

Anatomical variations of the azygos lobe from a developing country population: A computed tomography study

Qasim A El-Dwairi¹ , Sakha'a A Twaissi¹ , Kusai M Al-Muqbel² , Karem H Alzoubi^{3,4*} , Rania Mahafdeh⁵ 

¹Department of Anatomy and Cell Biology, Faculty of Medicine, Jordan University of Science and Technology, Irbid, JORDAN

²Department of Radiology, Faculty of Medicine, King Abdulla University Hospital, Jordan University of Science and Technology, Irbid, JORDAN

³Department of Pharmaceutical Sciences, College of Pharmacy, QU Health, Qatar University, Doha, QATAR

⁴Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology, Irbid, JORDAN

⁵Department of Doctor of Pharmacy, Faculty of Pharmacy, Jadara University, Irbid, JORDAN

*Corresponding Author: khalzoubi@just.edu.jo

Citation: El-Dwairi QA, Twaissi SA, Al-Muqbel KM, Alzoubi KH, Mahafdeh R. Anatomical variations of the azygos lobe from a developing country population: A computed tomography study. *Electron J Gen Med.* 2025;22(6):em696. <https://doi.org/10.29333/ejgm/17350>

ARTICLE INFO

Received: 20 Jun. 2025

Accepted: 09 Sep. 2025

ABSTRACT

Background: The right lung's upper lobe can have an uncommon anatomical variant known as an azygos lobe (AL). Its etiology is associated with a malfunction in the azygos vein (AV)'s migration during embryonic development. This study aimed to determine the prevalence of the AL and its types from a developing country's population.

Methods: A total of 3,600 chest computed tomography images for patients who were undergoing imaging in the diagnostic radiology department at a major medical center were examined to determine whether the left or right AL and axial plane fissure were present. Furthermore, the differences in the size of the ALs and the shape of the fissures were also evaluated according to the different types of ALs.

Results: The results revealed that, of the 3,600 subjects, only 0.92% had an AL, whereas 99.08% did not. The most prevalent azygos types were azygos type A (0.39%), followed by azygos type B (0.28%) and azygos type C (0.25%). AL abnormality is also very uncommon in both genders, with a frequency of 0.92% in females and 0.91% in males.

Conclusion: Variants of the AL are rare; however, properly identifying this structure may reduce many associated problems, such as bleeding risk and accidental AV injury. Our results show that the most prevalent azygos type variation is type A, and the prevalence of the AL is comparable to the prevalence rate reported in the literature.

Keywords: azygos lobe, computed tomography, prevalence, clinical anatomy

INTRODUCTION

Azygos lobe (AL) is a congenital azygos abnormality that presents as a right lung accessory lobe [1]. The formation of the AL occurs during embryogenesis when the right posterior cardinal vein, one of the azygos vein (AV)'s predecessors, enters the lung's apex rather than passing above it [2, 3]. The azygos venous system, a key component of the thoracic venous return, may present with different congenital abnormalities, including partly aberrant pulmonary circulation, the azygos and hemiazygos continuation of the inferior vena cava, and the absence of the AV [4].

In radiology, the AL appears as a curved shadow or comma-shaped fissure in the right upper lung field, often identified incidentally on chest X-ray or computed tomography (CT) scans [1, 5]. The AL's appearance is divided into three categories depending on how the azygos fissure relates to the lung's apex; the first category is type A, in which the trigon is lateral to the lung's apex. In contrast, the second type is type B, where the fissure is more vertical, and the trigon is positioned toward the center. While type C is the final group, where the fissure extends from the mediastinum, and the trigon is

positioned medially [6]. Accurate recognition of the AL is important, particularly in thoracic surgery, as unrecognized it may lead to unintentional injury to the AV, which can cause bleeding or vascular injury during the operational procedure [7]. So, before doing any thoracic surgery, it is necessary to precisely define the presence of the AL and a varied AV route, especially the left AV, which can complicate thoracoscopic surgery. More importantly, there is the challenge of accurate diagnosis of AL before surgical intervention, as it might be confused with certain disease processes like cysts or lung lesions [2]. Most of the interns were not able to diagnose AL, and only 57% of radiology residents were able to diagnose A [8]. The ability to diagnose the presence of AL's imaging properties is essential to prevent incorrect diagnoses and bleeding procedure [7, 9].

