Al-Rafidain J Med Sci. 2026;10(2):145-151.
DOI: https://doi.org/10.54133/ajms.v10i2.2875

AJMS

Online ISSN (3219-2789)

Research Article

Time Lag of Acromegaly Diagnosis and Associated Comorbidities in Sulaymaniyah City/Iraq

Aso Nasih Qadir[1]*, Taha Othman Mahwi[2], Zagros Ghaffor Rashid[2]

[1]*Candidate for Specialty in Endocrinology and Diabetes, Kurdistan Higher Council of Medical Specialties, Kurdistan Region, Iraq;* [2]*Department of Clinical Science, College of Medicine, University of Sulaimani, Sulaimani, Kurdistan Region, Iraq*

Received: 28 February 2026; Revised: 14 April 2026; Accepted: 19 April 2026

Abstract

Background: Acromegaly is a rare endocrine disease. The insidious onset and symptom overlap with frequently found diseases, resulting in an often delayed diagnosis. ***Objective***: To evaluate diagnostic delay in patients with acromegaly and its association with patient findings in Sulaymaniyah, Iraq. ***Methods***: A retrospective cross-sectional study was conducted in 49 patients diagnosed with acromegaly. Patient data were collected through interviews and medical record review. The diagnostic delay was determined as the period between the onset of symptoms and the formal diagnosis. ***Results***: The average diagnostic delay was 3.3 years, and the majority of patients were diagnosed with five years of symptom onset. Hypertension was observed in 32.7% of patients, and unemployment, lower education, cumulative comorbidity burden, and abnormal colonoscopy findings were significantly associated with longer delays. In patients <40 years old, the delay can be more extreme, wherein close to half had not undergone a colonoscopy. Normal finding (34.6%), Polyps (15.4%), and Malignancy (3.8%). However, in patients aged ≥40 years (46.9%), all underwent colonoscopy; 65.2% were normal, 26.1% had polyps, and 8.7% had malignancy. Overall, colorectal cancer was detected in three patients (6.1%), and there was a statistically significant correlation between age group and colonoscopic findings. ***Conclusions***: Acromegaly diagnostic delay is substantial in the Kurdistan Region and is related to socioeconomic factors, asymptomatic onset, and comorbidity. Increased awareness, access to endocrinology, and broader colorectal screening are essential to improve outcomes.

Keywords: Acromegaly; Colonoscopy findings; Comorbidity burden; Diagnosis delay.

التأخير الزمني في تشخيص ضخامة الأطراف والأمراض المصاحبة المرتبطة بها في مدينة السليمانية/العراق

الخلاصة

الخلفية: ضخامة الأطراف هو مرض نادر في الغدد الصماء. تتداخل البداية الخبيثة والأعراض مع الأمراض التي يتم اكتشافها بشكل متكرر، مما يؤدي إلى تأخير التشخيص في كثير من الأحيان. **الهدف**: تقييم التأخير التشخيصي لدى مرضى تضخم الأطراف وعلاقته بنتائج المرضى في السليمانية، العراق. **الطرائق**: أجريت دراسة مقطعية بأثر رجعي على 49 مريضا تم تشخيصهم بتضخم الأطراف. تم جمع بيانات المرضى من خلال مقابلات ومراجعة السجلات الطبية. تم تحديد التأخير التشخيصي على أنه الفترة بين ظهور الأعراض والتشخيص الرسمي. **النتائج**: كان متوسط التأخير التشخيصي 3.3 سنوات، وتم تشخيص غالبية المرضى بظهور الأعراض لمدة خمس سنوات. لوحظ ارتفاع ضغط الدم لدى 32.7٪ من المرضى، وكانت البطالة، وانخفاض التعليم، وعبء المرض المصاحب التراكمي، ونتائج تنظير القولون غير الطبيعية مرتبطة بشكل ملحوظ بتأخيرات أطول. في المرضى الذين تبلغ أعمارهم <40 عاما، يمكن أن يكون التأخير أكثر حدة، حيث لم يخضع ما يقرب من نصفهم لتنظير القولون. النتيجة الطبيعية (34.6٪)، السلائل (15.4٪)، الأورام الخبيثة (3.8٪). ومع ذلك، في المرضى الذين تبلغ أعمارهم ≤40 عاما (46.9٪)، خضعوا جميعا لتنظير القولون؛ 65.2٪ كانوا طبيعيين، 26.1٪ لديهم سوائل، و8.7٪ لديهم أورام خبيثة. بشكل عام، تم اكتشاف سرطان القولون والمستقيم في ثلاثة مرضى (6.1٪)، وكان هناك ارتباط ذو دلالة إحصائية بين الفئة العمرية ونتائج تنظير القولون. **الاستنتاجات**: التأخير في تشخيص ضخامة الأطراف كبير في إقليم كردستان ويرتبط بالعوامل الاجتماعية والاقتصادية، وظهور الأعراض، والأمراض المصاحبة. زيادة الوعي، والوصول إلى الغدد الصماء، والفحص الأوسع للقولون والمستقيم ضروري لتحسين النتائج.

