Original Article

Incidental diagnosis and reporting rate of abdominal aortic aneurysms on lumbar spine magnetic resonance imaging

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Background: Despite screening recommendations, many abdominal aortic aneurysms (AAAs) are incidentally imaged during various imaging studies but are frequently missed, especially when the imaging procedure is not specifically targeted to the aorta. The aims of this study were to conduct a retrospective analysis to assess the incidence of AAAs as incidental findings on lumbar spine magnetic resonance imaging (MRI) and to evaluate the detection rate of these findings reported by radiologists.

Methods: After ethics committee approval, this retrospective study included patients aged 55 years or older who underwent for any indication a lumbar spine 1.5-T MRI between January 2017 and June 2023 at the Unit of Radiology of the IRCCS (Research Hospital) Policlinico San Donato. Patients with a known history of AAA or prior AAA repair were excluded. The maximal aortic diameter of the abdominal aorta was measured on axial and sagittal T2-weighted images. A threshold of ≥30 mm was adopted to define the presence of an AAA. The Mann-Whitney *U* test was used to compare measurements between sexes and reporting status (reported or not reported). Bland-Altman analysis evaluated agreement between axial and sagittal measurements. Spearman's correlation assessed relationships between age, AAA detection, and measurement values.

Results: Out of 1,922 patients, 84 [4.4%, 95% confidence interval (CI): 3.5–5.3%] had an abdominal aorta diameter ≥30 mm, qualifying as AAAs. Only 26 (31.0%, 95% CI: 21.1–40.8%) of these AAAs were reported by radiologists. A significant difference in detection rates between sexes was observed (P<0.001), with males showing higher prevalence (8.4%, 95% CI: 6.4–10.3%) compared to females (1.7%, 95% CI: 0.9–2.4%). A significant difference was found also between the median maximal aortic diameter of 38 mm [interquartile range (IQR), 33–43 mm] for reported AAAs and 32 mm (IQR, 30–35 mm) for not reported AAAs (P=0.003). Bland-Altman analysis demonstrated good agreement between axial and sagittal measurements, showing also a strong correlation (ρ=0.93, P<0.001). Age correlated with the highest value between axial and sagittal measurements of AAAs (ρ=0.23, P<0.001) and detection rates (ρ=0.01, P<0.001), though the correlation was very weak.

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Conclusions: This study identified a substantial incidence of AAAs on lumbar spine MRI scans, with a significant proportion of these cases going unreported by radiologists. Age and male sex were key factors influencing AAA prevalence, underscoring the need for targeted screening and management strategies that account for demographic differences.

Keywords: Abdominal aortic aneurysm (AAA); magnetic resonance imaging (MRI); incidental findings; reporting; detection

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Introduction

An abdominal aortic aneurysm (AAA) is defined as a localized enlargement of the abdominal aorta with a vessel diameter ≥30 mm or >50% larger than the normal diameter (1). The risk of rupture of AAAs increases with the aneurysm diameter, and the mortality rate for patients with ruptured AAAs ranges from 65% to 85% (2). AAAs are typically asymptomatic until they rupture and are often incidentally discovered during imaging studies or physical exams that were not specifically conducted for this purpose (3,4).

Once diagnosed, the management strategies for AAAs depend on several factors including the size and location of the aneurysm and the overall health of the individual patient (1). Larger AAAs, those presenting symptoms or AAAs at high risk of rupture, generally require surgical intervention, either through open surgery or an endovascular approach (1,5).

Screening for AAAs is particularly recommended for specific demographics. For instance, men aged between 65 and 75 years who have an history of smoking, or a family history of AAA are advised to undergo a one-time abdominal ultrasound (6,7).

For AAAs measuring less than 5.5 cm in diameter for men and 5.0 cm for women, current guidelines advocate for periodic imaging to monitor any changes in size, ensuring timely intervention can be made if necessary (7,8).

