



TITLE

**PREVALENCE OF ANEMIA AND ITS ASSOCIATED FACTORS
AMONG GERIATRIC PATIENTS ADMITTED TO HOSPITAL
PAKAR UNIVERSITI SAINS MALAYSIA, KELANTAN, FROM
JANUARY 2023 TO JUNE 2023.**

January 2025

by

ESBA AHAMED

**Dissertation submitted in partial fulfillment of the requirements for
the degree of Bachelor of Health Science
(Honours) (Biomedicine)**

January 2025

CERTIFICATE

This is to certify that the dissertation entitled “The Prevalence of anemia and its associated factors among geriatric patients (age \geq 65 years) admitted to Hospital Pakar Universiti Sains Malaysia, Kelantan, from January 2023 to June 2023” is the bona fide record of research work done by “Esba Ahamed” under my supervision. I have read this dissertation, and it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation to be submitted in partial fulfillment of the Bachelor of Health Science (Honours) (Biomedicine).

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DECLARATION

I hereby declare that this dissertation is the result of my investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research, and promotional purposes.

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LIST OF SYMBOLS AND ABBREVIATIONS

<p>Acute upper gastrointestinal bleeding (AUGIB) 25</p> <p>Chronic kidney disease (CKD) 10</p> <p>Chronic obstructive pulmonary disease (COPD) 24</p> <p>Hematocrit (HCT) 17</p> <p>Hemoglobin (HGB) 17</p> <p>Interquartile range (IQR) 14</p> <p>Iron deficiency anemia (IDA) 26</p>	<p>Laboratory Information System (LIS) 26</p> <p>Mean corpuscular hemoglobin (MCH) 10</p> <p>Mean corpuscular hemoglobin concentration (MCHC) 10</p> <p>Mean corpuscular volume (MCV) 10</p> <p>Red blood cell (RBC) 17</p> <p>White blood cell (WBC) 17</p>
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ABSTRAK

Prevalens Anemia dan Faktor-faktor Berkaitan dalam Kalangan Pesakit Geriatrik (berumur ≥ 65 tahun) yang dimasukkan ke Hospital Pakar Universiti Sains Malaysia, Kelantan, dari Januari 2023 hingga Jun 2023

Anemia adalah keadaan kesihatan yang biasa, yang dicirikan oleh pengurangan dalam jumlah sel darah merah (RBC), menyebabkan keupayaan tubuh untuk mengangkut oksigen tidak berkesan. Anemia lebih prevalen dalam populasi geriatri dan sering diabaikan sebagai faktor dalam penyakit orang dewasa yang lebih tua. Populasi geriatri di kebanyakan negara membangun mengalami penderitaan yang ketara akibat anemia, dengan Asia Tenggara dan Afrika mencatat prevalens yang tertinggi. Kajian ini bertujuan untuk menyelidik prevalens anemia dan faktor-faktor yang berkaitan dalam kalangan pesakit geriatrik (umur ≥ 65 tahun) yang dimasukkan ke Hospital Pakar USM. Kajian rentas lintang retrospektif yang melibatkan 131 pesakit berumur 65 tahun ke atas. Keputusan makmal dan maklumat sosiodemografi didokumenkan menggunakan format proforma yang telah disahkan. SPSS digunakan untuk menganalisis data. Sebilangan besar pesakit yang mengalami anemia adalah dari julat umur 65-69 tahun (31.0%), dan kebanyakan mereka adalah lelaki (60%). Kebanyakan pesakit (74.0%) mengalami anemia normositik. Terdapat hubungan yang signifikan ditemui antara tahap anemia dan malignan ($p=0.041$), pendarahan gastrointestinal ($p=0.050$), dan penyakit kronik ($p<0.001$). Anemia kerap didiagnosis dalam populasi geriatrik yang dikaji. Punca anemia yang paling kerap dalam populasi geriatrik adalah anemia akibat penyakit kronik. Saranan: Penyelidikan geriatrik pada masa depan perlu mengkaji bagaimana anemia mempengaruhi kebolehan fungsional, kualiti hidup, dan pemulihan daripada penyakit.

ABSTRACT

The Prevalence of anemia and its associated factors among geriatric patients (age \geq 65 years) admitted to Hospital Pakar Universiti Sains Malaysia, Kelantan, from January 2023 to June 2023

Anemia is a common health condition characterized by a reduction in the number of red blood cells (RBCs), leading to an insufficient ability of the body to transport oxygen effectively. Anaemia is more prevalent in the geriatric population and is frequently disregarded as a factor in older adults' illnesses. The geriatric populations of many developing countries suffer significantly from anemia, with Southeast Asia and Africa having the highest prevalences. This study aimed to investigate the prevalence of anemia and its associated factors among geriatric patients (age \geq 65 years) admitted to Hospital Pakar USM. A cross-sectional, retrospective study involving 131 patients 65 or older. Laboratory results and sociodemographic information were documented using a validated proforma format. SPSS was used to analyze the data. Most of the anemic patients were 65-69 years (31.0%), and most were male (60%). Most of the patients (74.0%) had normocytic anemia. A significant association was found between the severity of anemia and malignancy ($p=0.041$), gastrointestinal bleeding ($p=0.050$), and chronic illness ($p<0.001$). Anaemia was frequently diagnosed in the studied geriatric population. The most frequent cause of anemia in the geriatric population was anemia of chronic illness. Future geriatric research might examine how anemia affects functional abilities, quality of life, and recovery from illness.

