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# Clinical and Paraclinical Profile of Autoimmune Myasthenia Gravis in Burkina Faso

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## Summary

**Introduction:** Studies on autoimmune myasthenia gravis are still rare in sub-Saharan Africa, and little is known about its profile. The aim of this study was to characterise the sociodemographic, clinical and paraclinical profile of autoimmune myasthenia gravis in Burkina Faso, West Africa.

**Patients and methods:** This was a longitudinal, descriptive, analytical, multicentre study carried out in various health facilities in Burkina Faso, from March 2015 to April 2023. The study concerned patients who had clinical symptoms suggestive of myasthenia gravis, associated with the presence in the serum of anti-AChR (acetyl choline receptor) antibodies and/or anti-MuSK (muscle specific kinase) antibodies and/or the presence of a decrement >10% on electroneuromyography of repetitive nerve stimulation and/or a positive therapeutic test with oral anticholinesterase drugs. Sociodemographic, clinical and paraclinical data were analysed using Epi- info 7.2.5.0 software.

**Results:** A total of 40 patients were enrolled. Women predominated (60%), with a sex ratio of 1.5/1. The mean age at onset was 26.6 ±13.7 years (4 and 71 years), i.e. 25.2 years in women and 28.7 years in men. The majority of patients, 29 cases (72.5%), lived in Ouagadougou. The average time to consultation was 22.4 months ± 37.7 months (1 month and 18 years). At the initial clinical examination, 17 patients (42.5%) had muscular fatigability judged to be severe (motor muscle score of myasthenia ≤ 50 points/100) and 16 patients (40%) were at the stage of severe generalised myasthenia gravis (stage IV of Myasthenia Gravis Fondation of America (MGFA)). Serum anti-AChR and anti-MuSK assays were performed in 33 patients (82.5%) and revealed 22 seropositive cases for anti-AChR (66.7%), 11 seronegative cases for anti-AChR (33.3%) and 4 seropositive cases (12.1%) for anti-MuSK. Chest CT scans and anatomopathological examination were performed in 38 pa-

tients (95%) and 16 patients (40%) respectively, and revealed thymic hyperplasia in 22 patients (57.9%) and thymoma in 6 patients (15.8%).

**Conclusion:** Autoimmune myasthenia gravis in Burkina Faso is characterised by delayed diagnosis, a predominance of young women, severe generalised forms and a tendancy of high frequency of plasma anti-MuSK antibodies. This profile appears to be different from that of patients of Caucasian origin. Further collaborative studies in general populations in the sub-Saharan region are needed.

**Keywords:** Autoimmune myasthenia gravis; Young women ; anti-ACRh antibody; anti-MuSK antibody; Thymoma; MGFA stade IV; Burkina Faso

**List of Abbreviations:** AIMG : autoimmune myasthenia gravis; Anti-AChR : anti actetylcholine receptor antibodies; Anti-DNA : anti desoxy nucleic acid; ANCA : anti-neutrophil cytoplasm antibodies; AMGSBF : Association of Myasthenia Gravis Sufferers in Burkina Faso; Anti-MuSK : anti muscle specific kinase; ELISA : enzyme-linked immunosorbent assay; ENMG : electro neuro myography; F/M : Female/male sex-ratio; LRP4 : Low-density lipoprotein receptor-related protein 4; MGFA : Myasthenia Gravis Foundation of America; MMS : motor muscle score; MuSK : muscle specific kinase; nAChR : nicotinic acetylcholine receptor; SSA : Sub-Saharan Africa; USA : United States of America

## Introduction

Myasthenia gravis is an autoimmune disease of the neuromuscular junction, characterised by muscle fatigue and weakness that occurs or worsens with exertion and decreases or disappears at rest. This is due to specific autoantibodies directed against proteins of the postsynaptic membrane of the neuromuscular junction. The following proteins have been identified as associated with the pathogenesis of myasthenia gravis: nicotinic acetylcholine receptor (nAChR), muscle-specific kinase (MuSK), low-density lipoprotein receptor-related protein 4 (LRP4), agrin, titin, and ryanodine. Depending on the clinical presentation and the presence of serum antibodies, autoimmune myasthenia gravis (AIMG) is divided into several subgroups. The following categories of autoimmune myasthenia gravis (AIMG) are distinguished based on the age at which symptoms first manifest: early-onset AIMG with anti-AChR antibodies (before the age of 50 years), late-onset AIMG (after the age of 50 years), AIMG with anti-AChR antibodies, AIMG with thymoma, AIMG with anti-MuSK antibodies, AIMG with anti-LRP4 antibodies, seronegative generalised AIMG, and ocular AIMG.