Despite these recommendations, many AAAs are not diagnosed until they rupture (9). Indeed, AAA are often incidentally found during abdominal computed tomography (CT) scans conducted for other reasons (10). Notably, radiologists can miss incidental findings of pathological aorta diameters, especially when the imaging procedure is targeted at other organs or body districts. This oversight leads to a gap in the continuity of care, where many cases are not referred for further screening or follow-up (10).

Lumbar spine magnetic resonance imaging (MRI) is commonly performed to evaluate low back pain in age groups who are also at risk for AAAs. Since the abdominal aorta is often included within the imaging study volume, this presents an opportunity for incidental detection of AAAs (11). Studies have indicated that a variety of incidental findings, including AAAs, can be identified through lumbar spine MRI (11-16). However, it appears there is a notable scarcity of research specifically focused on the detection rates of AAAs via this widely used imaging procedure in large patient cohorts.

The aims of this study were to conduct a retrospective analysis to assess the incidence of AAAs as incidental finding on lumbar spine MRI and to evaluate the detection rate of this incidental finding reported by radiologists. This approach not only adds to the existing body of research but also underscores the potential of lumbar spine MRI as a tool for the incidental detection of significant vascular abnormalities, potentially improving screening practices. We present this article in accordance with the STROBE reporting checklist (available at https://qims.amegroups.com/article/view/10.21037/qims-24-1291/rc).

Methods

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This retrospective study was approved by the ethics committee of Comitato Etico Territoriale Lombardia 1 on 5th June 2023 (No. 53/INT/2023). Informed consent was waived due to the retrospective nature of the study.

The study included patients of both sexes, aged 55 years or older, who underwent a lumbar spine MRI at the Unit of Radiology of the IRCCS (Research Hospital) Policlinico San Donato for any indication between January 2017 and

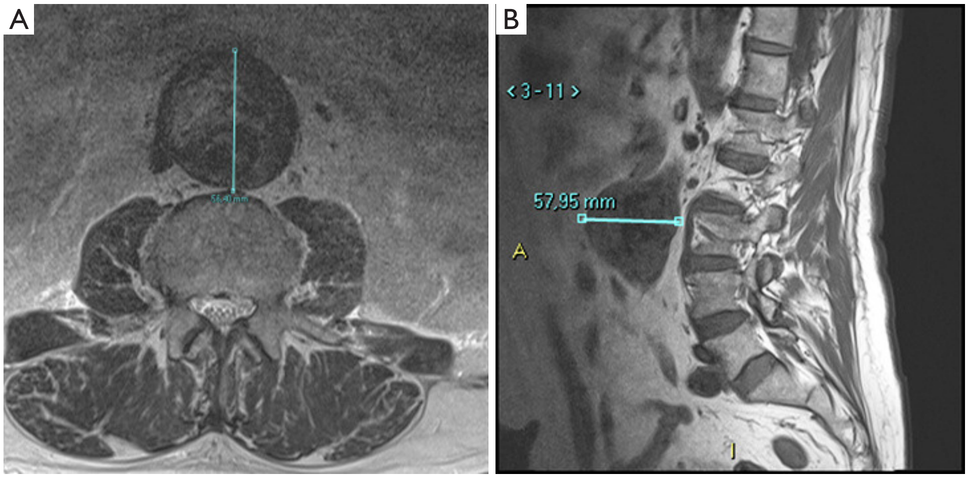

Figure 1 Examples of MRI scans showing axial and sagittal measurements of abdominal aortic aneurysm in a 76-year-old male patient. (A) Axial T2-weighted and (B) sagittal T1-weighted MRI scans of the lumbar spine revealed an incidental finding. MRI, magnetic resonance imaging.

June 2023. Patients with a known history of AAA or prior AAA repair surgery were excluded from the study.