In the literature, there are a limited number of studies on the AL and fissure, most of which are simply case reports. In Jordan, research about this anatomical abnormality is rare. A study conducted by [8] revealed that the prevalence of the right AL in the Jordanian population was 0.88%. Our research's main aim is to add baseline information regarding the prevalence of AL and its types to a sample of the Jordanian population. The primary focus of this research was to do a retrospective

analysis of CT scans taken from patients who were undergoing imaging in department of radiology and nuclear medicine at King Abdullah University Hospital (KAUH). By improving knowledge of these anatomical differences and their clinical significance, we can assist in planning radiological and surgical treatments for lung diseases in the Jordanian population more safely and efficiently.

METHODS

We conducted a retrospective review to analyze chest CT scans from patients who underwent scans in the department of diagnostic radiology at KAUH, Irbid, Jordan, the major hospital serving the Northern Province of Jordan. The study's target sample consisted of patients who were admitted or visited the radiology department as outpatients for a chest CT scan as part of their medical management. It involved 3,600 patients (1,862 men and 1,738 women). Inclusion criteria include all patients who underwent a CT scan for the chest, neck/chest, neck/chest/abdomen, or whole-body PET/CT. Images are archived, available on the picture archiving and communication system system, and reconstructed in axial, coronal, and sagittal planes. Exclusion criteria include repeat scans from the same patient and a surgical history of right-sided lobectomy or pneumonectomy.

Chest Computed Tomography Scan Analysis

Philips iCT 128 and 256-slice scanners (Clinical Imaging Systems, US) were used to conduct CT examinations. The imaging process required the patient to lie in a supine posture. Moreover, lifting the hands away from the chest and alternating between inspiration and expiration were needed to get a better image. The primary investigator analyzed CT images with the assistance of a single radiologist who has extensive experience with CT imaging.

The presence or absence of the right or left AL and axial plane fissure was examined in each CT image by two radiologists and an anatomist. The convex line in the para-mediastinal region of the upper-right lung on the CT image was identified as the AL. The cases were divided into two groups: one with an AL and the other without. After that, we separated the cases of the AL into three subgroups based on types A, B, and C. Regarding the lung apex, the appearance of the AL is divided into three categories. Type A is found to be lateral to the lung's apex, type B has a vertical fissure, and type C has a medial fissure that extends to the mediastinum [6].

Ethical Consideration

Every ethical guideline pertaining to medical research involving human beings was followed. Throughout the study, the rights and confidentiality of human participants were maintained and protected. The study was approved by the Institutional Review Board (IRB) of Jordan University of Science and Technology (JUST), Irbid, Jordan (IRB: 7/187/2025, dated January 19, 2025). The research will strictly follow legal and ethical requirements. Furthermore, precautions were taken to prevent any unauthorized access to the information gathered.

Statistical Analysis

The results of statistical analysis were displayed as medians and interquartile ranges for continuous variables and as counts and percentages for categorical variables. Fisher's

Table 1. Participants' AL frequency and percentage of each AL type, and their distribution across genders (N = 3,600)

Variables	Category	Frequency (n)	Percentage (%)
Gender	Male	1,812	50.33
	Female	1,788	49.66
Presence of AL	Male	17	0.93
	Female	16	0.89
Presence of AL	Absent	3,567	99.08
	Present	33	0.92
Azygos type A	Absent	3,586	99.61
	Present	14	0.39
Azygos type B	Absent	3,590	99.72
	Present	10	0.28
Azygos type C	Absent	3,591	99.75
	Present	9	0.25

exact tests and chi-squared tests were used to compare categorical variables. Furthermore, the Kruskal-Wallis test was employed to compare continuous variables. A statistically significant level was defined as a p-value of less than 0.05. The statistical program statistical package for the social sciences version 23 (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses.

