IBEROAMERICAN JOURNAL OF MEDICINE
iberoamericanjm
Journal homepage: www.iberoamjmed.com

Original article

Common errors in dual-energy x-ray absorptiometry (DXA) examinations: insights from a cross-sectional study in Northeastern Brazil

Luiz Henrique Rosendo [a], *Lucas Silva* [b,*], *Cátia Gondim* [a]

[a] *Hospital Universitário Alcides Carneiro, Universidade Federal de Campina Grande, Campina Grande, Brazil*
[b] *Faculty of Medical Sciences, Universidade Federal de Alagoas, Maceió, Brazil*

ARTICLE INFO

Article history:
Received 25 August 2025
Received in revised form 08 October 2025
Accepted 12 October 2025

Keywords:
Bone densitometry
Osteoporosis
Dual-energy X-ray absorptiometry
Fracture risk
Diagnostic accuracy

ABSTRACT

Introduction: Common technical errors in dual-energy X-ray absorptiometry (DXA) exams may compromise diagnostic accuracy. This study aims to analyze the frequency and types of those errors in DXA scans performed in a referral center.

Material and methods: This cross-sectional study evaluated 100 DXA exams performed at multiple radiology clinics and analyzed at the General Outpatient Clinic of the Medical Residency Program in Endocrinology and Metabolism at Alcides Carneiro University Hospital (HUAC), in Campina Grande. Exams were assessed for technical errors, including improper positioning, vertebral exclusion, and inaccurate region of interest (ROI) definition. Patient demographic data (age, sex, body mass index) were also collected. Descriptive statistics were used to summarize patient characteristics and the frequency of errors.

Results: The study population had a mean age of 65.6 years (± 10 years), with a predominance of female patients (95%). The mean BMI was 26.4 kg/m^2 (±4.8 kg/m^2). Regarding ethnicity, 91% of the sample identified as white. A total of 76% of exams presented at least one technical error, with the most common being osteophyte presence (64%), inadequate femoral rotation (45%), and incorrect ROI (35%). Only 24% of the exams were free of errors.

Conclusions: These findings highlight the need for systematic training and strict adherence to imaging protocols to improve diagnostic accuracy and patient outcomes.

* *Corresponding author.*
E-mail address: lucas.silva@famed.ufal.br
ISSN: 2695-5075 / © 2025 The Authors. Published by Iberoamerican Journal of Medicine. This is an open access article under the CC BY license (http://creativecommons. org/licenses/by/4.0/).
https://doi.org/10.53986/ibjm.2025.0024

Errores comunes en las exploraciones de absorciometría dual de rayos X (DXA): hallazgos de un estudio transversal en el noreste de Brasil

INFO. ARTÍCULO

Historia del artículo:
Recibido 25 Agosto 2025
Recibido en forma revisada 08 Octubre 2025
Aceptado 12 Octubre 2025

Palabras clave:
Densitometría ósea
Osteoporosis
Absorciometría dual de rayos X
Riesgo de fractura
Precisión diagnóstica

RESUMEN

Introducción: Los errores técnicos frecuentes en las exploraciones de absorciometría dual de rayos X (DXA) pueden comprometer la precisión diagnóstica. Este estudio tiene como objetivo analizar dichos errores en una unidad de referencia.
Material y métodos: Se trata de un estudio transversal que evaluó 100 exploraciones de DXA realizadas en diversas clínicas de radiología y analizadas en el Ambulatorio General del Programa de Residencia Médica en Endocrinología y Metabolismo del Hospital Universitario Alcides Carneiro (HUAC), en Campina Grande. Se examinaron los errores técnicos, incluidos el posicionamiento inadecuado, la exclusión vertebral y la definición incorrecta de la región de interés (ROI). También se recopilaron datos demográficos de los pacientes (edad, sexo e índice de masa corporal). Se utilizaron estadísticas descriptivas para resumir las características de los pacientes y la frecuencia de errores.
Resultados: La población del estudio presentó una edad media de 65,6 años (±10 años), con predominio de mujeres (95%). El IMC medio fue de 26,4 kg/m² (±4,8 kg/m²). En cuanto a la etnicidad, el 91% de la muestra se identificó como blanca. El 76% de los exámenes presentó al menos un error técnico, siendo los más frecuentes la presencia de osteofitos (64%), la rotación femoral inadecuada (45%) y la delimitación incorrecta de la ROI (35%). Solo el 24% de las exploraciones estuvieron libres de errores.
Conclusiones: Estos hallazgos subrayan la necesidad de formación sistemática y del cumplimiento riguroso de los protocolos de imagen para mejorar la precisión diagnóstica y los resultados en los pacientes.