Lumbar MRI was performed according to a standardized protocol using a 1.5-T MRI scanner (Magnetom Symphony, Siemens Healthineers, Erlangen, Germany) equipped with spine matrix coil, 8-channel CP mode. The MRI protocol typically included the following sequences: sagittal and axial T2-weighted turbo spin-echo, sagittal short-tau inversion-recovery, and sagittal T1-weighted turbo spin-echo. Fields of view of 60×30 cm^2 for the sagittal view or 45×20 cm^2 for the axial view were used. Incomplete MRI protocol acquisition, MRI images with artifacts not allowing image analysis and MRI performed at another institution were excluded.

The maximal aortic diameter of the abdominal aorta was measured on both axial and sagittal T2-weighted images by measuring the distance between the outer-wall to outer-wall of the aorta at its widest point (*Figure 1*). A threshold of ≥30 mm was adopted to define the presence of an AAA, as defined by the Society for Vascular Surgery in 2024 (7). Measurements were performed by two radiology residents, both with 4 years of experience; discrepancies were solved in consensus by two board certified radiologists with 5 and 15 years of experience.

Statistical analysis

The incidence of previously unknown AAA in the patient's cohort was estimated using descriptive statistics [medians and interquartile ranges (IQRs)] for continuous variables. Due to the non-normal distribution of all the data, as indicated by the Shapiro-Wilk test, non-parametric tests were used for inferential analysis. The Mann-Whitney *U* test was applied to compare the axial and sagittal measurements of the abdominal aorta between sex, reporting status (reported or not reported), age between AAA group and non-AAA group, and maximal aortic diameter between AAA group and non-AAA group. For the comparison of sex distribution between the AAA group and the non-AAA group, a Chi-square test was applied.

The Bland-Altman analysis was performed to evaluate the agreement between axial and sagittal measurements. Spearman's correlation coefficient (ρ) was used to assess the relationship between age and AAAs detection, and between the highest value between axial and sagittal measurements. P values <0.05 from two-tailed tests were considered statistically significant (17).

Results

Prevalence, detection of AAA and reporting rates

Among the initially included 1,934 patients, 12 were excluded due to a known history of AAA, previous AAA repair surgery, MRI images with artifacts, or MRI performed at another institution. Ultimately, 1,922 patients were included (*Figure 2*). Of these, 84 patients [4.4%, 95% confidence interval (CI): 3.5–5.3%] were found to have an abdominal aorta diameter

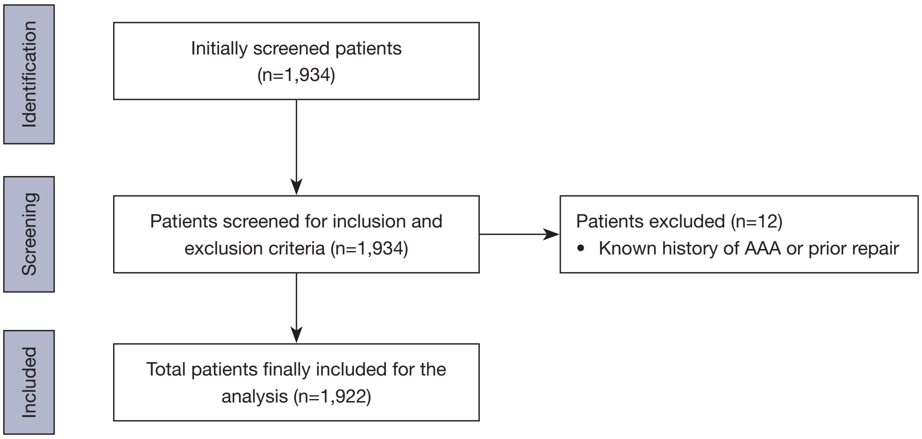

Figure 2 Flowchart of patients' selection. AAA, abdominal aortic aneurism.

Table 1 Demographic data of the patients included.

Variable	AAA group (n=84)	Non-AAA group (n=1,838)	P value
Age (years), median [IQR]	76 [73–80]	70 [61–76]	<0.001
Male, %	78%	39%	<0.001
Maximal aortic diameter (mm), median [IQR]	34 [31–38]	20 [19–21]	<0.001

AAA, abdominal aortic aneurism; IQR, interquartile range.