CHAPTER 1: INTRODUCTION

1.1 Background of the study

Anemia is a common health condition characterized by a reduction in the number of red blood cells (RBCs), leading to an insufficient ability of the body to transport oxygen effectively. It is characterized by a reduction in hemoglobin (Hb) levels in the blood of affected individuals (Ni et al., 2022). Anemia is characterized by a hemoglobin concentration of less than 12 g/dL for women and less than 13 g/dL for males, according to the World Health Organization (WHO) (Ashwini Aithal et al., 2023). Anemia becomes more common with advancing age and is often overlooked as contributing to illness in elderly people. In the elderly population, anemia increases the risk of several adverse outcomes, such as hospitalization, disability, and mortality. Globally, 11.0% of men and 10.2% of women aged 65 years and older are affected by anemia (Ni et al., 2022). Anemia in the elderly is often overlooked, as symptoms such as weakness, exhaustion, and dyspnea are commonly mistaken as typical aspects of aging. Older adults may experience more severe complications from anemia compared to younger individuals, significantly affecting their quality of life. The severity is categorized as mild (11.0-11.9 g/dL for women, 11.0-12.9 g/dL for men), moderate (8.0-10.9 g/dL), and severe (<8.0 g/dL) (Ashwini Aithal et al., 2023). The main categories of anemia are marrow production deficiencies (hypo-proliferation), red cell maturation defects (ineffective erythropoiesis), and decreased red cell survival (caused by blood loss or hemolysis). Elderly people are more likely to have acquired sideroblastic, chronic disease anemia, and myelodysplastic syndromes. Iron deficiency and chronic illness are the two most frequent causes of anemia in the elderly. However, up to 33% of elderly anemia cases remain unexplained, with the pathophysiology still unknown. Conjunctival

pallor is a reliable indicator of anemia, and clinicians should order blood tests to confirm its presence (Mann et al., 2014). Anemia in the elderly typically requires a comprehensive approach to management and treatment. The primary goal in treating anemia is to identify the underlying cause whenever possible. Unfortunately, this is only achievable in only a small percentage of cases, particularly among malnourished patients. Conventional treatments such as erythropoietic stimulating agents (ESAs) and blood transfusions have significant limitations, prompting an intensive search for novel therapeutic options (Busti et al., 2019).

1.2 Problem statement

Based on the previous study, anemia in older adults is more common in developing nations, where the prevalence ranges from 20.6% to 49.5% (Styszynski et al., 2018). Many developing countries have a significant burden of anemia in their elderly populations, with Southeast Asia and Africa having the highest prevalences (WHO, 2008). Malaysia, being a South Asian nation, is no exception. However, its exact prevalence in hospitals and the community is not known. At Hospital Pakar Universiti Sains Malaysia, Kelantan, there is a pressing need to understand the scope and underlying factors of anemia in the geriatric population. Therefore, a retrospective, cross-sectional descriptive study is needed to investigate the prevalence of anemia in geriatric patients according to hemoglobin level, severity, age range, underlying disease, and race.

1.3 Objective

1.3.1 General Objective

To determine the prevalence of anemia and its associated factors among geriatric patients (age \geq 65 years) admitted to Hospital Pakar Universiti Sains Malaysia (USM) from January 2023 to June 2023.

1.3.2 Specific Objectives

- i. To determine the prevalence of anemia among geriatric patients in Hospital Pakar USM.
- ii. To evaluate the demographic data of geriatric patients with anemia.
- iii. To determine the association between the comorbidities with severity and the types of anemia in geriatric patients in Hospital Pakar USM.

1.4 Research Hypothesis

1.4.1 Alternative hypothesis

There is a significant prevalence of anemia among geriatric patients (age \geq 65) admitted to Hospital Universiti Sains Malaysia from January 2023 to June 2023.

1.4.2 Null hypothesis

There is no significant prevalence of anemia among geriatric patients (age \geq 65) admitted to Hospital Universiti Sains Malaysia from January 2023 to June 2023.

1.5 Significance of study

Anemia is a common yet often under-recognized condition among geriatric populations. The elderly are at higher risk due to multiple factors, including chronic diseases, nutritional deficiencies, and physiological changes associated with aging. Therefore, this study on anemia among geriatric patients at Hospital Pakar USM is significant as it will provide essential insights into the prevalence, causes, and management of anemia in the elderly. This can lead to better health outcomes for older adults and guide future clinical practices, public health policies, and resource allocation in geriatric care.

Chapter 2: LITERATURE REVIEW

2.1 Anemia

Anemia is characterized by blood hemoglobin (Hb) concentrations below the lower limit of the reference interval specified for age, gender, race, and altitude. For the adult population, the World Health Organization (WHO) criteria, proposed by an expert committee almost fifty years ago, generally accept lower limits of 130 g/L for men and 120 g/L for women (Buttarelo, 2016). Anemia occurs when the body's red blood cell (RBC) count declines to the point where it cannot carry enough oxygen to meet physiological demands (Ashwini Aithal et al., 2023). Erythropoiesis is the process by which erythrocytes mature and differentiate into mature erythrocytes (RBC). Hematopoietic stem cells undergo a sequential differentiation process to become erythrocytes. Numerous cellular processes occur during erythropoiesis, including hemoglobin synthesis, chromatin and nucleus condensation, and the removal of most organelles. Erythroid progenitors expel condensed nuclei to form reticulocytes. After undergoing membrane and cytoskeletal remodeling and the elimination of any remaining organelles, reticulocytes take on the biconcave discoidal form that characterizes adult erythrocytes. Pathophysiological conditions like anemia could result from changes to any of these essential cellular processes (Jalal, 2021).