The overall incidence of AIMG is, on average, 5.3 per million person-years. The prevalence of AIMG varies depending on the geographical location. In predominantly Western populations, the prevalence is 1.5 to 17.9 cases per 100,000 inhabitants, while worldwide, it is 2.19 to 36.7 cases per 100,000 inhabitants. There has been a consistent and gradual increase in the prevalence of AIMG over recent decades. This is attributed to improvements in patient survival, enhanced diagnostic facilities, and an aging population. AIMG affects individuals of all ages, with a female predominance. Before the age of 40, the sex ratio is approximately three women to one man. This female preponderance is observed to diminish thereafter until the age of 50. After this age, men are the most affected by the disease. Infantile myasthenia gravis is a rare condition in Europe and North America, where it accounts for between 10 and 15% of patients. In contrast, the condition is much more prevalent in Asia, particularly in China, Taiwan, and Japan, where more than 50% of patients experience their first symptoms before the age of 15.

Studies of AIMG in Sub-Saharan Africa (SSA) are fairly rare, and the few studies available only involve a limited number of patients. It is estimated that patients with AIMG in SSA experience lengthy diagnostic delays, which can reach up to 26 months in Ouagadougou, Burkina Faso [8], 24 months in Senegal [7] and 11.2 months in Kenya [9]. Furthermore, difficulties in accessing diagnostic tools and an apparent higher incidence of severe forms are also observed [10]. Several studies, including compara-

tive research in the United States of America (USA) [11] and in South Africa [12], as well as systematic reviews [1, 13], have indicated that there is a higher frequency of early-onset forms of the disease. A greater prevalence of females among patients, a relatively lower incidence of anti-AChR antibodies, a higher prevalence of anti-MuSK antibodies and a tendency towards more severe forms of the disease in patients of Black African descent compared with those of European origin have been observed. These observations led us to conduct the present study, which aimed to characterise the socio-demographic, clinical, and paraclinical profile of AIMG in health facilities in Burkina Faso.

## Patients and Methods

This was a longitudinal, descriptive, multi-centre hospital-based study involving all private and public health facilities in the 13 health regions of Burkina Faso. It spanned a period of 5 years and 6 months, from March 2015 to September 2019. Prior to the commencement of the study, official correspondence was sent to all doctors practising in the various public (46 medical centres, 13 regional hospitals, 5 university hospitals) and private (350 clinics and private medical practices) health facilities, registered with the Burkina Faso Medical Association, and to the various administrative managers. We have also contacted the 13 Regional Health Directors and 70 Medical Officers in charge of Health Districts, requesting that they refer any suspected cases of myasthenia (patients presenting clinical symptoms suggestive of myasthenia) or any cases of myasthenia that have already been confirmed to us. A total of 218 health facilities in Burkina Faso were contacted, comprising seven hospitals, 11 urban medical centres and 200 private health facilities. Of these, 199 collaborated and 36 referred suspected cases to us. Confirmed cases were identified in four hospitals, two urban medical centres and three private clinics. The patients referred to us were regularly seen as neurology outpatients at the three main university hospitals in Ouagadougou (Burkina Faso): Tingandogo University Hospital, Yalgado Ouédraogo University Hospital and Bogodogo University Hospital. Patients who could not travel were examined at their home hospital, after express travel by the team of investigating neurologists.

All patients with clinical symptoms suggestive of myasthenia gravis associated with at least one of the following criteria were included in our study: presence in the serum of anti-AChR antibodies at a level > 0.4 nmol/ml (negative or doubtful if ≤ 0.4 nmol/ml) and/or anti-MuSK antibodies; presence of a >10% decrement, in at least 2 nerve-muscle pairs, during repetitive stimulation at 3 cycles/second in repetitive nerve stimulation electroneuromyography, after stopping anticholinesterase medication the day before the examination; therapeutic test with oral anticholinesterase drugs [pyridostigmine bromide, 60 mg tablets (Mestinon® ) or ambenonium chloride, 10 mg tablets (Mytelase® )] revealing a net functional benefit in the patient's daily life over a period of at least 14 days. A total of 78 cases of suspected myasthenia gravis benefited from a therapeutic test mainly with pyridostigmine bromide tablets 60 mg per os every 4 hours from early morning to bedtime for at least 14 days. A total of 96 patients were referred to us for suspected myasthenia gravis.