* ***Corresponding author***: Aso N. Qadir. Candidate for Specialty in Endocrinology and Diabetes, Kurdistan Higher Council of Medical Specialties, Kurdistan Region, Iraq; Email: aso.nasih@gmail.com

Article citation: Qadir AN, Mahwi TO, Rashid ZG. Time Lag of Acromegaly Diagnosis and Associated Comorbidities in Sulaymaniyah City/Iraq. *Al-Rafidain J Med Sci.* 2026;10(2):145-151. doi: https://doi.org/10.54133/ajms.v10i2.2875

INTRODUCTION

Acromegaly is a rare chronic condition caused by the excessive secretion of growth hormone (GH) and insulin-like growth factor 1 (IGF-1), with an overall global prevalence of acromegaly of about 6 per 100,000 people per year and an incidence rate of 0.36 per 100,000 persons [1]. The excessive secretion is mostly due to a pituitary neuroendocrine tumor (PiNET) that was formerly known as a pituitary adenoma [2-4]. Benign tumors can be classified by their histology as densely or sparsely granulated somatotrophomas, eosinophilic stem cell tumors, and mixed somatolactotroph or mammosomatotroph adenomas [5,6]. Rarely, the excess GH arises despite an intact pituitary gland; this condition is termed "ectopic acromegaly." Here, GH is secreted by a non-pituitary source, such as a neuroendocrine tumor in the lung or pancreas or a growth hormone-releasing hormone gangliocytoma [7,5]. Elevated levels of GH and IGF-1 lead to a series of symptoms and comorbidities, including enlarged hands and feet; facial feature changes; cardiovascular, musculoskeletal, endocrine, and metabolic disorders; and cancer [1,8]. Also, cardiovascular complications such as hypertension (the most common one), arrhythmia, subclinical cardiomyopathies, and heart failure are the leading causes of mortality [9,10].

Additionally, patients face an increased risk of malignancies, especially colorectal and thyroid cancer [11]. Acromegaly is associated with the development of type 2 diabetes. It is believed that GH and IGF-1 will induce insulin resistance and hyperinsulinemia and increase gluconeogenesis [12], and some other comorbidities include hypogonadism, obstructive sleep apnea, vertebral fracture, and arthropathies [13]. However, beyond physical problems, mental health is also affected by the excess GH; among them, depression is a major concern, as it's shown that proper treatment of acromegaly will decrease the rate and severity of depression [14]. Treatment aims are to normalize GH/IGF-1 release, resolve tumor mass effects, and manage acromegaly comorbidities. Generally, transsphenoidal pituitary surgery is the cornerstone of the management of acromegaly in those whose excess GH release is due to PiNET. And for those whose surgery fails or in ectopic acromegaly, medical therapy with somatostatin receptor ligands, cabergoline (dopamine D2 receptor agonist), pegvisomant (growth hormone receptor antagonist), or radiotherapy is used as second- and third-line management [13]. However, the insidious onset of these symptoms and the overlapping clinical manifestations with other common conditions increase the risk of the condition being overlooked in medical consultations, especially by doctors who are not specialists in this area [13], often due to misattribution of comorbidities (e.g., treating hypertension or diabetes without investigating underlying acromegaly), which eventually delayed the proper diagnosis and treatment of acromegaly [1]. This results in difficulties in diagnosing acromegaly, which may eventually cause misdiagnosis and lengthy durations before diagnosis that last for approximately 4.5–5 years from symptom onset to the diagnosis of acromegaly [13]. Diagnostic delay or long duration before diagnosis, suggesting a delay in initiation of management of their hormone level and detection of their comorbidities, might cause worse health outcomes for patients. Other than physical health, delayed diagnosis may also have a negative impact on the quality of life and psychosocial functions of daily life [13]. Therefore, early diagnosis is essential for the future health status of patients with acromegaly [15]. For that reason, this study aimed to determine the duration from the diagnosis of acromegaly to the start of its associated comorbidities, with a correct diagnosis of acromegaly.

METHODS

Study design and setting

This study employed a cross-sectional retrospective design to investigate diagnostic delay in acromegaly and its associated comorbidities. The study was conducted on 49 patients between March 2025 and August 2025 at the Endocrinology Outpatient Department, Shar Teaching Hospital, Sulaymaniyah, Iraq.

Data collection

Data were obtained through patient interviews and reviewing of medical records. Diagnostic delay was defined as the time interval between the onset of the first recalled symptom, sign, or comorbidity and the formal diagnosis of acromegaly [16]. Patients were asked to identify their earliest manifestations, since many did not realize certain characteristics were related to acromegaly. Participants provided access to prior laboratory results and radiological investigations, which were reviewed in hard copy and electronic formats.