HOW TO CITE THIS ARTICLE: Rosendo LH, Silva L, Gondim C. Common errors in dual-energy x-ray absorptiometry (DXA) examinations: insights from a cross-sectional study in Northeastern Brazil. Iberoam J Med. 2025;7(4):108-112. doi: 10.53986/ibjm.2025.0024.

1. INTRODUCTION

Osteoporosis is a metabolic bone disease characterized by decreased bone strength, predisposing individuals to fractures, even from low-impact events such as falls from standing height [1]. The most common fracture sites include the distal radius, vertebrae, and proximal femur, with particularly severe consequences among older adults due to the associated morbidity and mortality [2]. Early detection and effective management are critical to mitigating the disease's clinical burden.

Dual-energy X-ray absorptiometry (DXA) is the gold standard for diagnosing osteoporosis, providing quantitative measures such as bone mineral density (BMD), T-scores, and Z-scores, which guide clinical decisions [3]. However, DXA results can be significantly compromised by technical errors during image acquisition and processing [4]. Improper patient positioning, failure to exclude bone artifacts (e.g., osteophytes or prosthetic implants), and incorrect vertebral selection can result in misinterpretation of BMD values, leading to either overestimation or underestimation of bone loss [5].

These technical errors are often linked to the operator-dependent nature of DXA and highlight the importance of consistent image acquisition protocols and operator training [6]. Incorrect diagnoses may delay treatment initiation or lead to unnecessary therapeutic interventions, potentially increasing healthcare costs and patient burden [7]. Furthermore, DXA plays a crucial role in monitoring treatment responses, underscoring the need for precision at the initial diagnosis.

This study aims to evaluate the profile and prevalence of technical errors in DXA exams conducted at a referral hospital. By identifying common pitfalls, we aim to propose recommendations for minimizing diagnostic errors and optimizing the clinical management of osteoporosis.

2. MATERIAL AND METHODS

2.1.1. STUDY DESIGN AND SETTING

This study was designed as a cross-sectional, observational,

and descriptive analysis conducted at Alcides Carneiro University Hospital (HUAC), a referral institution in endocrinology and metabolism located in Paraíba, Brazil. The hospital is affiliated with the Federal University of Campina Grande (UFCG) and provides specialized outpatient care for patients undergoing routine clinical exams in the Medical Residency Program. The bone densitometry exams were performed at various radiology clinics throughout the city and were independently reanalyzed by an endocrinologist with over ten years of experience in bone metabolism and densitometry interpretation, formally trained according to the International Society for Clinical Densitometry (ISCD) standards.

2.1.2. STUDY POPULATION

The study included patients over the age of 18 who underwent DXA exams at the General Outpatient Clinic between June 2024 and November 2024. The sampling was non-probabilistic and based on convenience, comprising patients who provided informed consent.

2.1.3. ELIGIBILITY CRITERIA

Inclusion criteria: Patients aged 18 years or older, with DXA exams performed as part of routine clinical care, and who signed the informed consent form.
Exclusion criteria: Patients under the age of 18, DXA exams for whole-body composition assessment, and exams missing critical clinical or demographic information.

2.1.4. DATA COLLECTION AND PROCEDURES

Demographic and clinical data were collected, including age, sex, weight, and body mass index (BMI). The DXA exams were evaluated for technical errors, such as improper patient positioning, inadequate region of interest (ROI) selection, and failure to exclude artifacts. Images were analyzed using standardized protocols to identify technical and diagnostic inconsistencies [8].