The study excluded patients whose clinical symptoms were suggestive of myasthenia gravis but not confirmed by paraclinical examinations and/or who did not respond to therapeutic testing with oral anticholinesterase agents.

Given the unavailability of anti-AChR and anti-MuSK assays at a locally-based facility in Burkina Faso, all serum samples for these assays were taken and processed by a team of experienced biologists at the "Bio 2000 Laboratory" in Ouagadougou. This was a laboratory that had a cooperation agreement with a reference laboratory in France, which was able to perform these assays. The samples were then flown to the "Cerba medical biology laboratory" in France, where they were analysed using the radioimmunoassay method for anti-AChR antibodies and the enzyme-linked immunosorbent assay (ELISA) method for anti--MuSK antibodies.

The electroneuromyography (ENMG) examinations were carried out in the clinical neurophysiology laboratories of the Tengandogo and Bogodogo teaching hospitals using the same type of Neurosoft® equipment.

Thoracic CT scans for thymic abnormalities (thymic hyperplasia or thymoma) were performed at the Ouagadougou Imaging Center for all our patients, by senior radiologists experienced in CT scans of the thymus. Similarly, surgical removal of the thymus, when indicated, was performed by the same thoracic surgery team at Tengandogo University Hospital and " Wend-Toin clinic" in Ouagadougou. Anatomopathological examinations of thymus excision specimens were carried out by different teams of anatomopathologists in public and private health facilities in Burkina Faso. The cost of the various investigations was borne by the patients and their families.

The following variables were considered in the study: The following factors were considered: Socio-demographic factors (age, sex, time to neurology consultation), clinical data [reasons for consultation (myasthenic symptoms/signs), medical history, modes of onset (acute/subacute/progressive), functional signs, time to diagnosis, assessment of muscle fatigability, assessment of progressive stages]; paraclinical data included pharmacological tests with pyridostigmine bromide or ambenonium chloride, serum measurements of anti-AChR and anti-MuSK antibodies, results of thoracic camputer tomography (CT) scans (presence or absence of thymus enlargement), ENMG results, autoimmune serum balance, serum measurements of thyroid hormones, and anatomopathological examinations of excised thymus tissue. The Motor Muscle Score (MMS) was employed to assess muscle fatigability during the initial clinical examination and subsequently at the various follow-up neurological consultations. It is a quantitative analytical score, ranging from 0 to 100 points. During the initial clinical examination, patients were subdivided into five subgroups of increasing clinical severity according to the international classification of the Myasthenia Gravis Foundation of America (MGFA) [12].

The data were analysed using Epi-Info 7.2.5.0 software. Data were expressed as frequencies for quantitative variables and means +/- standard deviation for quantitative variables. The Burkina Faso National Ethics Committee approved the study. Data were gathered with the authorization of the administrations of the various health facilities. Data collection forms were completed on site following the consent of the patients or their legal guardians. All collected data remained confidential.

## Results

A total of 40 patients were enrolled in the study, with 24 women (60%) and 16 men (40%). The sex ratio (F/M) was 1.5. The mean age at onset of symptoms was 26.6 ±13.7 years (ranging from 4 to 71 years). The age of onset of symptoms was predominantly between 10 and 30 years, with 62% of the study population falling within this age range. Three clinical forms of AIMG were identified according to age: AIMG in children (≤15 years), 5 cases (12.5%); AIM in young adults (16-50 years), 32 cases (80%) and AIMG in elderly subjects, 3 cases (7.5%). Figure 1 illustrates the distribution of patients by age of onset of symptoms.