Inclusion criteria

Patients were included only if acromegaly was diagnosed. Diagnosis was based on age- and sex-adjusted elevation of insulin-like growth factor-1 (IGF-1), absence of growth hormone suppression after an oral glucose tolerance test (OGTT), and the imaging result of the pituitary adenoma on the magnetic resonance imaging (MRI).

Exclusion criteria

Exclusion criteria were as follows: age <18 years, did not consent to provide written informed consent, and inability to reliably recall the date(s) of symptom onset and/or comorbidities. Such exclusion practices were to guarantee only adult participants who had the ability to consent and an adequate clinical history were present, thereby increasing the diagnostic delay estimation validity.

Ethical considerations

We received ethical approval from the KHCMS (reference ID: 1412 in 15/4/2025). All participants provided written informed consent in their language of preference. Participants were notified that they have the choice not to participate or to withdraw at any point without penalty.

Statistical analysis

IBM SPSS Statistics version 27.0 was used for the analysis of data. For categorical variables, we present the frequencies and percentages, while continuous variables are reported as mean ± standard deviation (SD) for parametric data or median for non-parametric data. The normality was evaluated by the Shapiro–Wilk tests. A chi-square test or Fisher–Freeman–Halton exact test (Monte Carlo method) was used to test associations between categorical variables. A p-value ≤ 0.05 is considered statistically significant.

RESULTS

The study included 49 patients with acromegaly. The average diagnostic delay was 3.3 ± 3.0 years. About 73.5% (n= 36) of patients were diagnosed within 5

years from the onset of symptoms, 22.4% (n= 11) had a delay of 5–10 years between onset of symptoms and diagnosis, and 4.1% (n= 2) had a delay greater than 10 years. In demographic characteristics, the most frequent age was 31–39 years old, 38.8% (n= 19), followed by 40–49 years old, 26.5% (n= 13); ≥ 50 years old, 20.4% (n= 10); and younger than 30 years old, 14.3% (n= 7). There were 28 females (57.1%) and 21 males (42.9%) in the study cohort. The majority of the participants were married, 69.4% (n= 34), compared to 30.6% (n=15) who were single. Forty-four (44.9%) lived outside of the city and twenty-seven (55.1%) lived within the city limits of Sulaimani. As for occupational status, 46.9% (n= 23) were unemployed, 28.6% (n= 14) were working informally, and 24.5% (n= 12) were working formally. Most referred to their educational attainment as either secondary school, 55.1% (n= 27), primary school or less, 24.5% (n= 12); or college/university-level education, 20.4% (n=10). A family history for acromegaly was present in 10.2% (n= 5). Macroadenomas were found in 85.7% (n= 42) and microadenomas in 14.3% (n= 7) of patients based on radiological features. Of them, 6.1% (n= 3) had concomitant prolactinomas, while 93.9% (n= 46) did not have any other pituitary tumor (Table 1).

Table 1: Demographic and clinical characteristics of the study population

Demographic and Clinical Characteristics		n(%)
Age group (year)	<30	7(14.3)
	31–39	19(38.8)
	40–49	13(26.5)
	≥50	10(20.4)
Gender	Male	21(42.9)
	Female	28(57.1)
Marital status	Single	15(30.6)
	Married	34(69.4)
Residence	Inside city	27(55.1)
	Outside city	22(44.9)
Occupation	Formal employment	12(24.5)
	Informal employment	14(28.6)
	Jobless	23(46.9)
Education level	Low (primary school or less)	12(24.5)
	Moderate (secondary school)	27(55.1)
	High (college/university)	10(20.4)
Family history of acromegaly	Yes	5(10.2)
	No	44(89.8)
Adenoma type	Macroadenoma	42(85.7)
	Microadenoma	7(14.3)
Delay category	<5 years	36(73.5)
	5–10 years	11(22.4)
	>10 years	2(4.1)
Other gland tumors	None	46(93.9)
	Prolactinoma	3(6.1)