RESULTS

Out of 3,600 chest scans evaluated, the results show that 99.08% (n = 3,567 participants) did not have an AL, while a minority of 0.92% (n = 33 participants) presented with it. The results presented in **Table 1** indicate that the gender distribution was relatively equal among the samples, with 50.33% (n = 1,812) males and 49.66% (n = 1,788) females. However, the association between the presence of an AL and gender was not statistically significant ($\chi^2 = 0.001$, $p = 0.981$).

The types of AL were categorized into three distinct anatomical variations among the Jordanian population: types A, B, and C. Azygos type A had the highest prevalence, appearing in 14 participants (0.39%), followed by azygos type B, which was identified in 10 participants (0.28%). Azygos type C had the lowest prevalence, appearing in 9 participants (0.25%).

Identifying the Azygos Lobe Using Computed Tomography

The chest axial, coronal, and sagittal CT scans were examined to assess the anatomical characteristics and classification of the AL in the Jordanian participants. We present representative CT scans analyzed for this investigation.

Figure 1 indicates the axial chest CT scan showing the characteristics of the azygos fissure and AV, which are identified as a curvilinear line extending from the apex of the right lung down to the level of the azygos arch. The appearance of the AL is classified in three forms in relation to the lung apex. Type A is located laterally at the apex of the trigon; in type B, the fissure is vertically located; in type C, the fissure is medial and extends to the mediastinum. In our patients, azygos type A had the highest prevalence (**Table 1**).

Figure 2 shows a coronal CT scan of three patients with each having a different AL type. To further support the radiological findings, the sagittal CT scans were reviewed in selected cases to examine the vertical orientation and medical relationship of the azygos fissure and AV.

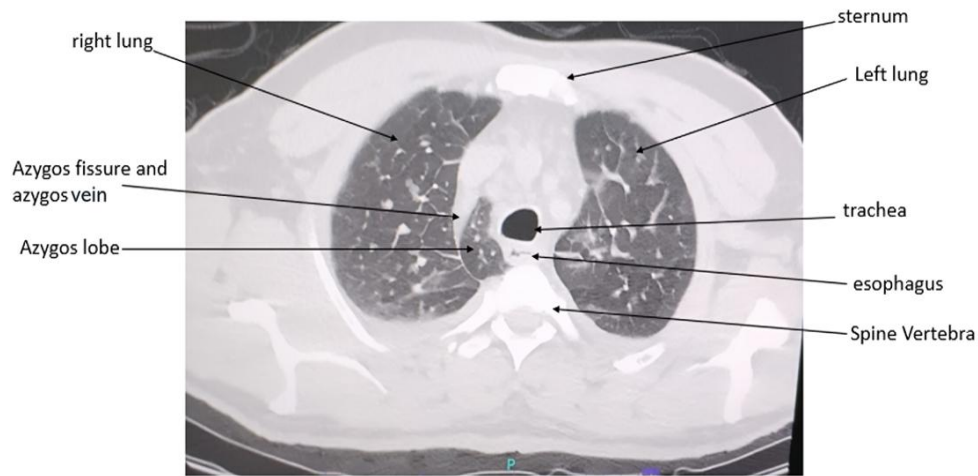


Figure 1. Axial CT scan showing an AL, azygos fissure, AV, and the surrounding anatomical structures such as the trachea, spine, and esophagus in a Jordanian patient (Reprinted with permission of the patient)

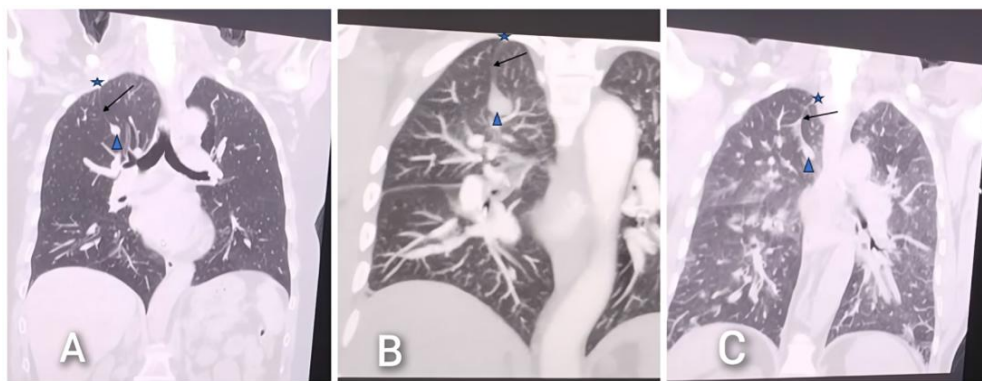


Figure 2. The AL and its various types are shown in coronal CT images for three Jordanian patients as follows: (A) type A, (B) type B, and (C) type C (in all images, the azygos fissure (arrow →), AV (arrowhead ▲), and trigon (star ★) are labeled) (Reprinted with permission of the patients)