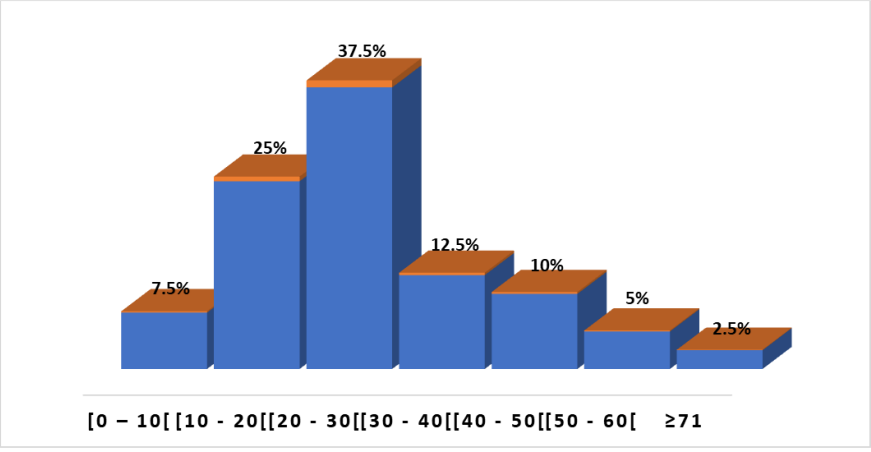


**Figure 1:** Distribution of patients according to age (years) at onset of symptoms

The mean age at symptom onset was 28.7 ± 18.1 years (range: 4-71 years) in males and 25.2 ± 9.9 years (range: 3-46 years) in females. The age of symptom onset was predominantly between 20-40 and 10-30 years for males and females, respectively (see Figure 2).

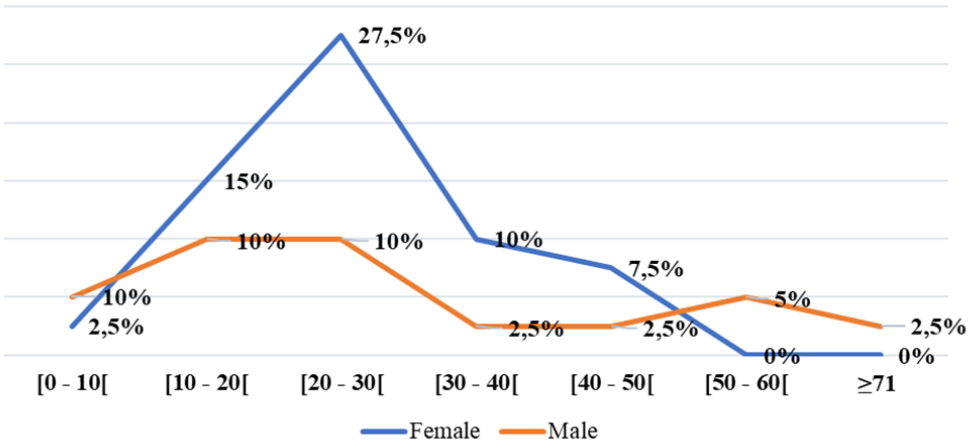


**Figure 2**: Distribution of patients by age (years) of onset of symptoms and sex

The majority of patients (29, 72.5%) were from the centre's health region.

The mean time to neurology consultation was 21.3 months ±37.4 (ranging from one month to 18 years). The disease manifested acutely in 8 patients (20%), subacutely in 6 patients (15%), and progressively in 26 patients (65%). The circumstances of onset were known in 15 patients (37.5%): four cases involved intensive sport, three cases stress, five cases a specific pathophysiological context, and two cases medication.

The clinical presentation was characterised by oculomotor or visual disorders in 36 patients (90%), phonation disorders in 28 patients (70%), limb muscle weakness in 27 patients (67.50%) and dyspnoea due to respiratory muscle damage in 26 patients (65%) (see Figure 3).

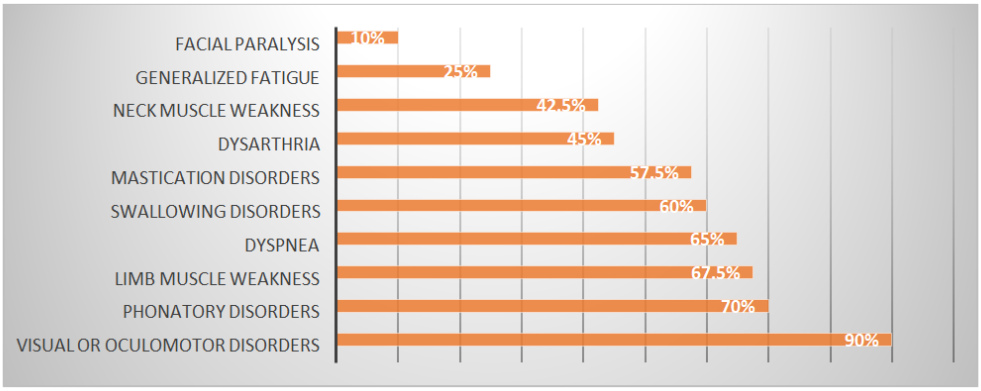


**Figure 3:** Distribution of patients according to the clinical presentations revealing AIMG in the 40 patients

Oculomotor or visual disorders were predominantly characterised by ptosis, which was present in 31 patients (77.5%) (see Figure 4).