2.2 Types of Anemia

Microcytic anemia, normocytic anemia, and macrocytic anemia are the three primary forms of anemia. Red blood cells in microcytic anemia are smaller than they should be. This occurs due to insufficient hemoglobin, a protein found in red blood cells that aids in transporting oxygen throughout your body and bloodstream. The most common cause of microcytic anemia is iron deficiency anemia, which occurs when the body does not have enough iron to

produce hemoglobin. Iron deficiency anemia is frequently brought on by internal bleeding, heavy menstruation, surgery, and inadequate dietary iron intake. However, this type of anemia can also result from other disorders, such as sideroblastic anemia and thalassemia. A hereditary condition called thalassemia causes aberrant hemoglobin synthesis, frequently leading to microcytic anemia. Ineffective hemoglobin synthesis is the cause of sideroblastic anemia, a disorder that can be acquired or inherited. The most frequent cause of acquired sideroblastic anemia is myelodysplastic syndromes, characterized by aberrant blood cell growth (Berliner, 2024). To diagnose underlying conditions like lead poisoning, which can affect heme production and result in both microcytic and hypochromic anemia, more research into the causes of microcytic anemia is essential (Tina et al., 2020).

In normocytic anemia, the red blood cells are all the same size, but there isn't enough circulation to meet the body's requirements. The most common cause of normocytic anemia is an underlying chronic illness. It is commonly associated with inflammatory conditions, chronic infections, or malignancies, which interfere with red blood cell production. For instance, chronic kidney disease (CKD) is known to cause normocytic anemia due to decreased erythropoietin production, which is essential for red blood cell production in the bone marrow (Kumar et al., 2021). Additionally, bone marrow failure, such as seen in aplastic anemia or certain forms of leukemia, can also present as normocytic anemia (Ershler, 2019). In the elderly, normocytic anemia is often linked to chronic inflammatory conditions such as rheumatoid arthritis or cardiovascular disease (Mann et al., 2014).

Lastly, the bone marrow produces larger-than-normal red blood cells in patients with macrocytic anemia. Megaloblastic anemia and non-megaloblastic anemia are the two types of macrocytic anemia. Insufficient intake of vitamin B12 or folate can result in megaloblastic

anemia. Certain medical conditions may impact the body's ability to absorb nutrients necessary for producing healthy red blood cells in non-megaloblastic anemia. It is most frequently caused by liver disease and hypothyroidism, also referred to as an underactive thyroid (Healthline, 2023). Impaired DNA synthesis can lead to megaloblastic anemia, which is mainly brought on by folate or vitamin B12 deficits and impacts red blood cell maturation. This kind of anemia is frequently linked to inadequate dietary intake or malabsorption disorders like coeliac disease, especially in older people or those with restricted access to nutrient-dense foods (Ryan et al., 2023). On the other hand, liver disease or hypothyroidism can cause non-megaloblastic macrocytic anemia, which disrupts lipid metabolism in cell membranes, leading to bigger red blood cells. Research has demonstrated that hypothyroidism, which can be treated with hormone replacement therapy, or liver dysfunction are frequently associated with macrocytic anemia in the elderly (Mann et al., 2014).

Three main types of anemia are reduced red cell survival (blood loss/hemolysis), red cell maturation defects (ineffective erythropoiesis), and marrow production defects (hypoproliferation) (Ershler, 2019). The prevalence of acquired sideroblastic, chronic disease anemia, and myelodysplastic syndromes is higher in the elderly (Berliner, 2024). Iron deficiency and chronic illness are the two most frequent causes of anemia in the elderly. Other causes of anemia in the elderly include myelodysplastic syndrome, gastrointestinal bleeding, vitamin B12 deficiency, and folate deficiency (Mann et al., 2014). Marrow production abnormalities, frequently seen in diseases like myelodysplastic syndromes and aplastic anemia, are another significant group of anemia. These conditions cause anemia by causing the bone marrow to produce red blood cells inefficiently or insufficiently (Ershler,

2019). Mutations in hematopoietic stem cells can result in aberrant blood cell production and inefficient erythropoiesis, making myelodysplastic syndromes (MDS) especially pertinent in the elderly (Berliner, 2024). Although the less common, autoimmune loss of hematopoietic stem cells can cause aplastic anemia, which can develop in pancytopenia, or a reduction in all blood cell types (Kumar et al., 2021).

Anemia management typically involves addressing the underlying cause. In iron deficiency anemia, iron supplementation or dietary modification is often the first line of treatment, while vitamin B12 and folate deficiencies are corrected through supplementation. In cases of chronic disease anemia, treatment focuses on managing the underlying disease and may include erythropoiesis-stimulating agents (ESAs) or blood transfusions in severe cases (Ryan et al., 2023). However, the management of anemia in the elderly is often complicated by polypharmacy, comorbidities, and the potential for adverse reactions to treatments. Therefore, a personalized and holistic approach is required to balance the risks and benefits of interventions for this population.

The etiology of anemia is diverse and can be categorized based on cell size (microcytic, normocytic, and macrocytic), the mechanism of development (ineffective erythropoiesis, blood loss, or marrow failure), and the patient's age and comorbid conditions. A thorough understanding of the various causes, particularly in vulnerable populations such as the elderly, is crucial for effectively diagnosing and managing anemia.