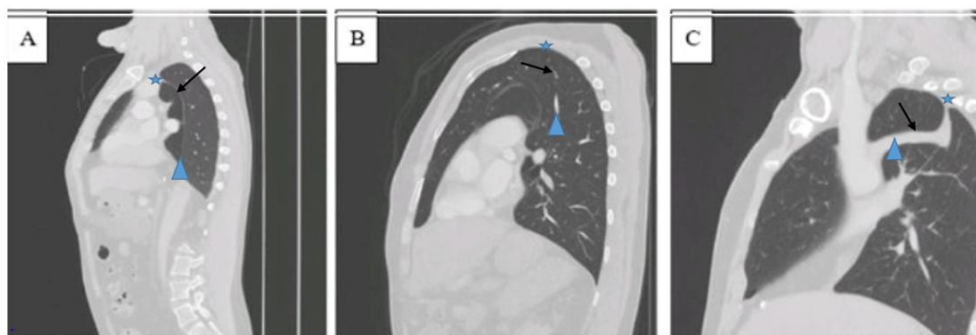


Figure 3. The AL in sagittal CT images of three different Jordanian patients (each panel highlights the key anatomical components of the AL variant; all sagittal CT scans present a type C AL; in all images, the azygos fissure (arrow →), AV (arrowhead ▲), and trigon (star ★) are labeled) (Reprinted with permission of the patients)

In **Figure 3**, three sagittal views were identified, each demonstrating the finding of an AL. The CT images highlight the anatomical configuration of a type C AL.

DISCUSSION

The AL is a rare anatomical variant that arises during embryological development. One of the AV's ancestors, the right posterior cardinal vein, migrates incompletely medially

into the lung's apex rather than typically across the lung, resulting in the formation of the AL [10]. The incidence of accidentally discovered ALs, often during imaging, is 0.4% in chest radiography and around 1.2% in high-resolution CT scans [11].

In our study, out of the 3,600 subjects in our research, 99.08% did not have an AL, whereas a minority (0.92%) were affected. Additionally, our study's findings showed that the prevalence of AL abnormality is 0.93% for men and 0.89% for women. Our results align with recent publications where the AL

also predominates among males, even though no significant differences were observed between the two genders [12, 13].

The prevalence of AL among the Jordanian population aligns with previous findings in the literature, and it also falls within the global incidence ranges of 0.2% and 1.2% [14]. The study in [11] evaluated 5,854 thoracic computed tomographies of the Turkish population, revealed that the incidence of ALs was greater in men, 56% (n = 36), than in women, 44% (n = 28), and the overall prevalence was 1.09% (n = 64). Additionally, the study in [2] evaluated a total of 1,965 chest CT scans to determine if a right AL and a fissure on the axial plane were present. It was discovered that the AL frequency was 0.76% (n = 15) and 0.58% (n = 6) in females and 0.95% (n = 9) in males [2]. The prevalence of the AL among the Iranian population was reported, which analyzed chest CT images from 789 patients. It was discovered that the AL is more predominant in men (1.83%) than in women (1.34%) [15].