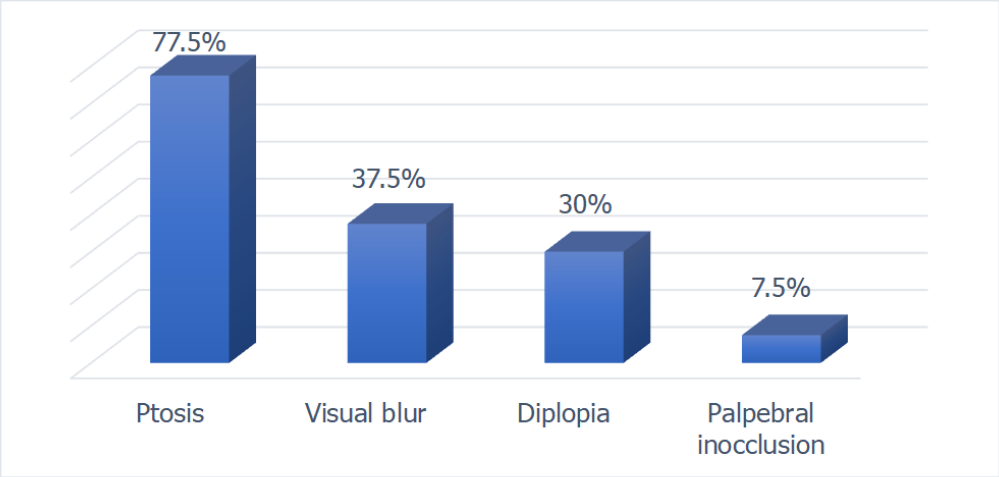


**Figure 4**: Distribution of patients according to oculomotor or visual disorders indicative of AIMG

The presence of damage to bulbar innervated muscles was indicated by the presence of disorders of phonation in 28 patients (70%), disorders of swallowing in 24 patients (60%), disorders of mastication in 23 patients (57.50%), and finally dysarthria in 18 patients (45%).

At the initial clinical examination, muscular fatigability was assessed with an average initial SMM of 57.3 points out of 100, with a standard deviation of ±19.5 (27-95 points). Seventeen patients (42.5%) exhibited severe initial muscular fatigability, defined as an SMM initial score of ≤50 points out of 100. Figure 5 illustrates the distribution of patients according to the extent of initial muscle fatigability by MMS.

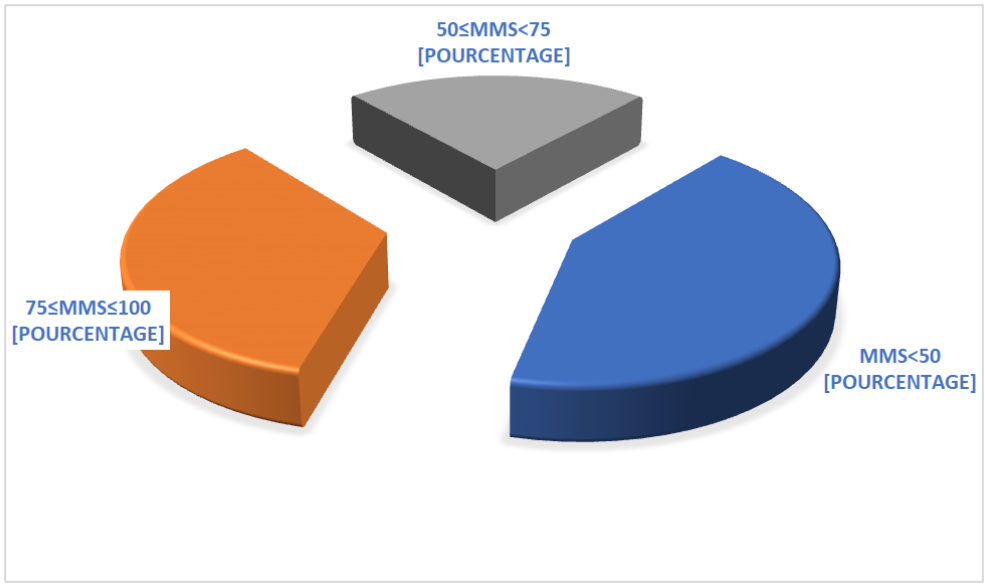


**Figure 5:** Distribution of patients according to degree of initial muscle fatigue by initial motor muscle score (MMS)

On initial clinical examination, assessment of clinical severity using the MGFA score revealed that 16 patients (40%) had severe generalised myasthenia gravis (MGFA stage IV). Figure 6 shows the distribution of patients according to the initial clinical severity stage based on the MGFA classification at diagnosis.