2.3 Prevalence of anemia and associated factors

2.3.1 Demographic characteristics

Previous studies have shown that the overall prevalence of geriatric anemia ranges between 10% and 24% (Stauder & Thein, 2014). In another prior research, from 144 patients, 67 were men, and 77 were women, from which 63.9% of the participants were non-anemic, and 36.1% were anemic (Ashwini Aithal et al., 2023). Females had a higher prevalence of anemia. A different study suggested that among Indian women in the reproductive age range, anemia is more common. Numerous factors, including multiple pregnancies, nutritional imbalances, and other gynecological issues, may be connected to this. Therefore, it is assumed that the anemia observed in young females persisted in older females (Singh, Nagesh, and Ray, 2018). A study was conducted in southern India where 13 patients (25%) were classified as moderately anemic, 3 patients (6%) as severely anemic, and 36 patients (69%) as mildly anemic (Ashwini Aithal et al., 2023). A study carried out in an Indian hospital had 60 study participants, 40% were between the ages of 65-69, 38.33% were between the ages of 70-74, 15% were between the ages of 75-79, and 6.66% were 80 years of age or older (Mann et al., 2014). This shows that the prevalence of anemia in the age group 65 – 69 years was higher compared to other groups. According to a study done

2.3.2 Hematological parameters

The highest percentage of elderly people (50%) in the above study had normocytic normochromic anemia, which was followed by microcytic hypochromic anemia (40.40%) and Macrocytic and Macro normocytic (10%). Haemoglobin (8.42 ± 1.91) and serum ferritin (424.67 ± 391.48) mean values were higher in the normocytic normochromic group than in the microcytic hypochromic and macrocytic groups (Table 2.1). The macrocytic group had

higher mean values for mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) (Mann et al., 2014). The mean corpuscular volume category anemia is microcytic (less than 80 fL), normocytic (80 to 100 fL), or macrocytic (greater than 100 fL) (Lanier, Park, and Callahan, 2018).

Haematological parameters	MCHC (n=24)	NCNC (n=30)	Macrocytic + macro-normocytic (n=6)
Hb (gm %)	7.33 ± 2.28	8.42 ± 1.91	7.3± 1.59
MCV (fl)	68.68 ± 9.60	85.17± 7.4	100.05± 10.33
MCH (pg)	21.88 ± 3.97	29.64± 3.20	33.6± 4.65
MCHC (gm/dl)	32.29 ± 2.88	34.58± 2.31	34.71± 2.6
S. Ferritin (µ/l)	70.58±183.66	424.67±391.48	261.33± 148.86

Figure 2.1 Mean value of hematological parameters in various types of anemia (Ashwini Aithal et al., 2023).

2.3.3 Underlying disorders

Risk factors that are more prevalent in elderly patients include androgen deficiency, cancer, myelodysplastic disorders, gastrointestinal bleeding, chronic alcohol use, malnutrition, chronic kidney disease, liver disease, and age-related declines in stem cell proliferation (Lanier, Park and Callahan, 2018). A British prospective cohort study was conducted in 2016, where anemia was linked to a higher all-cause mortality rate one year following hospitalization for 220 patients with a mean age of 83.6 years. Iron deficiency from secondary causes (bowel cancer) is one of the nutritional deficiencies that affect one-third of elderly anemic patients. One-third had an unidentified cause, and another third had chronic kidney disease (CKD) or chronic inflammation (Joosten, Detroyer and Milisen, 2016). The most prevalent comorbidities among older adult anemia patients, according to an analysis of 1121 records from a hospital-based study, were diabetes mellitus (44.2%) and hypertension (48.7%). Based on Table 2.2, 5 (0.4%) of the CKD patients were in stage 3a, 29 (2.6%) were in stage 3b, 47 (4.2%) were in stage 4, and 42 were in stage 5 (Sujanitha et al., 2022).

Age group (years)	Male n (%)	Female n (%)	Total n (%)
60-69	232(42.4)	259(45.1)	491 (43.8)
70-79	222 (40.5)	251(43.7)	473 (42.2)
80 and above	93(17.1)	64(11.2)	157 (14.0)
Total	547 (100)	574(100.0)	1121 (100.)
Comorbidities			
Diabetes Mellitus	233 (42.6)	263 (45.8)	496 (44.2)
Hypertension	256 (46.8)	290 (50.5)	546 (48.7)
Cerebrovascular Accident	41 (7.5)	27 (4.7)	68 (6.1)
Bronchial Asthma	49 (9.0)	56 (9.8)	105 (9.4)
Chronic obstructive pulmonary disease	34 (6.2)	6 (1.0)	40 (3.6)
Rheumatoid Arthritis	6 (1.1)	28 (4.9)	34 (3.0)
Peptic Ulcer Disease	11 (2.0)	18 (3.1)	29 (2.6)
Chronic kidney disease	71 (13.0)	57 (9.9)	128 (11.4)
Hypothyroidism	17 (3.1)	52 (9.1)	69 (6.2)
Malignancies	17 (3.1)	20 (3.5)	37 (3.3)
Dyslipidaemia	34 (6.2)	59 (10.3)	72 (6.5)
Epilepsy	10 (1.8)	7 (1.2)	17 (1.5)
Psychiatric illness	6 (1.1)	7 (1.2)	13 (1.2)
Tuberculosis	12 (2.2)	5 (0.95)	17 (1.5)
Chronic liver cell disease	13 (2.3)	9 (1.6)	22 (2.0)
Dementia	1 (0.2)	1 (0.2)	2 (0.2)

Figure 2.2 Distribution of study subjects according to their age, sex, and comorbidities (V. Sujanitha et al., 2022).