2.1.5. STATISTICAL ANALYSIS

Descriptive statistics were used to summarize the demographic characteristics of the study population and the frequency of technical errors. Categorical variables were presented as frequencies and percentages, while continuous variables were described using means and standard deviations. All analyses were performed using SPSS software, version 25.0 (IBM Corp., Armonk, NY, USA).

2.1.6. ETHICAL CONSIDERATIONS

The study was conducted in accordance with the ethical principles outlined in the Brazilian National Health Council Resolution No. 466/2012. Approval was obtained from the HUAC Ethics Committee under number: 79465024.5.0000.5182. All participants provided informed consent prior to enrollment.

3. RESULTS

3.1.1. DEMOGRAPHIC CHARACTERISTICS

100 patients underwent DXA exams, with a mean age of 65.6 ± 10 years. The majority of participants were female (95%) and of white ethnicity (91%). The average body weight was 62 ± 12.4 kg, and the mean body mass index (BMI) was 26.4 ± 4.8 kg/m².

3.1.2. PREVALENCE OF TECHNICAL ERRORS

Among the 100 DXA exams evaluated, 76% exhibited at least one technical error. Of these, the most common error was the presence of osteophytes, identified in 64% of exams followed by inadequate femoral rotation (45%) and incorrect ROI (35%). Incorrect vertebral cataloging was the least frequent error (16%). It is noteworthy that no artifacts were observed in the analyzed exams. Only 24% of exams were free of any technical errors.

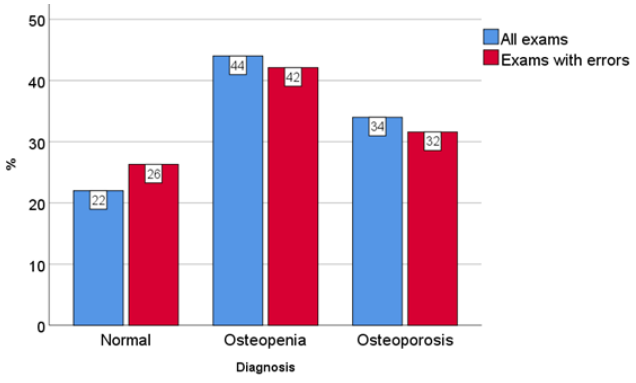

***Figure 1**: Comparison of dual-energy X-ray absorptiometry diagnoses distribution between all exams and those with technical errors.*

3.1.3. DISCREPANCIES IN OSTEOPOROTIC DIAGNOSIS

The initial reports diagnosed 34% of patients with osteoporosis, 44% with osteopenia, and 22% with normal bone mass. However, when analyzing only the exams containing any type of error, the rate of normal diagnoses increases, while the rates of osteopenia and osteoporosis

decrease. Figure 1 represents those values.

4. DISCUSSION

The demographic profile of the patients in this study aligns with known osteoporosis risk factors, reinforcing the need for precise DXA assessments. The mean age of 65.6 years and the predominance of female patients reflect the well-established higher prevalence of osteoporosis in postmenopausal women due to hormonal changes affecting bone density [9]. Additionally, the mean BMI of 26.4 kg/m² suggests that many patients fall within the overweight range, which can influence DXA accuracy, as higher soft tissue composition may lead to overestimated bone mineral density values [10]. Ethnicity is another critical variable, as 91% of the sample identified as white, a group with generally lower bone mass compared to individuals of African descent, who tend to have higher peak bone density [11].

Additionally, this work still reveals a high prevalence of technical errors in DXA exams, with significant implications for the diagnosis and management of osteoporosis. The most frequent error observed was the presence of osteophytes, affecting 64% of the exams. Osteophytes can falsely elevate BMD readings, leading to the underdiagnosis of osteoporosis and inappropriate clinical management [7]. Studies have shown that undetected osteophytes can obscure the severity of bone loss, potentially delaying the initiation of preventive therapies for fractures [12].