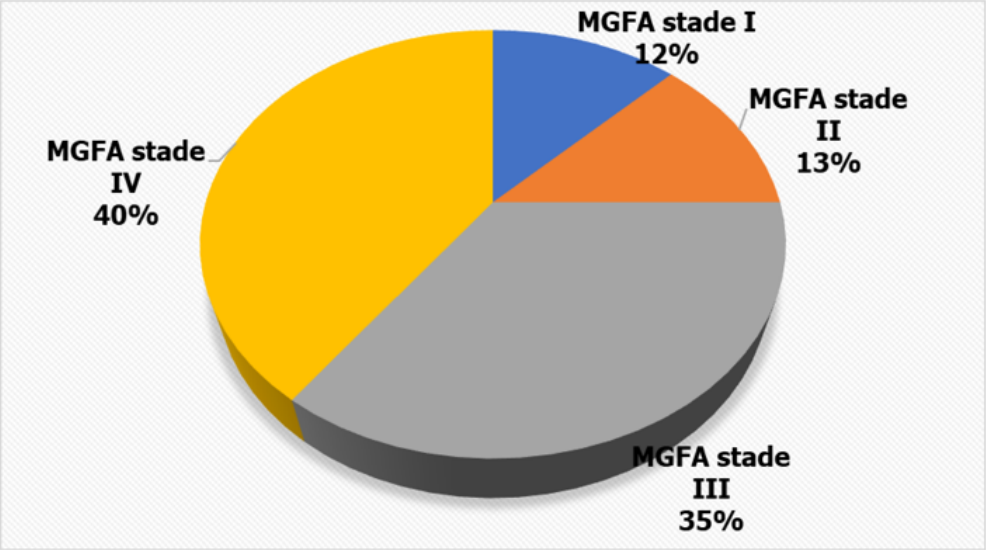


**Figure 6:** Distribution of patients with AIMG according to initial clinical severity (MGFA classification) at diagnosis

The topography of the muscle involvement was found to be a determining factor in the classification of the cases. Two sub-groups were identified: Ocular AIMG (5 cases, 12.5%) and generalised AIMG (35 cases, 87.5%).

The pyridostigmine bromide/ambenonium chloride test was performed in 39 patients (97.5%) and was found to be positive in all cases (100%).

Anti-AChR and anti-MuSK assays were carried out in 33 patients (82.5%) and were positive in 22 cases (66.7%) for anti-AChR and 4 cases (12.1%) for anti-MuSK, while 7 patients (21.2%) exhibited a negative result. Seven patients (17.5%) were unable to undergo the assay. Among the 11 patients who were seronegative for anti-AChR antibodies, four (36.4%) exhibited positive anti-MuSK Ac results.

The clinical forms of the disease, as determined by the nature of the auto-Ac found, were divided into three sub-groups: AChR seropositive AIMG with 22 cases (66.7%), MuSK seropositive AIMG with 4 cases (12.1% of all AIMG or 36.4% of AChR seronegative cases).

Anti-thyroglobulin antibodies, anti-striated muscle and smooth muscle antibodies, anti-intrinsic factor antibodies, anti-nuclear antibodies, anti-DNA (Desoxy Ribonucleic Acid) antibodies, anti-polynuclear cytoplasm antibodies, and anti-citrullinated peptide antibodies assays were carried out in eight patients. All results were normal, except for the anti-nuclear antibodies assay, which was positive in one patient. Thyroid hormone assays were carried out in 15 patients (37.5%), with two patients exhibiting dysthyroidism (one case of hypothyroidism and one case of hyperthyroidism).

A total of 39 patients underwent repetitive nerve stimulation ENMG (97.5%): a significant (≥10%) decrease in muscle action potential amplitude between the first and fifth stimulations was demonstrated in 34 patients (87.2%).

Chest CT scans were performed in 38 patients (95%), revealing thymic hyperplasia in 22 patients (57.9%), thymoma in 6 patients (15.8%) and normal thymus in 10 patients (26.3%). Thymectomy was performed in 16 patients (40%), with pathological examination confirming thymoma in 6 patients.