According to a different study, anemia and chronic illnesses are significantly correlated. For chronic diseases, patients who had been diagnosed during the investigation and those who were already receiving treatment were considered. The majority of anemic patients had type 2 diabetes, followed by hypertension, cardiovascular disease, and renal disease (Figure 2.3) (Ashwini Aithal et al., 2023).

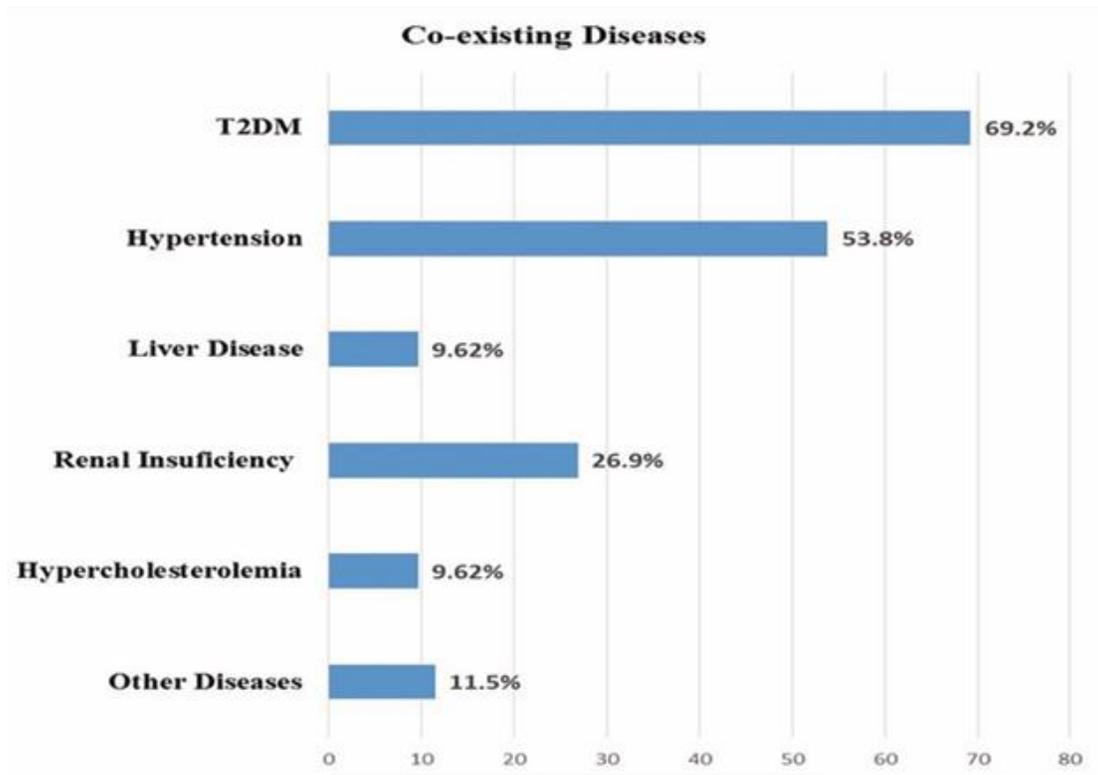


Figure 2.3 The pattern of coexisting health conditions present in anemic patients (Ashwini Aithal et al., 2023)

Low Hb levels and the resulting anemia in geriatric patients should not be assumed to be a regular aspect of aging. Anemia in aging is caused by a gradual decrease in erythropoietin production by the kidneys. This medical condition must be appropriately investigated and managed. Due to the decline in erythropoietin secretion, diabetes causes a significant percentage of anemia cases in older adults, even at subclinical stages (Ye et al., 2016).

According to a study

Chapter 3: MATERIALS AND METHODS

3.1 Study Design and Target Population

This was a retrospective, cross-sectional descriptive study performed on geriatric patients aged ≥ 65 years. The data were extracted retrospectively from the hematology database and clinical records of geriatric patients admitted to Hospital Pakar USM from January 2023 to June 2023 (6 months). This specific period was considered for our study, as the Hematology LIS contained a complete set of patient data for this time period. Data was retrieved from the Hematology Laboratory Information System (LIS) and medical record unit. Data were recorded using a semi-structured, validated proforma listing the important hematological parameters needed to investigate anemia in patients.

3.2 Ethical Statement

This study was approved by Human Research Ethics Committee of Universiti Sains Malaysia (USM/JEPeM/19090552).

3.3 Sample size

The sample size was calculated using the website Calculator.net, and it was determined to be 101, where 101 or more patients are needed to have a confidence level of 95% that the real value is within $\pm 5\%$ of the measured value. The population proportion was considered to be 50% and the population size was 135 (Calculator.net, 2024).

3.4 Inclusion and exclusion criteria

In this study, the inclusion criteria included patients aged more than 65 years admitted to Hospital Pakar USM from January 2023 to June 2023. Patients with Hb levels below 13 g/dl for men and 12 g/dl for women were accepted. Lastly, patients with available medical records from Hospital Pakar USM during the study period were included. Exclusion Criteria included

patients with incomplete or missing medical records from Hospital Pakar USM relevant to anemia diagnosis during the study period.