Another frequent issue was inadequate femoral rotation, present in 45% of cases, which led to the inclusion of the lesser trochanter in the image, thereby falsely elevating BMD measurements [13]. Errors in the selection and exclusion of vertebrae were identified in 24% of cases. Improper exclusion of abnormal vertebrae, as highlighted in the literature, can result in inaccurate diagnoses of osteopenia or osteoporosis, depending on the affected vertebrae [13, 14]. Additionally, incorrect vertebral cataloging, observed in 16% of exams, can further distort diagnostic outcomes, particularly when L1 is misidentified or confused with T12 [15].

The presence of scoliosis, noted in 20% of cases, represents another critical diagnostic challenge. Scoliosis alters spinal curvature and bone density measurements, increasing the likelihood of false-negative or false-positive results, as previously documented in clinical studies [16, 17]. Furthermore, incorrect ROI selection, affecting 20% of the exams, underscores the importance of proper operator training and adherence to standardized imaging protocols [18].

Comparisons with international studies provide valuable context. For instance, the error rate in vertebral cataloging in this study (16%) was lower than the 38% reported in Ecuador [19] but similar to findings from Turkey, where error rates ranged from 10.5% to 65.5% depending on the institution [20]. This variability highlights the critical role of institutional protocols and operator experience in minimizing technical errors [6].

Errors in DXA scans can lead to significant misclassification, particularly underestimating osteoporosis diagnoses. In the analyzed data, exams with technical errors showed an increased rate of normal diagnoses and reduced rates of osteopenia and osteoporosis, highlighting the risk of false-negative results. Similar findings have been reported, with studies indicating that technical errors in DXA occur frequently and can result in misdiagnoses, potentially delaying appropriate treatment [21]. These inaccuracies underscore the importance of rigorous quality control and standardized protocols to ensure accurate bone density assessment, in this context secondary reviews improve diagnostic sensitivity by addressing errors in image acquisition and interpretation[17].

This study is limited by its non-probabilistic sampling, which restricts the generalization of findings. Additionally, the single-researcher analysis may have introduced observer bias, despite adherence to protocols. Future research should involve larger, multicenter samples and automated quality control to minimize bias and improve reliability.

5. CONFLICT OF INTERESTS

The authors have no conflict of interest to declare. The authors declared that this study has received no financial support.

6. REFERENCES

1.Pouresmaeili F, Kamalidehghan B, Kamarehei M, Goh YM. A comprehensive overview on osteoporosis and its risk factors. Ther Clin Risk Manag. 2018;14:2029-49. doi: 10.2147/TCRM.S138000.

2.LeBoff MS, Greenspan SL, Insogna KL, Lewiecki EM, Saag KG, Singer AJ, et al. The clinician's guide to prevention and treatment of osteoporosis. Osteoporos Int. 2022;33(10):2049-2102. doi: 10.1007/s00198-021-05900-y.

3.Blake GM, Fogelman I. The role of DXA bone density scans in the diagnosis and treatment of osteoporosis. Postgrad Med J. 2007;83(982):509-17. doi: 10.1136/pgmj.2007.057505.

4.Choksi P, Jepsen KJ, Clines GA. The challenges of diagnosing osteoporosis and the limitations of currently available tools. Clin Diabetes Endocrinol. 2018;4:12. doi: 10.1186/s40842-018-0062-7.

5.Krueger D, Shives E, Siglinsky E, Libber J, Buehring B, Hansen KE, et al. DXA Errors Are Common and Reduced by Use of a Reporting Template. J Clin Densitom. 2019;22(1):115-24. doi: 10.1016/j.jocd.2018.07.014.

6.US Preventive Services Task Force; Curry SJ, Krist AH, Owens DK, Barry MJ, Caughey AB, et al. Screening for Osteoporosis to Prevent Fractures: US Preventive Services Task Force Recommendation Statement. JAMA. 2018;319(24):2521-31. doi: 10.1001/jama.2018.7498.

7.Martineau P, Morgan SL, Leslie WD. Bone Mineral Densitometry Reporting: Pearls and Pitfalls. Can Assoc Radiol J. 2021;72(3):490-504. doi: 10.1177/0846537120919627.