Based on the findings, three subgroups were identified: A total of 22 cases (57.9%) exhibited thymic hyperplasia, 6 cases (15.8%) thymoma, and 10 cases (26.3%) exhibited normal thymus.

## Discussion

In sub-Saharan Africa, the available data on autoimmune myasthenia gravis (AIMG) are based on small numbers of patients. For example, between 2015 and 2018, five cases of juvenile-onset AIMG were reported [3]. Additionally, six cases were collected in Benin [3]. In Gabon, 20 patients were identified between 2003 and 2013 [14], 18 cases were reported in Meknes in Morocco over 10 years [15], and 25 cases were documented in Madagascar in 2020 [16]. In Ouagadougou, Burkina Faso, 25 cases were reported between 2015 and 2019, rising to 40 cases in 2023 for the country as a whole. This trend can be explained by greater awareness of the symptoms of the disease among healthcare professionals and the general public, thanks to the awareness and screening campaigns run by the Association of Myasthenia Gravis Sufferers in Burkina Faso (AMGSBF).

The female predominance of AIMG, with an F/M sex ratio of approximately 1.5 [5, 18], was confirmed in our series. The disease is encountered in all genders and at all ages, although it is considered to be "a disease of young women and elderly men" [5]. Indeed, the average age of onset is between 20 and 39 in women [8] and between 50 and 70 in men [19].

It has been observed that there are certain epidemiological differences between different population groups around the world. Indeed, the age of onset of AIMG is higher in Western patients, particularly white Americans, than in black Americans (51.8 years versus 33.5 years, $p < 0.0001$) [11, 20]. This tendency towards an early age of onset of AIMG, between 25 and 35 years, reported in black populations is effectively confirmed in series from sub-Saharan Africa, such as ours, and those of Ojini FI et al. [7, 21, 22] and in Trinidad and Tobago with patients of predominantly black African origin [18]. It is noteworthy that in Asia, particularly in China, the age of onset of AIM is even earlier, with the majority of patients in the under-14 age group. However, in Iran [23], Singapore [24] and the Netherlands [25], the average age of onset is over 40. A trend towards a constant increase in late-onset forms observed in Western countries [26] and certain Asian countries [27] over the last 30 years could explain the advanced average age of Western patients when the disease is discovered. In contrast, in our series, patients aged ≥60 years represented only 7.5%.

In Western series, the age of onset of AIMG is typically bimodal for women, with an early onset peak between the ages of 20 and 39, and a late onset peak. In contrast, in men, there is only a single late onset peak. The peak occurs between the ages of 50 and 70 [1]; in contrast, in SSA series, such as ours and that of Bundi Karau P. et al. in Kenya [28], a single peak is observed for each of the two genera. Furthermore, the proportions of late-onset forms reported are lower in African, Japanese, Indian and Chinese patients [1, 19]. Throughout the world, myasthenic patients usually suffer from a delay in diagnosis that can extend over several years. In fact, the diagnostic delay (between the first symptoms and diagnosis) was 21.3 months for our patients in 2023, compared with 26 months in 2019 [29], 24 months in Senegal [7] and in 80% of patients in Italy [30], and > 24 months in more than 50% of patients in the Netherlands [31]. In contrast, relatively short diagnostic delays of 2 months in South Korea [32] and 11.2 months in Kenya [28] have been reported. This delay in diagnosis could be the result of a delay in patients seeking healthcare, diagnostic and therapeutic wandering on the part of patients due to difficulties in making the diagnosis (lack of neurologists) and an inefficient referral system [9, 28].

The clinical symptoms of AIMG, regardless of age or geographical origin, typically manifest with ocular involvement in 60 to 85% of cases [33, 34]. In our series, anti-AChR antibodies were positive in 64% of cases. The low rate of seropositivity to anti-AChR antibodies observed in this study may be attributed to the low rate of anti-AChR assay (68%), as well as the non-repetition of this assay in the event of seronegativity at the time of the initial assay, due to its high cost. Indeed, repeating the anti-AChR antibodies plasma assay increases its diagnostic yield during initial seronegativity [34, 35]. Bundi Karau P. et al. propose that patients with ptosis and/or diplopia should be thoroughly examined and evaluated for myasthenia gravis [28].

In the initial clinical examination, up to 75% of patients exhibited generalised AIMG, while 40% exhibited a severe to very severe generalised form (MGFA class IV to V), a result comparable to that observed in Kenya [28]. These data are likely to reflect late diagnosis at the most severe stages of the disease, or a trend towards a more severe prognosis for AIMG, which has already been observed in black Americans compared with Caucasians [11].