3.5 Data and Statistical Analysis

This study involved descriptive and inferential analyses using IBM SPSS Statistics version 29. Frequencies and percentages were used to display the demographic data, while the median, range, and interquartile range (IQR) were used to display the hematological parameters. Here, median was used instead of mean, as the median is not impacted by extreme outliers or asymmetric score distributions because it only takes one or two values. In contrast, in skewed distributions, the mean and mode may differ. All analyses considered a p-value of less than 0.05 to be statistically significant. The association between the diagnosis and the type and severity of anemia was analyzed using Pearson's Chi-square and Fisher exact tests for two independent groups.

Chapter 4: RESULTS

One hundred thirty-five (135) of patient data based on the criteria described in section 3.3, were collected from January 2023 until June 2023. Based on the collected data, 100 patients were anemic (74.1%), while 35 were non-anemic (25.9%). This section presents the results in tables to interpret the prevalence of anemia in geriatric patients and its related factors.

4.1 Demographic analysis of anemia in geriatric groups

The prevalence of anemia among the geriatric population in Kelantan, Malaysia, was 5000 cases per 100,000 people. The total geriatric population in Kelantan was taken from DOSM'23 (DOSM Malaysia, 2023). The majority of the anemic patients were from the age range 65-69 years (31.0%), followed by the 70–74-year group (26.0%). There were very few patients aged 85 years and older; hence, the percentage was the lowest compared to other age groups. Male patients were higher (60.0%) than females (40.0%). Moreover, there were more Malay patients (94.0%) than Chinese (6.0%). The majority of the patients had normocytic normochromic anemia (74.0%), followed by microcytic hypochromic anemia (24.0%) and macrocytic anemia (2.0%), respectively. The severity of anemia in most of the patients was moderate (49.0%) compared to mild (34.0%) and severe (17.0%). The most common comorbidities in the study population were chronic illness (39.0%), followed by infection (23.0%) and chronic disease with CKD (16%). The least common comorbidity among the patients was gallbladder stones (1%) and stroke (1%). The percentage was the same for patients with gastrointestinal bleeding, malignancy, and autoimmune hemolytic anemia (Table 4.1).

Table 4.1 Demographic characteristics of the study group (n=100)

Characteristics	N (%)
Age	
65-69	31 (31.0)
70-74	26 (26.0)
75-79	22 (22.0)
80-84	16 (16.0)
85 and above	5 (5.0)
Gender	
Male	60 (60.0)
Female	40 (40.0)
Race	
Malay	94 (94.0)
Chinese	6 (6.0)
Types of anemia	
Microcytic hypochromic (MCV < 80)	24 (24.0)
Normocytic normochromic (MCV = 80 – 100)	74 (74.0)
Macrocytic (MCV > 100)	2 (2.0)
Severity	
Mild	34 (34.0)
Moderate	49 (49.0)
Severe	17 (17.0)
Diagnosis	
Chronic illness	39 (39.0)
Chronic illness with CKD	16 (16.0)
Chronic lung disease	3 (3.0)
Gallbladder stones	1 (1.0)
Gastrointestinal bleeding	3 (3.0)
Infection	23 (23.0)
Malignancy	11 (11.0)
Autoimmune hemolytic anemia	3 (3.0)
Stroke	1 (1.0)

***Note:** MCV = Mean corpuscular volume, N= Number of patients, CKD= Chronic kidney disease

Regarding hematological parameters, the minimum hemoglobin value (Hb) was 3.40g/dL, and the maximum was 12.90g/dL. Here, hemoglobin had a median of 10.40g/dL, and the interquartile range (IQR) was 2.40g/dL. In the case of MCV, the minimum value was 59.10fL, while the maximum value was 105.90fL. The median value for MCV was 86.10fL, along with an Interquartile range of 10.10fL. The minimum value for WBC was $3.11 \times 10^9/L$, and the median was $9.48 \times 10^9/L$. In the case of platelets, the lowest was $19 \times 10^9/L$, while the maximum value was $602 \times 10^9/L$. It had a median value of $195 \times 10^9/L$ with an IQR of $157 \times 10^9/L$ (Table 4.2).

Table 4.2 Hematological parameters

Parameter	Range (minimum-maximum)	Median (IQR)
HGB (g/dL)	3.40-12.90	10.40 (2.40)
RBC ($\times 10^{12}/L$)	1.19-6.33	3.72 (0.94)
HCT (%)	12.60-52.70	31.60 (7.20)
MCV (fL)	59.10-105.90	86.10 (10.10)
MCH (pg)	16.30-33.50	28.50 (3.50)
MCHC (g/dL)	27.00-36.50	32.50 (1.60)
WBC ($\times 10^9/L$)	3.11-37.10	9.48 (6.19)
Platelets ($\times 10^9/L$)	19.00-602.00	195.00 (157.00)

***Note:** IQR, interquartile range; HGB, hemoglobin; RBC, red blood cell; HCT, hematocrit; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; WBC, white blood cell.

4.2 Association of types of anemia with diagnosis

Based on Table 4.3, normocytic normochromic anemia was the most common type of anemia in chronic illness, followed by infection and chronic disease with CKD. However, no significant association was observed between the comorbidities and the types of anemia. On the other hand, very few patients had macrocytic anemia, making it the least common type of anemia in geriatric patients. In the case of chronic lung disease, stroke, and autoimmune hemolytic anemia, there were very few patients, and hence, finding any significance with these few patients was difficult. Chronic illness with CKD was very close to showing significance (p-value, 0.096).