Between individual comorbidities such as diabetes mellitus (36.7%, n = 18) and hypertension (32.7%, n= 16) (Table 2). Diagnostic delay and patient or disease characteristics Associations between diagnostic delay and patient or disease characteristics are presented in Table 3. There were strong associations per occupation (p= 0.023), education level (p= 0.039), first presenting symptom (5 years, with 32.0% (n= 8) diagnosed at 5–10 years and 8.0% (n= 2) after >10 years. In comparison, among those who received only one modality (38.8%, n= 19), 89.5% (n= 17) were diagnosed within five years. Delays were longest in patients requiring three modalities (10.2% [n= 5]; 20.0% [n= 1] were diagnosed after 5–10 years). Third, colonoscopy findings were highly associated. Patients with malignancy (6.1%, n= 3) had prolonged delays (66.7% (n= 2) after 5–10 years). The median time to diagnosis was delayed in those with polyps (20.4%, n= 10), with 50.0% (n= 5) not diagnosed until >5–10 years. On the other hand, patients with normal results (49.0%, n= 24) had five-year colon cancer diagnoses in 79.2% (n= 19) of cases, and cases without colonoscopy (24.5%, n= 12) had the diagnosis within five years in 91.7% (n= 11) of cases. In individual comorbidities, no statistically significant associations were found with diagnostic delay, including diabetes mellitus (36.7%, n= 18), hypertension (32.7%, n= 16), depression (12.2%, n= 6), anxiety (8.2%, n= 4), obstructive sleep apnea (12.2%, n= 6), and prediabetes (10.2%, n= 5) (p> 0.05 for all comparisons). The proportion of patients diagnosed with ≤5 years of presentation was 77.8% (n= 14) in those with diabetes mellitus, whereas it was 71.0% (n= 22) in patients without diabetes (p= 0.868). Likewise, with regard to hypertension, 56.3% (n= 9) of hypertensive patients were diagnosed within five years and 81.8% (n= 27) of normotensive patients (p= 0.166). Non-significant patterns were noted for depression, anxiety, obstructive sleep apnea, and prediabetes. In contrast, a statistically significant relationship was identified between diagnostic delay and cumulative comorbidity burden (p= 0.033). Patients without comorbidities (26.5%, n= 13) were all diagnosed within five years (100%). Those with a single comorbidity (30.6%, n= 15) had 20.0% (n= 3) diagnosed after ≥5 years. The greatest delays were observed among patients with two comorbidities (36.7%, n= 18), where 44.4% (n= 8) were diagnosed after 5–10 years and 5.6% (n= 1.0) after more than 10 years. Similarly, patients with three or more comorbidities (4.1%, n= 2.0) showed prolonged delays, with 50.0% (n= 1.0) diagnosed after 5–10 years (Table 3).

Table 2: Associations between diagnostic delay and patient demographic, clinical, and tumor variables

Sociodemographic and clinical characteristics		Diagnostic delay years				*p*-value
		<5 years 36(73.5)	5–10 years 11(22.4)	>10 years 2(4.1)	Total 49(100)	
Age group	<30	6(85.7)	0(0.0)	1(14.3)	7(14.3)	0.449
	30–39	14(73.7)	5(26.3)	0(0.0)	19(38.8)	
	40–49	9(69.2)	3(23.1)	1(7.7)	13(26.5)	
	≥50	7(70)	3(30)	0(0.0)	10(20.4)	
Gender	Male	18(85.7)	3(14.3)	0(0.0)	21(42.9)	0.226
	Female	18(64.3)	8(28.6)	2(7.1)	28(57.1)	
Marital status	Single	13(86.7)	2(13.3)	0(0.0)	15(30.6)	0.297
	Married	23(67.6)	9(26.5)	2(5.9)	34(69.4)	
Residency	Urban	21(77.8)	6(22.2)	0(0.0)	27(55.1)	0.321
	Rural	15(68.2)	5(22.7)	2(9.1)	22(44.9)	
Occupation	Formal employment	11(91.7)	1(8.3)	0(0.0)	12(24.5)	0.023
	Informal employment	13(92.9)	1(7.1)	0(0.0)	14(28.6)	
	Jobless	12(52.2)	9(39.1)	2(8.7)	23(46.9)	
Education level	Low	1(8.3)	5(41.7)	6(50)	12(24.5)	0.039
	Medium	23(85.2)	3(11.1)	1(3.7)	27(55.1)	
	High	8(80)	2(20)	0(0.0)	10(20.4)	
Family history of acromegaly	No	32(72.7)	10(22.7)	2(4.5)	44(89.8)	0.989
	Yes	4(80)	1(20)	0(0.0)	5(10.2)	
Adenoma type	Microadenoma	6(85.7)	1(14.3)	0(0.0)	7(14.3)	0.756
	Macroadenoma	30(71.4)	10(23.8)	2(4.8)	42(85.7)	
First symptom	Physical change	18(69.2)	7(26.9)	1(3.8)	26(53.1)	<0.001
	Neurological Symptoms	12(92.3)	1(7.7)	0(0.0)	13(26.5)	
	Metabolic (HTN/DM/Amenorrhea)	9(90)	1(10)	0(0.0)	10(20.4)	
Treatment burden	1 modality	17(89.5)	2(10.5)	0 (0.0)	19(38.8)	<0.001
	2 modalities	15(60)	8(32)	2(8)	25(51.0)	
	3 modalities	4(80)	1(20)	0(0.0)	5(10.2)	
Colonoscopy finding	Not done	11(91.7)	1(8.3)	0(0.0)	12(24.5)	0.043
	Normal	19(79.2)	3(12.5)	2(8.3)	24(49.0)	
	Polyp (≤2)	5(50.0)	5(50)	0(0.0)	10(20.4)	
	Malignancy	1(33.3)	2(66.7)	0(0.0)	3(6.1)	

Values are presented as frequency and percentage.