Anti-AChR antibodies are present in approximately 80% of patients with generalised AIMG and 50-60% of patients with ocular AIMG [1, 36], whereas in our series, anti-AChR antibodies were positive in only 66.7% of patients. Anti-AChR antibodies were positive in only 66.7% of patients, which may be attributed to the unavailability of autoimmunity tests in our context, as 17.5% of patients were unable to undergo this assay due to its inaccessibility.

In the literature, MuSK antibodies have been reported in approximately 7-10% of all patients with AIM and up to 40% of patients with generalised AIMG who are seronegative for AChR antibodies [1, 36], whereas in our series, MuSK antibodies were present in 12% of AIMG cases. The results of our study confirm the higher prevalence of MuSK antibodies in patients of African descent. Furthermore, several studies have demonstrated that the prevalence of MuSK antibodies is higher in patients of black African descent in the USA and in European or Asian patients from the equatorial region. This higher prevalence is likely to be genetically predisposed and not environmentally influenced.

In the literature, the prevalence of thymomas in patients with AIMG ranges from 15 to 30%, with the majority of studies reporting a thymoma prevalence of 20% or higher. Our series demonstrated a thymoma prevalence of 15.8%, which is consistent with the literature.

In the Kenyan series [28] and our own, pure ocular AIMG accounted for only 12.5% of cases, mainly in the infantile subgroup. In contrast, ocular AIMG is reported with greater frequency in sub-Saharan African and African-American populations [20, 40]. Ocular AIMG is even more prevalent in Asian populations, accounting for up to 30-56% of cases, with a clear predominance in children [1, 6], whereas it accounts for only 10-15% of cases in the Caucasian population [1]. The under-representation of pure ocular AIMG in our context can be attributed to several factors. Firstly, doctors, patients, or their relatives rarely link isolated ocular symptoms to myasthenia gravis.

Secondly, delays in diagnosis in the generalised stages of the disease are common. Thirdly, the low level of medical referral given the relatively benign nature of ocular AIMG. It is recommended that doctors and patients should be more frequently alert to the possibility of myasthenia gravis in the presence of ocular symptoms such as ptosis and/or diplopia, and that a more comprehensive clinical and paraclinical examination should be performed.

## Limitations and Strengths Of Our Study

The small number of patients in our study, and the absence of serum anti-RACh and anti-MuSK assays in a relatively large proportion of our patients () due to a lack of financial resources, may have induced biases in the distribution of serological subgroups of myasthenic patients in our study. Similarly, the hospital nature of our study may have induced a selection bias towards the most severe cases, at the expense of pure ocular or mild generalized clinical forms.

Despite these limitations, our study has a number of strong points: serum assays for anti-AChR or anti-MUSK Ac were performed in the same laboratory, in accordance with recommended methods; the diagnosis of AIMG was based on a combination of clinical, electrophysiological and biological evidence for the majority of our patients; the multicentric nature of our study.

## Conclusion

In Burkina Faso, the implementation of public awareness initiatives has led to the diagnosis of 40 cases of AIMG to date. AIMG in Burkina Faso is predominantly a disease of young women, diagnosed late and characterised by a predominance of severe generalised forms, a low frequency of ocular, juvenile and geriatric forms, poor access to immunological diagnostic tests and a high frequency of forms with anti-MuSK antibodies. This profile may differ from that of other populations, particularly Caucasians and Asians. Further collaborative multicentre studies of large numbers of people with AIMG in sub-Saharan Africa will be needed to better characterise the specific epidemiological, clinical, paraclinical and evolutionary profile of AIMG in this part of the world.

## Declarations

## Ethical Approval and Consent to Participate

The National Ethics Committee of Burkina Faso approved the study. Data collection was conducted with the approval of the administrations of the various health facilities in Burkina Faso. Data collection forms were completed on site after obtaining the consent of the patients or their legal guardians. The data collected remained confidential

## Consent for Publication

All study participants or their legal guardians (for minor participants) have given their informed consent for publication of the study results

## Availability of Data and Materials

All data on which the conclusions of the present manuscript are based are kept in the archives of the various health structures in Burkina Faso and are accessible to the public on request, provided confidentiality is respected

## Competing Interests

The authors declare that they have no competing interests

## Funding

The authors declare no source of funding

## Authors' Contributions

All authors collected articles and references, discussed and organized the content in the manuscript. All authors read and approved the final manuscript

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Not applicable

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