Table 4.3 Association of types of anemia with the comorbidities

Comorbidities	Types of anemia			X ²	P-Value
	Microcytic	Normocytic	Macrocytic		
Chronic illness	9	30	1	0.155	0.925
Chronic illness with CKD	1	14	1	4.690	0.096
Chronic lung disease	1	2	0	0.197	0.906
Gallbladder stones	1	0	0	3.199	0.202
Gastrointestinal bleeding	1	2	0	0.197	0.906
Infection	7	16	0	1.192	0.551
Malignancy	4	7	0	1.214	0.545
Autoimmune hemolytic anemia	1	2	0	0.197	0.906
Stroke	0	1	0	0.355	0.837

***Note:** CKD stands for chronic kidney disease, a two-sided value of $p < 0.05$ was considered statistically significant.

4.3 Association of severity of anemia and diagnosis

The association of the severity level with the diagnosis was then assessed from the medical record. There was a significant association observed between the severity of anemia and chronic illness ($p < 0.001$). Mild anemia was the most common type of anemia for patients with chronic illness, followed by moderate and severe. Moreover, a significant association was observed between types of anemia and gastrointestinal bleeding ($p=0.050$). A significant association was seen between severity of anemia and malignancy ($p=0.041$). However, there were very few patients with gastrointestinal bleeding and malignancy. There was a difference in the number of patients with mild, moderate, and severe anemia having infection, but no association was observed (Table 4.4).

Table 4.4 Association of severity of anemia with the diagnosis

Variable	Severity of anemia			X ²	P-Value
	Mild	Moderate	Severe		
Chronic illness	23	14	3	17.034	< .001
Chronic illness with CKD	2	9	5	5.069	0.079
Chronic lung disease	2	1	0	1.651	0.438
Gallbladder stones	0	1	0	1.051	0.591
Gastrointestinal bleeding	1	0	2	6.004	0.050
Infection	5	14	4	2.182	0.336
Malignancy	0	8	3	6.390	0.041
Autoimmune hemolytic anemia	0	3	0	3.219	0.200
Stroke	1	0	0	1.961	0.375

***Note:** CKD stands for chronic kidney disease; a two-sided value of $p < 0.05$ was considered to be statistically significant, that are written in bold font.

CHAPTER 5: DISCUSSION

Anemia is a vital global public health issue affecting about one-quarter of the world's population (Kassebaum, 2016). Information from earlier epidemiological studies shows that several factors influence anemia status in the geriatric population. Thus, we aimed to address anemia's prevalence, types, and severity in elderly patients admitted to Hospital Pakar USM and thoroughly investigate its association with subjects' background characteristics.

Anemia in geriatric patients is a significant clinical concern, as it is associated with increased morbidity, functional decline, and mortality. Anaemia in older persons has a complex etiology that frequently combines bone marrow failure, dietary deficits, and chronic illness. Chronic inflammatory diseases like diabetes, cardiovascular disease, and rheumatoid arthritis are commonly associated with anemia of chronic disease (ACD), which is especially common in the elderly. These disorders result in normocytic, hyperproliferative anemia because inflammation affects erythropoiesis and iron metabolism (Mann et al., 2014). Furthermore, gastrointestinal blood loss, malnourishment, or insufficient absorption are the leading causes of iron deficiency anemia in the elderly.

The overall percentage of anemia among our geriatric patients was 74.1%. Another study from northern India found that the older population had a prevalence of 68.8%, which is close to our study results (Singh et al., 2020). According to a study conducted in North India, the average age of anemia patients was 68.1 ± 7.8 years, the male-to-female ratio was 1.6:1, and the mean hemoglobin level was 8.8 ± 2.3 g/dL (Kumari et al., 2019). According to another study done in a hospital in India, out of 60 participants, 40% were 65–69 years old, 38.33% were 70–74 years old, 15% were 75–79 years old, and 6.66% were 80 years of age or older (Mann et al., 2014). In comparison, our study population revealed a similar result where most

patients aged 65-69 were anemic (31%). However, some studies had contrasting results where the age group >80 years had the most anemic patients compared to other groups (Kumari et al., 2019). The prevalence of anemia increases with increasing age, however, in our study, there were few patients in the age groups above 80 years. Another study in Russia have shown the frequency of anaemia was 23.9% in geriatric population. According to their research in Russia, the chance of detecting anaemia rises by 4% for every year that an individual's age increases. Males were more likely than females to have anaemia (28.1% versus 22.1%; $p < 0.001$) and anaemia was often mild in most elderly (Khovasova *et al.*, 2022).

A study by Debnath et al. analyzed 238 participants, of which 52.1% were male, and the mean (SD) age was 68.9 years (Debnath et al., 2022). In our study, male patients were more anemic than females. In a study on the Iranian population, the prevalence of anemia was significantly higher in women than in men in every age group (17.08% versus 4.87%, p -value < 0.0001). However, the lines converge in older ages as the prevalence rises in males and falls in females after middle age. The prevalence of anemia in women was more in the 45–49 age group, while the youngest subjects in the 20–24 age group showed similarly low rates (23.39% versus 12.88%, p -value < 0.0001). Conversely, as men aged, the prevalence of anemia experienced a consistent upward trend (Akbarpour et al., 2022). The prevalence of anemia among men increased steadily as they aged. However, anemia was more common in women, especially in the 35–49 age range, and then started to decline. These differences could be explained by aging, inflammation, menopause, chronic illnesses, and decreased testosterone production. Hence, men can be more prone to anemia than women with advancing age (Akbarpour et al., 2022). In our study, the number of Malay patients was

higher than that of other races, as the target population is mainly from Kelantan, which has a high percentage of the Malay population.