≥30 mm on either axial or sagittal measurement, thus meeting the criteria for AAA. Out of the 84 detected AAAs, 26 were reported by the radiologists, yielding a reporting rate of 31.0% (95% CI: 21.1–40.8%). The entire cohort of 1,922 patients had a median age of 72 years (IQR, 63–81 years). Among these, 1,143 (59.5%) were female, with a median age of 67 years (IQR, 59–76 years), and 779 (40.5%) were male, with a median age of 71 years (IQR, 63–77 years). A significant difference in terms of detection rate between sexes was found: females 1.7% (95% CI: 0.9–2.4%), males 8.4% (95% CI: 6.4–10.3%), P<0.001. The median age for the group with AAA reported is 79 years (IQR, 75–81 years), while for the group with AAA not reported, the median age is 71.0 years (IQR, 63–77 years). A significant difference in terms of age between reported group and not reported group was found (P<0.001). *Table 1* presents the data of the patients included considering the AAA group and the non-AAA group.

Figures 3-5 provide examples of reported and not reported AAAs in three separate patients. The median maximal aortic diameter on axial measurement was 19 mm (IQR, 18–21 mm) for females and 22 mm (IQR, 21–24 mm) for males, while it was 19 mm (IQR, 18–21 mm) for females and 21 mm (IQR, 20–23 mm) for males on sagittal measurement. According to the Shapiro-Wilk test both axial and sagittal measurements in males and females were not normally distributed. The Mann-Whitney *U* tests for both axial and sagittal measurements show significant differences between males and females in terms of these measurements. Among the 26 reported AAAs, the median maximal aortic diameter was 38 mm (IQR, 33–43 mm), while for the not reported AAAs, the median was 32 mm (IQR, 30–35 mm). This difference is statistically significant according to the Mann-Whitney *U* test (P=0.003).

Assessment of measurement agreement

According to Bland-Altman analysis, the mean difference, or the average bias between axial and sagittal measurement was found to be approximately 0.33 mm. The limits of agreement, which describe the range within which the majority (95%) of differences between the two measurements fall, ranged from −2.79 to 3.45 mm. These results are summarized in *Figure 6*.

Correlation analysis

A strong correlation was found between axial and sagittal

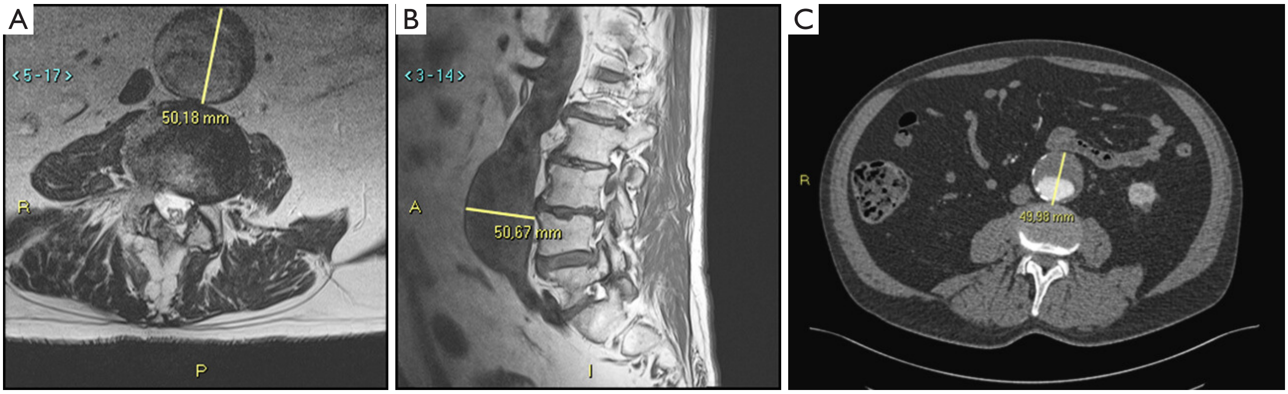

Figure 3 MRI and CT imaging of an abdominal aortic aneurysm measuring approximately 50 mm in diameter. (A) Axial T2-weighted and (B) sagittal T1-weighted MRI scans of the lumbar spine with AAA with diameter of 50 mm. (C) CT confirming the presence of an AAA. AAA, abdominal aortic aneurism; CT, computed tomography; MRI, magnetic resonance imaging.