Depending on the vein's migration path, the formation of the azygos fissure can be categorized as type A, type B, or type C [3, 6]. Our study also categorized the AL into three anatomical categories based on the orientation of the azygos fissure. The most common type is azygos type A, which was found in 0.39% of participants. In contrast, azygos type B was found in about 0.28% of participants. In comparison, azygos type C was the least common, occurring in only nine individuals (0.25%). Despite the limited studies on AL classification, several case-report studies support our findings. For example, it was reported a unique case study of a 35-year-old male patient who presented with symptoms of a lung hydatid cyst, but whose CT scan revealed an AL [16]. It was disclosed that the patient had a type A-like azygos fissure [16]. Another case study presented a case of a 52-year-old man who was admitted to the emergency room after trauma, and an AL was discovered on his CT [17]. The male patient's azygos fissure was found to be consistent with type B [17]. Additionally, a 45-year-old woman with pulmonary tuberculosis was the subject of a study. Her CT chest scan revealed that the AL in her right lung resembled type C [18]. However, these case-report studies are informative and highlight the need for wider population-based imaging studies to more accurately understand the prevalence and anatomical classification of AL.

Clinically, the AL is usually asymptomatic and diagnosed incidentally. However, the presence of the AL can have diagnostic and surgical implications [9]. For example, it was reported that the existence of the mesoazygos may separate the AL from pathological processes that typically affect the lung's apex, such as the spread of pulmonary tuberculosis, which rarely involves the AL [19, 20]. Despite the rarity of the AL variations, all physicians can significantly benefit from knowledge regarding them, and thoracic surgeons should be aware of this abnormality. Misidentifying this structure during surgery or medical procedures can lead to accidental injury to the AV. Our study is the first to reveal the prevalence of the AL among the Jordanian population. It contributes valuable findings to the limited existing evidence and could help in reducing surgical complications.

CONCLUSION

Current results indicate that the AL is a rare developmental anomaly, affecting 0.92% of the studied sample, and is more prevalent in males than in females. However, the difference is

not statistically significant. The most prevalent azygos type variation is type A, followed by type B, and finally type C. These findings are valuable contributions to the limited literature on the prevalence and classification of AL variants in the Middle East.

Author contributions: QAE-D, SAT, KMA-M, KHA, & RM: conceptualization, design; SAT & KMA-M: validation; QAE-D, SAT, & KMA-M: formal analysis, investigation; QAE-D, SAT, KMA-M, KHA, & RM: writing – original draft, writing – review & editing. All authors reviewed the results and approved the final version of the manuscript. All authors agree to be accountable for the content and conclusions of the article. All authors have agreed with the results and conclusions.

Funding: This study was supported by the Deanship of Research, JUST, Irbid, Jordan.

Ethical statement: The authors stated that the study was approved by the Institutional Review Board at JUST on 19 January 2025 with approval number 7/178/2025. Written informed consents were obtained from the participants.

AI statement: The authors stated that “Grammarly Pro” was used for grammar and language checks during revisions of the manuscript.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

REFERENCES

- Oliveira Bustamante L, Amaral Gualberto VH, de Sa e Souza CF, dos Santos AS, Faria Magalhães Torres D, Silva JG. Clinical and surgical implications of the pulmonary azygos lobe: A systematic review. *Int J Morphol*. 2022;40(2):473-82. <https://doi.org/10.4067/S0717-95022022000200442>
- Gürün E, Akdulum İ. A rare anatomical variation detected incidentally on computed tomography of the thorax: The azygos lobe. *Acta Med Alanya*. 2021;5(1):93-7. <https://doi.org/10.30565/medalanya.847756>
- Priya A, Philip SE, Jain A, Sikka A. Variations of azygos vein: A cadaveric study with clinical relevance. *Anat Cell Biol*. 2023;56(4):448-55. <https://doi.org/10.5115/acb.23.074> PMID:37710917 PMCID:PMC10714084
- Kim HN, Lee Y, Hong SJ, Kang JH, Jung JH. CT findings of azygos venous system: Congenital variants and acquired structural changes. *J Korean Soc Radiol*. 2024;85(1):95-108. <https://doi.org/10.3348/jksr.2023.0079> PMID:38362401 PMCID:PMC10864146
- Nakashima R, Tajima K, Koyanagi K, et al. Thoracoscopic McKeown esophagectomy in a patient with an azygos lobe. *J Cardiothorac Surg*. 2024;19:127. <https://doi.org/10.1186/s13019-024-02621-1> PMID:38491472 PMCID:PMC10941622
- Akhtar J, Lal A, Martin KB, Popkin J. Azygos lobe: A rare cause of right paratracheal opacity. *Respir Med Case Rep*. 2018;23:136-7. <https://doi.org/10.1016/j.rmcr.2018.02.001> PMID:29719800 PMCID:PMC5925948
- Toruńska E, Klepacki Ł. The azygos lobe, an incidental finding in computer tomography. *Folia Morphol (Warsz)*. 2024;83(2):478-81. <https://doi.org/10.5603/FM.a2023.0033> PMID:37183517
- Al-Mnayyis A, Al-Alami Z, Altamimi N, Alawneh KZ, Aleshawi A. Azygos lobe: Prevalence of an anatomical variant and its recognition among postgraduate physicians. *Diagnostics (Basel)*. 2020;10(7):470. <https://doi.org/10.3390/diagnostics10070470> PMID:32664403 PMCID:PMC7400486