Our study's most common type of anemia was normocytic anemia, accounting for 74% of all the cases. Therefore, it indicates that most cases are related to anemia of chronic illness. An MCV blood test measures the average size of the red blood cells. An $MCV < 80$ fL can cause some forms of anemia, such as the most prevalent kind, iron deficiency anemia. It occurs when your body does not contain enough iron. A class of hereditary blood illnesses, thalassemia, is handed down via families. Due to these conditions, the body produces less hemoglobin and fewer healthy red blood cells. Severe anemia may result from this. On the other hand, when ($MCV > 100$), this can indicate pernicious anemia, a deficiency in vitamin B12. Moreover, Crohn's disease, coeliac disease, or several inflammatory disorders that impair your body's capacity to use vitamin B12 can also be seen, including liver disease. Additionally, anemia with a normal MCV can be a sign of chronic illness, kidney failure, or unexpected blood loss (MedlinePlus, 2022).

According to a study by Tettamanti et al., the majority of anemia was normocytic (72.3%), and 16.9% of anemic subjects had microcytosis (MCV less than 80 fL), compared to 1.5% of non-anemic subjects (Tettamanti et al., 2010). The most prevalent anemia types were normocytic normochromic forms, followed by macrocytic and microcytic hypochromic forms based on a different study (Soraci et al., 2024). The majority of people with microcytic and normocytic anemia are elderly. There is considerable overlap between the signs and symptoms of these disorders, even though microcytic anemia is traditionally linked to iron deficiency and normocytic anemia to chronic illness or unidentified causes. Thus, when assessing these patients, the first step is to measure their serum ferritin level. However, serum

ferritin levels were not included in our study. Iron deficiency anemia is strongly suggested by a serum ferritin level of less than 19 ng/mL (43 pmol/L). However, it is less likely to occur in patients with serum ferritin levels of 46 to 100 ng/mL (103 to 225 pmol/L), though it cannot be ruled out. The serum transferrin receptor-ferritin index can be utilized to differentiate iron deficiency anemia from other forms in these patients. Iron deficiency anemia is diagnosed when the index is greater than 1.5. The most likely cause of microcytic or normocytic anemia, if iron deficiency anemia is ruled out, is anemia of chronic disease. Serum creatinine and glomerular filtration rate are indicators of chronic kidney disease (CKD), the most common cause of anemia in older patients (Lanier et al., 2018). If both microcytosis and normocytic anemia are ruled out, this might indicate macrocytosis due to bone marrow issues or nutritional deficiencies like vitamin B12 or folate deficiency. Our study found that the lowest MCV was 59.10fL, the highest MCV was 105.90fL, and the median was 86.10fL. This was similar to a study by Sangita Pawar et al., where the MCV range was (53.2-124.6) fL, and the mean was 83.8 fL (Sangita Pawar et al., 2020). The average size of the red blood cells is measured by an MCV blood test.

In this study, most patients had moderate anemia (49%) compared to mild and severe anemia. Similar findings were noted by Sangita Pawar et al., where the majority of the study participants had moderate-grade anemia (47.6%), which was followed by mild-grade anemia (38.8%) and severe-grade anemia (13.6%). At the time of the investigation, the majority of males (46.2%) and females (49.3%) had moderate-grade anemia (Sangita Pawar et al., 2020). However, there were contrasting results in other studies where mild anemia was more common in the geriatric population (Melku et al., 2018). In our study, patients' data were

taken from the hematology ward where most patient had chronic illness, therefore, many of the cases were moderate anemia.

The most common comorbidity was found to be chronic illness, followed by infection and chronic illness with chronic kidney disease (CKD). The chronic illnesses among patients included diabetes mellitus, hypertension, chronic obstructive pulmonary disease (COPD), and cardiovascular disease. From which diabetes mellitus and hypertension were most common. Previous studies found that anemia was more common in people with diabetes or chronic kidney disease (CKD) than in people without these diseases (Ni et al., 2022). From our study, anemia of chronic illness was the most common among the elderly because when the chronic disease lasts longer than three months in the body, it can cause inflammation. Thus, the body's capacity to use iron, which is necessary to produce enough red blood cells, can be impacted by chronic inflammation and cause anemia. Moreover, numerous age-related factors may contribute to reduced red blood cell production or shortened red blood cell survival, raising the prevalence of anemia in this age group. According to Debnath et al., anemia of chronic diseases was highly prevalent as 70% of study participants had chronic illnesses (Debnath et al., 2022).

The current study found no significant association between types of anemia and comorbidities. However, patients with chronic illness mostly had normocytic anemia compared to microcytic and macrocytic anemia. It is the same for patients with chronic illness and CKD and also infection. These conditions are crucial indicators of anemia, even though no significant association was found. On the other hand, there was a significant association found between the severity of anemia and chronic illness, gastrointestinal bleeding, and malignancy. In cases with chronic illness, mild anemia was more common in patients,