Table 3: Association between diagnostic delay and comorbidity among patients with acromegaly

Patients' comorbidity		Diagnostic delay (year)				*p*-value
		<5 years 36(73.5)	5–10 years 11(22.4)	>10 years 2(4.1)	Total 49(100)	
Diabetes Mellitus	Yes	14(77.8)	4(22.2)	0(0.0)	18(36.7)	0.868
	No	22(71)	7(22.6)	2(6.5)	31(63.3)	
Hypertension	Yes	9(56.3)	6(37.5)	1(6.3)	16(32.7)	0.166
	No	27(81.8)	5(15.2)	1(3.0)	33(67.3)	
Depression	Yes	4(66.7)	2(33.3)	0(0.0)	6(12.2)	0.704
	No	32(74.4)	9(20.9)	2(4.7)	43(87.8)	
Anxiety	Yes	2(50)	1(25)	1(25)	4(8.2)	0.122
	No	34(75.6)	10(22.2)	1(2.2)	45(91.8)	
Obstructive Sleep Apnea	Yes	4(66.7)	1(16.7)	1(16.7)	6(12.2)	0.338
	No	32(74.4)	10(23.3)	1(2.3)	43(87.8)	
Prediabetes	Yes	2(40.0)	3(60)	0(0.0)	18(36.7)	0.112
	No	34(77.3)	8(18.2)	2(4.5)	31(63.3)	
Comorbidity burden (sum of all)	0	13(100)	0(0.0)	0(0.0)	13(26.5)	0.033
	1	12(80)	2(13.3)	1(6.7)	15(30.6)	
	2	9(50)	8(44.4)	1(5.6)	18(36.7)	
	≥3	1(50)	1(50)	0 (0.0)	2(4.1)	

Values are presented as frequency and percentage.

A statistically significant association was identified between age group and colonoscopic findings (p= 0.001). Among patients aged less than 40 years (53.1%, n= 26), nearly half had not undergone colonoscopy (46.2%, n= 12). Of those examined, the majority demonstrated normal findings (34.6%, n= 9), while 15.4% (n= 4) had polyps and 3.8% (n=1) had malignancy. In contrast, all patients aged ≥40 years (46.9%, n= 23) underwent colonoscopy, with 65.2% (n= 15) showing normal results, 26.1% (n= 6) presenting with polyps, and 8.7% (n= 2) diagnosed with malignancy (Table 4 and Figure 1).

DISCUSSION

Acromegaly is a rare endocrine disease with great clinical impact, marked by late onset and multisystem exposition, and therefore often diagnosed only long after the first symptoms appear [17,18].

Table 4: Association between colonoscopy findings and age group (<40 *vs.* ≥40 years)

Colonoscopy findings	Age groups (year)			*p*-value
	< 40 years 26(53.1)	≥ 40 years 23(46.9)	Total 49(100)	
Not done (0)	12(46.2)	0(0.0)	12(24.5)	0.001
Normal (1)	9(34.6)	15(65.2)	24(49)	
Polyps (2)	4(15.4)	6(26.1)	10(20.4)	
Malignancy (4)	1(3.8)	2(8.7)	3(6.1)	

Values are presented as frequency and percentage.

Although biochemical tests and neuroimaging have progressed, prolonged diagnostic delay in acromegaly is still reported all over the world [8,19]. These delays are clinically relevant since prolonged exposure to excess growth hormone (GH) and insulin-like growth

factor-1 (IGF-1) is cumulatively involved with a spectrum of cardiovascular, metabolic, respiratory [10], and neoplastic disorders [20].

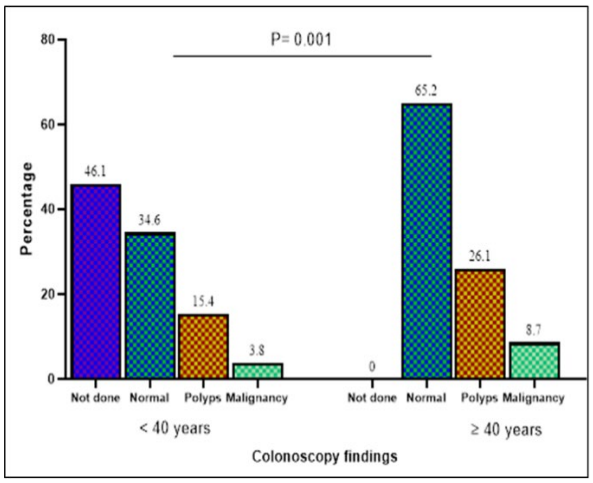

Figure 1: Colonoscopy findings stratified by age group.