9. Srinivasan A, Hollingsworth RL, Lowry N, Fahl J, Smith MP, Khan AS. A rare cadaveric report of the azygos lobe of the right lung. *Anatomy*. 2023;17(1):41-4. <https://doi.org/10.2399/ana.23.1273366>
10. Moawad CM, Griep DW, Moawad KA, Sajan A. The azygos lobe of the lung. *Pulmonology*. 2022;28(3):241-2. <https://doi.org/10.1016/j.pulmoe.2021.12.012> PMID: 35135741
11. Perincek G, Avci S, Celtikci PY. Azygos lobe detected by thoracic computed tomography and frequency of concomitant variations. *J Enam Med Coll*. 2019;9(3):177-80. <https://doi.org/10.3329/jemc.v9i3.43247>
12. Chakravarthi KK, Sarvepalli A, Siddegowda SK, Nelluri V. Congenital rare abnormal shapes of lungs in relation to abnormal lobes and fissures and its clinical implications. *Ann Afr Med*. 2024;23(2):113-7. https://doi.org/10.4103/aam.aam_37_23 PMID:39028157 PMCID:PMC11210724
13. Karre PR, Cooper GB. The azygos lobe and vein: Interesting and typical clinical image. *BMJ Case Rep*. 2011;2011:bcr0520114266. <https://doi.org/10.1136/bcr.05.2011.4266> PMID:22679313 PMCID:PMC3185453
14. Özdemir L, Özdemir B, Duman T. Prevalence of an azygos lobe using thoracic computed tomography. *Cyprus J Med Sci*. 2016;1(3):55-7. <https://doi.org/10.5152/cjms.2016.97>
15. Ryu HS, Lee HN, Kim JI, Ryu JK, Lim YJ. Incidental detection of ground glass nodules and primary lung cancer in patients with breast cancer: Prevalence and long-term follow-up on chest computed tomography. *J Thorac Dis*. 2024;16(3):1804-14. <https://doi.org/10.21037/jtd-23-1605> PMID:38617779 PMCID:PMC11009589
16. Hanif A, Shahid S, Soomro NH, Sarosh U, Jawed S. An incidental finding of azygos lung lobe. *Pak J Med Dent*. 2021;10(4):88-91. <https://doi.org/10.36283/pjmd10-4/017>
17. Jimah AM, Goldstein AT, McCann M, Stoudemire C. Azygos lobe: Exploring the bronchial supply and clinical implications. *Anat Cell Biol*. 2025;58(2):311-5. <https://doi.org/10.5115/acb.24.240> PMID:39933956 PMCID:PMC12178689
18. Kotov G, Dimitrova IN, Iliev A, Groudeva V. A rare case of an azygos lobe in the right lung of a 40-year-old male. *Cureus*. 2018;10(6):e2780. <https://doi.org/10.7759/cureus.2780>
19. Awal SS, Biswas SS, Goyal H, Awal SK. A case of tuberculosis of the rare azygos lobe of the right lung. *Egypt J Bronchol*. 2021;15:52. <https://doi.org/10.1186/s43168-021-00100-y>
20. Arbat SA, Arbat AP, Singh T, Deshpande PS. A rare case of an azygos lobe in the right lung of a 45-year-old female. *J Datta Meghe Inst Med Sci Univ*. 2020;15(3):462-4. https://doi.org/10.4103/jdmimsu.jdmimsu_4_20