8.Slart RHJA, Punda M, Ali DS, Bazzocchi A, Bock O, Camacho P, et al. Updated practice guideline for dual-energy X-ray absorptiometry (DXA). Eur J Nucl Med Mol Imaging. 2025;52(2):539-63. doi: 10.1007/s00259-024-06912-6.

9.Charde SH, Joshi A, Raut J. A Comprehensive Review on Postmenopausal Osteoporosis in Women. Cureus. 2023;15(11):e48582. doi: 10.7759/cureus.48582.

10.Liu Y, Liu Y, Huang Y, Le S, Jiang H, Ruan B, et al. The effect of overweight or obesity on osteoporosis: A systematic review and meta-analysis. Clin Nutr. 2023;42(12):2457-67. doi: 10.1016/j.clnu.2023.10.013.

11.Cauley JA. Defining ethnic and racial differences in osteoporosis and fragility fractures. Clin Orthop Relat Res. 2011;469(7):1891-9. doi: 10.1007/s11999-011-1863-5.

12.Watts NB. Fundamentals and pitfalls of bone densitometry using dual-energy X-ray absorptiometry (DXA). Osteoporos Int. 2004;15(11):847-54. doi: 10.1007/s00198-004-1681-7.

13.Brandão CM, Camargos BM, Zerbini CA, Plapler PG, Mendonça LM, Albergaria BH, et al. [2008 official positions of the Brazilian Society for Clinical Densitometry--SBDens]. Arq Bras Endocrinol Metabol. 2009;53(1):107-12. doi: 10.1590/s0004-27302009000100016.

14.Ensrud KE, Crandall CJ. Osteoporosis. Ann Intern Med. 2017;167(3):ITC17-ITC32. doi: 10.7326/AITC201708010.

15.Kecskemethy HH, Kubaski F, Harcke HT, Tomatsu S. Bone mineral density in MPS IV A (Morquio syndrome type A). Mol Genet Metab. 2016;117(2):144-9. doi: 10.1016/j.ymgme.2015.11.013.

16.Izadyar S, Golbarg S, Takavar A, Zakariaee SS. The Effect of the Lumbar Vertebral Malpositioning on Bone Mineral Density Measurements of the Lumbar Spine by Dual-Energy X-Ray Absorptiometry. J Clin Densitom. 2016;19(3):277-81. doi: 10.1016/j.jocd.2015.12.001.

17.Jung EY, Park SJ, Shim HE, Cho YJ, Lee JM, Lee SS, et al. Multidisciplinary team training reduces the error rate of DXA image. Arch Osteoporos. 2020;15(1):115. doi: 10.1007/s11657-020-00791-8.

18.Gong B, Mandair GS, Wehrli FW, Morris MD. Novel assessment tools for osteoporosis diagnosis and treatment. Curr Osteoporos Rep. 2014;12(3):357-65. doi: 10.1007/s11914-014-0215-2.

19.Maldonado G, Intriago M, Larroude M, Aguilar G, Moreno M, Gonzalez J, et al. Common errors in dual-energy X-ray absorptiometry scans in imaging centers in Ecuador. Arch Osteoporos. 2020;15(1):6. doi: 10.1007/s11657-019-0673-3.

20.Karahan AY, Kaya B, Kuran B, Altındag O, Yildirim P, Dogan SC, et al. Common Mistakes in the Dual-Energy X-ray Absorptiometry (DXA) in Turkey. A Retrospective Descriptive Multicenter Study. Acta Medica (Hradec Kralove). 2016;59(4):117-23. doi: 10.14712/18059694.2017.38.

21.Lewiecki EM, Binkley N, Morgan SL, Shuhart CR, Camargos BM, Carey JJ, et al. Best Practices for Dual-Energy X-ray Absorptiometry Measurement and Reporting: International Society for Clinical Densitometry Guidance. J Clin Densitom. 2016;19(2):127-40. doi: 10.1016/j.jocd.2016.03.003.