Recent evidence suggests that while diagnostic timeliness has improved in some regions due to increased awareness and access to specialized endocrinology services, disparities persist, particularly in low- and middle-income settings where socioeconomic factors and limited screening infrastructure play a critical role [1]. In summary, this study offers one of the few recent regional assessments of diagnostic delay in acromegaly from the Kurdistan Region of Iraq and demonstrates the clinical effects associated with a delay in recognition of the disease. In our cohort, the mean diagnostic delay was 3.3 years (median 2 years), shorter than in many previous historical series, but still a clinically relevant time considering the progressive, multisystemic nature of acromegaly. No single comorbidity was independently associated with a delay in diagnosis, but a clear link between diagnostic delay and comorbidity burden was apparent, suggesting that chronic exposure to excess growth hormone (GH) and insulin-like growth factor-1 (IGF-1) may produce cumulative organ damage rather than isolated complications [21,22]. There is limited information from the Kurdistan Region; nevertheless, hospital-based observations indicate delays in diagnosis of around 4–6 years, especially for patients with insidious physical changes rather than obvious neurological symptoms. On the other hand, other aspects of our cohort, such as the shorter delays, would suggest better access to endocrinology services, availability of hormonal assays, and the use of pituitary MRI for the preliminary diagnosis in Sulaymaniyah. However, the high rate of macroadenomas at diagnosis (85.7%) is consistent with regional experience. It implies that although earlier diagnosis may have been achieved for some, the majority still present with disease at an advanced stage, as reported in low- and middle-income settings [23,24]. Iraqi studies from different provinces have shown national averages of diagnostic delays between 5 years and 8 years, and macroadenomas represent >80% of tumors at presentation. When compared to these reports, our results show an inch of improvement in diagnosis timeliness in the Kurdistan region. The strong association between prolonged diagnostic delay and socio-economic factors, including unemployment and low education, in our study is in keeping with national data trends regarding limited access to healthcare and health literacy as one move across Iraq. These findings highlight the impact of social determinants of health on acromegaly disease recognition and referral pathways [25,26]. The diagnostic delay of our cohort is, in general, comparable with published data from Gulf countries, including Saudi Arabia, Kuwait, and the United Arab Emirates. Gulf-based studies mostly identify 2–4 years of median delays, a higher preponderance of females, and a high macroadenoma rate at diagnosis, which parallels our results. In contrast, cohorts from the Gulf are pointedly more methodical when it comes to monitoring for acromegaly-related complications, especially colorectal neoplasia and cardiovascular disease. The strong association between longer diagnostic delay and abnormal colonoscopy findings in our cohort may therefore represent a delay in referral for proactive screening rather than any real variability in disease biology and highlights healthcare system–level differences across regions [27]. Internationally, diagnostic delay in acromegaly has historically ranged from 7 to 10 years, particularly in older European and North American series. More recent registry-based studies report shorter delays of approximately 4–6 years, reflecting improved awareness, biochemical testing, and imaging availability. The diagnostic delay suggested by our data compares favorably with these contemporary reports; however, the observed association between prolonged delay and increased comorbidity burden is consistent with international evidence demonstrating that cumulative exposure to excess GH and IGF-1 is a key driver of cardiovascular, metabolic, respiratory, and neoplastic complications [28,11,20]. The absence of a significant association between delay and individual comorbidities in our study likely reflects the study's limited sample size and the multifactorial nature of these conditions, rather than a lack of biological effect. The finding that patients presenting with physical changes experienced significantly longer diagnostic delays than those presenting with neurological or metabolic symptoms is in line with previous reports. Gradual acral and facial changes are often normalized by patients and overlooked in primary care settings, whereas headaches and visual disturbances prompt earlier neuroimaging and referral. Additionally, the association between longer diagnostic delay and higher treatment burden observed in this study suggests that delayed diagnosis results in more advanced disease requiring multimodal therapy, including surgery, medical treatment, and radiotherapy, as reported in large international series [29,30]. Finally, the association between diagnostic delay and colonoscopic abnormalities, particularly in older patients, is clinically significant. Current guidelines recommend colonoscopic screening in patients with acromegaly due to the increased risk of colorectal polyps and

malignancy mediated by chronic IGF-1 excess. Our findings support these recommendations and suggest that delayed diagnosis may further amplify neoplastic risk, emphasizing the importance of early disease recognition and timely surveillance [31,22]. In summary, diagnostic delay in acromegaly in the Kurdistan Region of Iraq appears shorter than that reported in many historical and regional studies yet remains clinically significant. Prolonged delay is associated with increased cumulative comorbidity burden, more advanced diseases at presentation, and greater treatment complexity. Targeted strategies to improve disease awareness, particularly among socioeconomically disadvantaged populations, alongside early screening for acromegaly-related complications, are essential to reduce diagnostic delay further and improve long-term patient outcomes [24,21,11].