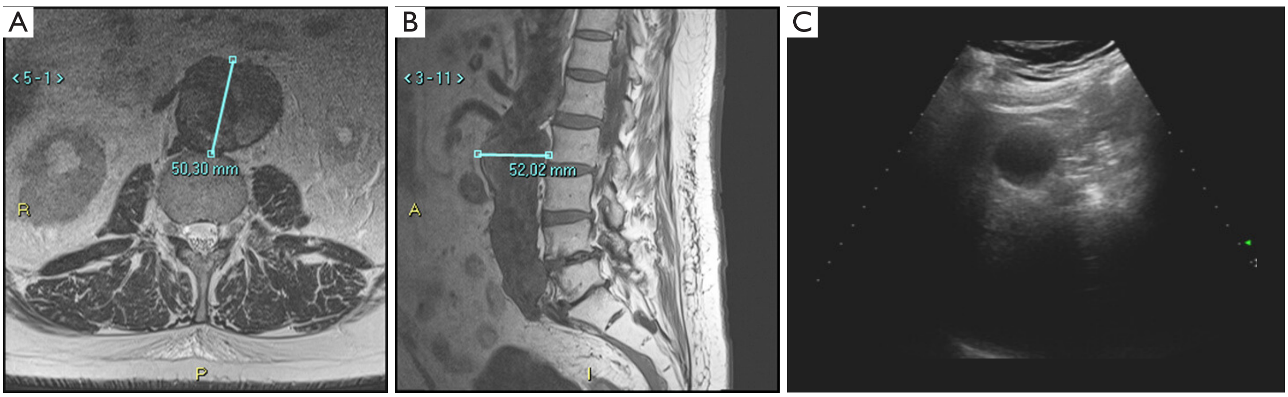

Figure 4 Comparison of MRI and ultrasound imaging of a previously unreported abdominal aortic aneurysm. (A) Axial T2-weighted and (B) sagittal T1-weighted MRI scans of the lumbar spine showed a not reported AAA. (C) Abdominal ultrasound image made for unrelated reasons five months later based on which the enlargement was reported. AAA, abdominal aortic aneurism; MRI, magnetic resonance imaging.

