patients consistently have lower SNR, but benefit more from extended acquisition times.
- Normal-weight patients achieve adequate SNR even with shorter scan durations and lower doses.



0.05 mci/kg **0.05 mci/kg** **0.1 mci/kg**



1.5 min/bed position **3 min/bed position** **1.5 min/bed position**

Fig. (1e): Example liver region PET-CT images showing visual SNR differences for the tested dose-time combination.

Investigating the impact of body mass index on image noise measures in PET scans was the purpose of this effort. The evaluation of SNR was carried out on bed frames covering the livers of all of the patients. Because the liver is the largest organ in the body and has a radiotracer uptake that is relatively consistent and uniform, it has been decided to use this bed position. As a measure of image noise, SD of the pixel values inside the area of interest (ROI) was used. Despite being often utilized in clinical imaging research, the SD of ROI has limitations as a noise indicator. The term "noise" refers to the degree of radioactive fluctuation (SD) in image of uniform uptake. Image noise is a result of numerous variables. The quantity of photons detected determines stochastic noise. The reconstruction process produces structured noise, which is impacted by visual field heterogeneity [11].

Numerous patient-related problems could affect the signal-to-noise ratio. The administration of FDG is the first. The second factor is body size, specifically the total volume of the body where FDG is dispersed and diluted. Thirdly, the mean path length of photons from the liver to the detector depends on the size of the subject. As a result, larger people will exhibit increased photon attenuation. The "half distance"—analogous to the half-life—over which 511 keV photons in water attenuate 50% of their counts is 7.3 cm. Consequently, the count density may be significantly impacted by increased abdominal girth. Fourthly, although it

wouldn't be anticipated that patient movement would correlate with body size indices, it would also reduce the signal-to-noise ratio [12]. After filling in all the values in the Table (1) about mean, standard deviation, SNR, injection dose (in mci), weight (in kg), height (in m) and BMI, several figures related to BMI and SNR were made to see which the results were. All the figures were made with the values of the PET to see if there are any significant differences between them. The findings indicate that the signal-to-noise ratio (SNR) and image noise worsen dramatically with rising BMI. This is due to the loss of real coincidence events, most likely as a result of greater attenuation in larger patients. However, the quality appears to be optimal when the patient's weight is regarded as normal (between the BMI values of 18 and 24, approximately).

Figure (1a, 1b, and 1c) shows a scatter plot of the SNR versus BMI for both scanners. Here each dot in the figure represents a single patient. The figures indicate that SNR decreases more quickly at lower BMI values than at higher values, indicating that image quality deteriorates more quickly as BMI increases from low values. More dosage cannot, however, be injected to compensate for poorer image quality in larger individuals.

Figure (1d and 1e) illustrate the comparison of signal-to-noise ratio (SNR) across different ^{18}F-FDG dose and bed position time protocols. The figures demonstrate that image quality improves progressively with both increasing acquisition time and higher injected dose. This trend highlights the effectiveness of dose-time optimization in enhancing PET/CT image clarity. These findings confirm earlier research that was extrapolated from phantom data and published. By extending the scan time, it may be possible to improve image quality in this patient population [13,14].

Individual variability in liver metabolism, attenuating tissue thicknesses, image reconstruction parameters, and aberrations such as respiratory motion blur impair the ability of hepatic SNR to distinguish between image quality [15]

This study highlights the ongoing challenge of balancing diagnostic quality and patient safety in nuclear medicine, especially in the context of varying body compositions. The significant inverse correlation between BMI and SNR in PET/CT liver imaging underscores the need for tailored imaging protocols. For example, adjusting scan duration or using advanced reconstruction algorithms such as time-of-flight (TOF) and point-spread function (PSF) modeling may mitigate image degradation in obese patients. The data also support the findings of prior phantom-based and clinical studies, reinforcing that increased FDG dosage alone does not sufficiently compensate for signal attenuation in patients with high BMI. Future studies should explore AI-based noise reduction techniques, dynamic acquisition models, and hybrid PET/MR modalities to further refine image quality. Additionally, patient-specific dosimetry planning could be considered to personalize protocols. Limitations of this study include the relatively small cohort and single-center design, which may limit generalizability. However, these findings pave the way for more nuanced approaches in protocol optimization and emphasize the critical role of BMI in PET imaging performance.

The results revealed a notable relationship between injected dose, scan duration, and image quality. When comparing image quality under a constant scan duration of 1.5 minutes per bed position, it was observed that patients injected with a lower dose of 0.05 mCi/kg demonstrated a significantly lower SNR compared to those injected with 0.1 mCi/kg. This indicates that reducing the dose without adjusting scan time can degrade image quality[19].

However, when the scan time was increased to 3 minutes per bed position for patients injected with 0.05 mCi/kg, the resulting SNR values were comparable to those observed in patients who received 0.1 mCi/kg with a 1.5-minute scan time. This demonstrates that extended scan duration can effectively compensate for reduced radiotracer dose, preserving image quality and diagnostic value [20 , 21].

A central consideration in PET/CT protocol optimization is the balance between radiation dose reduction and preservation of diagnostic accuracy. Lowering the injected FDG activity decreases patient radiation exposure and aligns with the ALARA (As Low As Reasonably Achievable) principle, which is especially relevant in younger patients or those requiring multiple follow-up scans. However, reducing dose inherently lowers the number of detected counts, which can lead to increased image noise, decreased signal-to-noise ratio, and potential underestimation of quantitative parameters such as SUV. These changes may compromise lesion detectability, particularly for small or low-uptake lesions. the findings support that while moderate reductions in activity may still yield

diagnostically useful images, especially when compensated by longer acquisition times or advanced reconstruction/denoising algorithms, aggressive dose reduction risks impairing diagnostic confidence. Therefore, radiation dose optimization must always be balanced against the need for accurate and reliable clinical interpretation, with adjustments tailored to patient BMI, scanner sensitivity, and the clinical indication

CONCLUSION

This study clearly demonstrates that body weight and body mass index (BMI) have a substantial impact on PET/CT image quality, particularly in terms of signal-to-noise ratio (SNR) in liver imaging. As patient BMI increases, SNR consistently decreases, indicating a deterioration in image quality. This inverse relationship underscores the importance of accounting for patient body habitus during scan protocol planning.While increasing scan time or adjusting technical parameters—such as attenuation correction algorithms or reconstruction filters—can partially mitigate the effects of noise caused by increased adiposity, these adjustments are not a complete solution. Enhancing SNR through post-acquisition processing may improve the visual smoothness of the image but could potentially compromise lesion detectability by reducing contrast resolution.

The results support the feasibility of dose-time optimization strategies. For example, extending scan time for patients receiving lower FDG doses can achieve SNR values comparable to those receiving standard doses with shorter acquisition times. This approach can be particularly beneficial in reducing radiation exposure while maintaining diagnostic image quality.

However, protocol adjustments must be tailored to the operational workflow, scanner capabilities, and patient throughput constraints of each nuclear medicine department. A standardized approach may not be universally applicable, and individualized protocols based on BMI or patient category (normal, overweight, obese) may be more appropriate to ensure consistent diagnostic reliability across diverse patient populations.

In conclusion, this work highlights the critical role of patient body composition in determining PET/CT image quality and emphasizes the need for adaptive imaging strategies that balance diagnostic accuracy with radiation safety and clinical efficiency.

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