Study Limitations

This study is limited by its restricted sample size and single-center methodology, potentially hindering the generalizability of its findings to wider groups. The retrospective data collection relied on patients' recollection of symptom onset, thereby introducing potential memory bias. Moreover, the lack of longitudinal follow-up hindered the evaluation of long-term consequences beyond the diagnostic delay. Ultimately, the cross-sectional design prevents causal conclusions, necessitating larger multicenter investigations to corroborate these findings.

Conclusion

Results from the Kurdistan Region of Iraq indicate that socioeconomic deprivation, low educational levels, and a progressive nature of the disease contribute to a clinically meaningful long diagnostic delay in acromegaly. While no single comorbidity was independently associated with a delay, a higher burden of comorbidities and abnormal colonoscopic findings were strongly associated with longer diagnosis intervals. Conclusion: These findings emphasize the necessity of early recognition, fair access to endocrinology care, and regular screening to prevent disease advancement and improve outcomes.

Conflict of interests

The authors declared no conflict of interest.

Funding source

The authors did not receive any source of funds.

Data sharing statement

Supplementary data can be shared with the corresponding author based on a reasonable request.

REFERENCES

1. Wang K, Guo X, Yu S, Gao L, Wang Z, Zhu H, et al. Patient-identified problems and influences associated with diagnostic delay of acromegaly: A nationwide cross-sectional study. *Front Endocrinol*. 2021;12:704496. doi: 10.3389/fendo.2021.704496.
2. Melmed S. Pituitary tumors. *Endocrinol Metab Clin North Am*. 2015;44(1):1-9. doi: 10.1016/j.ecl.2014.11.004.
3. Liu X, Wang R, Li M, Chen G. Pituitary adenoma or pituitary neuroendocrine tumor: A narrative review of controversy and perspective. *Transl Cancer Res*. 2021;10(4):1916-1920. doi: 10.21037/tcr-20-3446.
4. Bianchi A, Chiloiro S, Giampietro A, Gaudino S, Calandrelli R, Mazzarella C, et al. Multidisciplinary management of difficult/aggressive growth-hormone pituitary neuro-endocrine tumors. *Front Endocrinol*. 2023;14:1123267. doi: 10.3389/fendo.2023.1123267.
5. Zendran I, Gut G, Kaluzny M, Zawadzka K, Bolanowski M. Acromegaly caused by ectopic growth hormone releasing hormone secretion: A review. *Front Endocrinol (Lausanne)*. 2022;13:867965. doi: 10.3389/fendo.2022.867965.
6. Lenders NF, Earls PE, Inder WJ, Mccormack AI. The evolution in pituitary tumour classification: A clinical perspective. *Endocr Oncol*. 2023;3(1):e220079. doi: 10.1530/EO-22-0079.
7. Ravindra VM, Raheja A, Corn H, Driscoll M, Welt C, Simmons DL, et al. Primary pituitary diffuse large b-cell lymphoma with somatotroph hyperplasia and acromegaly: Case report. *J Neurosurg*. 2017;126(5):1725-1730. doi: 10.3171/2016.5.JNS16828.
8. Dhaneshwar S, Shandily S, Tiwari V. Growth hormone excess: Implications and management. Endocr. Metab. Immune Disord. *Drug Targets*. 2023;23(6):748-763. doi: 10.2174/1871530322666221012155533.
9. Elbaum M, Daroszewski J, Bolanowski M. Cardiovascular complications of acromegaly. *Acta Endocrinol (Buchar.)*. 2018;14(3):365. doi: 10.4183/aeb.2018.365.
10. Rivera FB, Taliño MK, Ansay MF, Mangubat GF, Mahilum ML, Menghrajani RH, et al. Cardiovascular effects of excess growth hormone: How real is the threat? *Rev Cardiovasc Med*. 2023;24(4):95. doi: 10.31083/j.rcm2404095.
11. Dal J, Leisner MZ, Hermansen K, Farkas DK, Bengtsen M, Kistorp C, et al. Cancer incidence in patients with acromegaly: A cohort study and meta-analysis of the literature. *J Clin Endocrinol Metab*. 2018;103(6):2182-2188. doi: 10.1210/jc.2017-02457.
12. Hannon AM, Thompson CJ, Sherlock M. Diabetes in patients with acromegaly. *Curr Diab Rep*. 2017;17(2):8. doi: 10.1007/s11892-017-0838-7.
13. Giustina A, Barkan A, Beckers A, Biermasz N, Biller BMK, Boguszewski C, et al. A consensus on the diagnosis and treatment of acromegaly comorbidities: An update. *J Clin Endocrinol Metab*. 2020;105(4). doi: 10.1210/clinem/dgz096.
14. Algahtany M, Sharma S, Fahoum K, Jing R, Zhang S, Kovacs K, et al. The role of growth hormone in depression: A human model. *Front Neurosci*. 2021;15:661819. doi: 10.3389/fnins.2021.661819.
15. Zahr R, Fleseriu M. Updates in diagnosis and treatment of acromegaly. *Eur Endocrinol*. 2018;14(2):57-61. doi: 10.17925/EE.2018.14.2.57.
16. Chiloiro S, Giampietro A, Gagliardi I, Bondanelli M, Veleno M, Ambrosio MR, et al. Impact of the diagnostic delay of acromegaly on bone health: Data from a real life and long term follow-up experience. *Pituitary*. 2022;25(6):831-841. doi: 10.1007/s11102-022-01266-4.
17. Carroll PV, Joshi MN. Acromegaly. 2022 Sep 7. In: Feingold KR, Adler RA, Ahmed SF, Anawalt B, Blackman MR, Chrousos G, et al, (editors). Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000. PMID: 25905322.
18. Fleseriu M, Langlois F, Lim DST, Varlamov EV, Melmed S. Acromegaly: pathogenesis, diagnosis, and management. *Lancet Diabetes Endocrinol*. 2022;10(11):804-826. doi: 10.1016/S2213-8587(22)00244-3.
19. Bai X, Duan L, Yang S, Wang T, Yao Y, Zhang M, et al. Biochemical remission, diagnostic delays, and comorbidities of acromegaly in china: A large single-centre retrospective study. *Front Endocrinol (Lausanne)*. 2025;16:1526625. doi: 10.3389/fendo.2025.1526625.