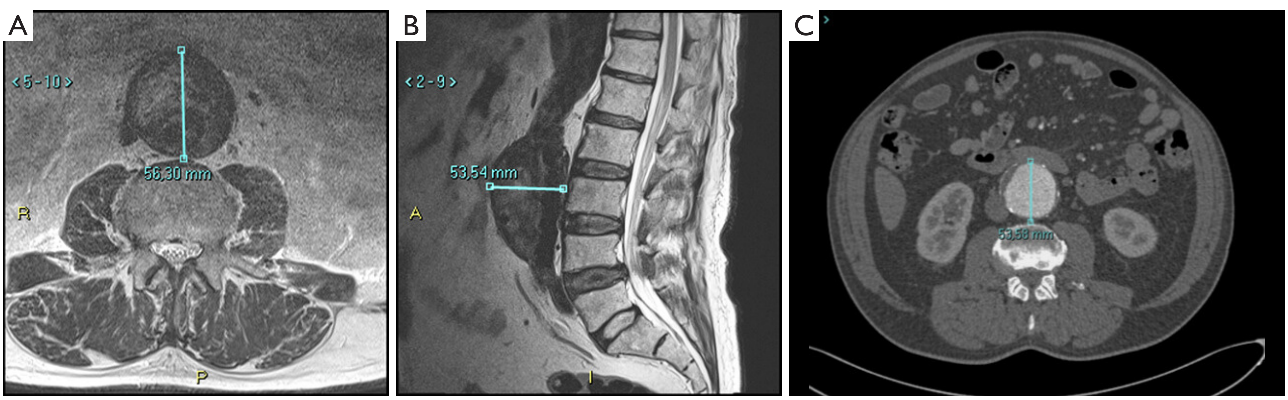

Figure 5 MRI and CT imaging of a previously unreported AAA. (A) Axial T2-weighted and (B) sagittal T2-weighted MRI scans of the lumbar spine with not reported abdominal aortic aneurysm. (C) CT-scan of the same patient. AAA, abdominal aortic aneurism; CT, computed tomography; MRI, magnetic resonance imaging.

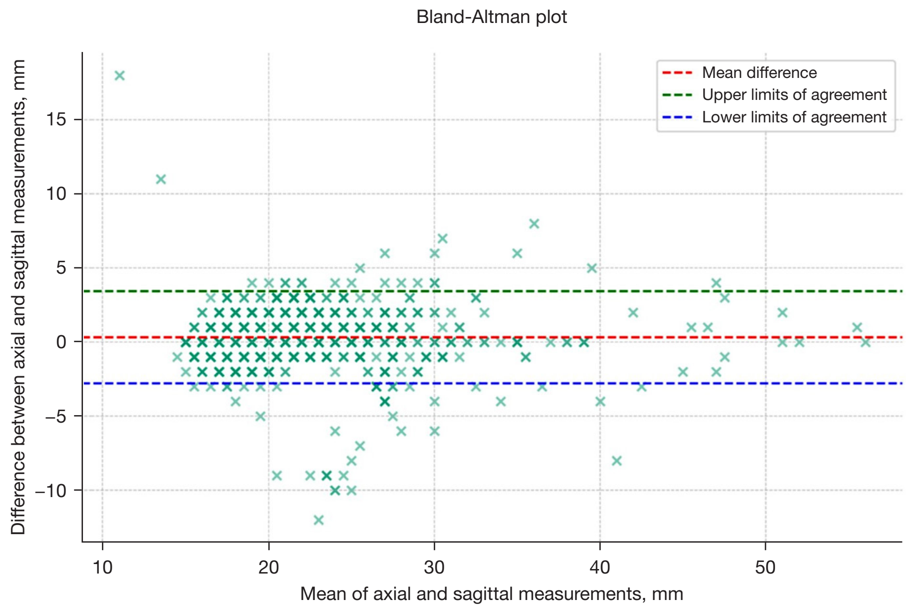

Figure 6 Bland-Altman plot with axial and sagittal measurements per patient based on lumbar spine MRI. The mean difference, or average bias, between axial and sagittal measurements is approximately 0.33 mm. The limits of agreement, indicating the range within which 95% of differences fall, are −2.79 to 3.45 mm. MRI, magnetic resonance imaging.

measurements (ρ=0.93, P<0.001), underscoring the consistency between these two measurement methods on MRI.

The Spearman correlation coefficient between age and the highest value between axial and sagittal measurements of AAAs resulted to be ρ=0.23, P<0.001. A significant correlation between age and both axial and sagittal measurements (ρ=0.22 and ρ=0.19, respectively, P<0.001) was found.

Discussion

This study showed that among 1,922 patients undergoing lumbar MRI, 84 (4.4%, 95% CI: 3.5–5.3%) had an abdominal aortic diameter equal or greater than 30 mm, based on either axial or sagittal measurements. This AAA rate based on lumbar MRI findings aligns with existing literature documenting prevalence rates between 1.3% and 8.9% in individuals aged 65 and older in the general population (18). Out of these 84 detected AAAs, 26 were reported by radiologists, resulting in a reporting rate of only 31% in MRI scans primarily aimed at examining the lumbar spine.

Zucker *et al.* (11) reported a higher prevalence of 9.6% AAAs, but a much lower reporting rate of 10.5%. They highlighted the underreporting of AAAs in lumbar spine MRI within a single year and an age range of 65–75 years. Our study extends these observations by confirming that underreporting persists across a broader age range and a more diverse patient population over multiple years. By involving a larger patient cohort, our study reinforces the call for systemic changes in radiological practices to ensure these incidental findings are not overlooked, highlighting the persistent issue of underreporting AAAs.

Our results showed a difference in terms of sex and AAAs detection rates, with males exhibiting a higher prevalence compared to females: 8.35% (95% CI: 6.41–10.30%) *vs.* 1.66% (95% CI: 0.92–2.40%). This gender discrepancy is consistent with established epidemiological trends, attributed primarily to hormonal, genetic, and lifestyle factors (19).

The analysis reveals a significant difference in the median maximal aortic diameter between reported and not reported AAAs (38 mm, IQR 33–43 *vs.* 32 mm, IQR 30–35 mm, respectively). The larger diameter of reported AAAs could be explained considering that larger AAAs are more easily identified, while smaller AAAs might be overlooked.

The strong correlation between axial and sagittal measurements on images not tailored for examining the abdominal aorta—as shown by Bland-Altman analysis—supports the relative reliability of these measurements on lumbar spine MRI.

With a positive correlation found between age and the size of AAAs, our findings underscore the importance of detecting AAAs in older patients, who are also more likely to undergo lumbar spine MRI due to the high prevalence of low back pain in this demographic. Interestingly, while the correlation between age and the detection rate of AAAs was very weak (ρ=0.01), it was statistically significant ($P<0.001$). This is an important consideration, especially given the overlap in MRI use among older subjects for low back pain.

This study highlights a gap in clinical practice and emphasizes the need for improved awareness and education among neuroradiologists and musculoskeletal radiologists about identifying and reporting aortic abnormalities in spine MRI studies. Failure to report incidental AAAs can delay necessary interventions or follow-up programs, leading to adverse outcomes for patients (10). Strategies aimed at enhancing radiologist training and implementing standardized reporting protocols may help improve reporting rates and facilitate timely management of AAAs (20). In this regard, automated detection for incidental findings on MRI scans might be feasible in the future with the use of artificial intelligence.

Study limitations

This study has some limitations. The retrospective design and the single-center nature of the study may introduce selection bias, potentially limiting the generalizability of findings. Future prospective multicenter studies incorporating diverse patient populations are warranted to validate these findings and inform evidence-based clinical guidelines. A prospective study could further assess the clinical implications and the added value of diagnosing AAA on lumbar MRI, including an analysis of follow-up data patients' outcomes. Such a study would also facilitate the implementation of standardized imaging and reporting protocols, ensuring the documentation of incidental AAAs across different sites. Additionally, a multicenter approach would enhance the robustness and applicability of the findings by including a more diverse patient population from various geographic and clinical settings, addressing variability in radiological practices and potentially improving detection rates. Clinical data, such as BMI and smoking history, were unavailable, which may have limited our ability to fully assess potential risk factors associated with AAAs. Finally, we should consider that we cannot determine whether the radiologist in charge failed to identify the AAA (resulting into non-reporting) or identified it correctly but considered it "not clinically relevant enough" to include in the radiological report. This uncertainty further underscores the need for prospective studies.

Conclusions

In conclusion, this study found a notable incidence of AAAs in lumbar spine MRI scans, and a nonnegligible portion of these AAAs were not reported by radiologists. Age and male sex emerged as significant determinants of AAAs prevalence, highlighting the importance of tailored screening and management strategies that consider demographic factors.

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None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://qims.amegroups.com/article/view/10.21037/qims-24-1291/rc

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This retrospective study was approved by the ethics committee of Comitato Etico Territoriale Lombardia 1 on 5th June 2023 (No. 53/INT/2023). Informed consent was waived due to the retrospective nature of the study.

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