20. Esposito D, Ragnarsson O, Johannsson G, Olsson DS. Prolonged diagnostic delay in acromegaly is associated with increased morbidity and mortality. *Eur J Endocrinol*. 2020;182(6):523-531. doi: 10.1530/EJE-20-0019.
21. Melmed S. Acromegaly pathogenesis and treatment. *J Clin Invest*. 2009;119(11):3189-3202. doi: 10.1172/JCI39375.
22. Colao A, Grasso LF, Giustina A, Melmed S, Chanson P, Pereira AM, et al. Acromegaly. *Nat Rev. Dis Primers*. 2019;5(1):20. doi: 10.1038/s41572-019-0081-7.
23. Holdaway IM, Rajasoorya C. Epidemiology of acromegaly. *Pituitary*. 1999;2:29-41. doi: 10.1023/a:1009965803750.
24. Chanson P, Salenave S. Acromegaly. *Orphanet J Rare Dis*. 2008;3(1):17. doi: 10.1186/1750-1172-3-17.
25. Ben-Shlomo A, Melmed S. Acromegaly. *Endocrinol Metab Clin North Am*. 2008;37(1):101-122. doi: 10.1016/j.ecl.2007.10.002.
26. Adelman DT, Liebert KJ, Nachtigall LB, Lamerson M, Bakker B. Acromegaly: The disease, its impact on patients, and managing the burden of long-term treatment. *Int J Gen Med*. 2013;6:31-38. doi: 10.2147/IJGM.S38594.
27. Almalki MH, Elhadd T, Aldahmani KM, Ekhzaimy A, Alqanaei A, Frookh H, et al. Management of patients with acromegaly in clinical practice in the gulf countries: A delphi consensus survey. *Front Endocrinol*. 2025;16:1593959. doi: 10.3389/fendo.2025.1593959.
28. Dekkers OM, Biermasz NR, Pereira AM, Romijn JA, Vandenbroucke JP. Mortality in acromegaly: A metaanalysis. *J Clin Endocrinol Metab*. 2008;93(1):61-67. doi: 10.1210/jc.2007-1191.
29. Katznelson L, Laws ER, Melmed S, Molitch ME, Murad MH, Utz A, et al. Acromegaly: An endocrine society clinical practice guideline. *J Clin Endocrinol Metab*. 2014;99(11):3933-3951. doi: 10.1210/jc.2014-2700.
30. Giustina A, Barkhoudarian G, Beckers A, Ben-Shlomo A, Biermasz N, Biller B, et al. Multidisciplinary management of acromegaly: A consensus. *Rev Endocr Metab Disord*. 2020;21(4):667-678. doi: 10.1007/s11154-020-09588-z.
31. Renehan AG, O'connell J, O'halloran D, Shanahan F, Potten CS, O'dwyer ST, et al. Acromegaly and colorectal cancer: A comprehensive review of epidemiology, biological mechanisms, and clinical implications. *Horm Metab Res*. 2003;35(11-12):712-725. doi: 10.1055/s-2004-814150.