Clinical characteristics, severity and symptom burden of anaemia among patients with cancer receiving treatment

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Abstract. Anaemia is a common complication among patients with cancer that contributes to impaired physical functioning, increased symptom burden and a reduced quality of life. The present study examined the mechanisms through which clinical characteristics and symptom burden affect the severity of anaemia in adults undergoing active cancer treatment. The present descriptive-analytical cross-sectional study evaluated the severity of anaemia and its association with clinical characteristics and symptom burden in 254 adult patients with cancer receiving treatment. Data were obtained via face-to-face interviews, chart reviews and physical examinations, and symptom burden was measured using the Edmonton Symptom Assessment System. Data were analysed using descriptive and inferential statistics, including the Chi-square and Fisher's tests. The mean age of the study participants was 51.19±10.79 years, and 57.09% of these participants were female. The majority of the patients (87.4%) had moderate anaemia, with a mean haemoglobin concentration of 9.14±1.02 g/dl. Laboratory findings demonstrated a pattern suggestive of anaemia of inflammation, with low serum iron and increased ferritin and C-reactive protein levels. Moderate symptom burden was reported, particularly tiredness, drowsiness, anxiety, depression and poor overall well-being. The severity of anaemia was significantly associated with the type of cancer (P=0.007). There was no statistically significant association between categorical anaemia severity and overall symptom-burden categories (P=0.150); however, the mean haemoglobin levels differed significantly across symptom-burden categories (P=0.003), with lower haemoglobin levels observed among patients with a greater symptom burden. On the whole, these findings highlight the importance of assessing anaemia severity and symptom burden among patients with cancer with anaemia receiving treatment.

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Abbreviations: ESAS, Edmonton Symptom Assessment System; ; CRP, C-reactive protein; RBC, red blood cell

Key words: severity of anaemia, patients with cancer, symptom burden, cancer treatment, haemoglobin, supportive care

Introduction

The global health burden of cancer continues to increase, with almost 20 million new cases and almost 10 million related deaths reported globally in 2022. The annual number of new cancer cases is expected to reach 35 million by 2050. Within this increasing burden, anaemia remains a significant clinical concern, and the World Health Organisation (WHO) still recommends a haemoglobin-based approach to its detection (1,2). Cancer-related anaemia is a frequent complication of malignancy and is linked to fatigue, the loss of functional status, decreased quality of life and an adverse prognosis. The causes are multifactorial and include chronic inflammation, bone marrow toxicity, iron and other nutritional deficiencies, blood loss, diminished erythropoietin response, and tumour cell infiltration of the marrow (3-5). The development of cancer-related anaemia depends on the type of tumour, stage of cancer, treatment received and the specific clinical context. However, research from nearby Middle Eastern countries demonstrates that cancer-related anaemia is particularly common among oncology patients (6-8). There is still limited published evidence from cancer centres in Iraq regarding the burden of anaemia, and the existing studies focus more on patterns of cancer registrations or on single-centre, disease-specific haematological toxicities instead of the burden of anaemia in the adult oncology population (9,10). Therefore, the present study was undertaken to assess the clinical characteristics, severity and symptom burden of anaemia among adult patients with cancer with anaemia receiving treatment at Hiwa Hospital in Sulaymaniyah, Iraq, and to examine the association of anaemia severity with selected clinical characteristics and symptom burden.

Patients and methods

Study design and setting. A descriptive-analytical cross-sectional study was conducted at Hiwa Hospital in Sulaymaniyah City, the Kurdistan Region of Iraq, to assess

the clinical characteristics, severity and symptom burden of anaemia among adult patients with cancer receiving treatment. Hiwa Hospital is the largest public oncology and haematology referral centre in Iraq, receiving patients from all parts of the country. It provides full-spectrum cancer services, combining inpatient and outpatient oncology, chemotherapy and radiotherapy, laboratory and diagnostic imaging, and supportive care. Considering the status of the hospital as a central referral facility with routinely recorded data on the anaemia-related hospital visits of patients with cancer, the institution was identified as the most suitable venue for the study.

Study population, sample and sampling technique. The intended demographic consisted of adult patients with both cancer and anaemia who were undergoing treatment at Hiwa Hospital between December 10, 2025 and March 10, 2026. The required sample size was calculated using the Sample Size Calculator found on Calculator.net. This calculator computes the minimum sample size based on the parameters selected, including confidence level, margin of error, population proportion and total population. As the expected population proportion was unknown, a value of 50% was used, as suggested, to obtain the maximum sample size estimate. A finite population correction was applied to the population size specification. With these assumptions, the minimum sample size for the study was 254 participants (https://www.calculator.net/sample-size-calculator.html). Non-probability purposive sampling was used as the study focused on a particular clinical subset of adults.

Inclusion and exclusion criteria. Eligible patients for the study had to be diagnosed with cancer, aged ≥18 years, and being treated with chemotherapy, radiotherapy, or both. They also had to participate in the study and have clinical and laboratory data in their records to be considered anaemic based on haemoglobin levels. Newly diagnosed cases in 2026 were excluded unless there were sufficient data, as the majority had just commenced their treatment and had received a minimal amount of chemotherapy. Patients were also excluded from participation in the study for having non-malignant haematological conditions that caused anaemia, cognitive or psychiatric disorders that were communicative, and also for receiving palliative care, or for not consenting to participate, or for having data that was not relevant to the study.

Data collection tool and study measurements. Using feedback from pertinent literature (3,11) and experts, a structured, interviewer-administered questionnaire was developed for the present study. The questionnaire consisted of three main sections: i) Socio-demographic characteristics: Age, sex, marital status, educational level, employment status and residence; ii) clinical and cancer-related history: Cancer type/site, stage of disease, duration of diagnosis, and current oncological treatment regimen (e.g., chemotherapy, radiotherapy, targeted therapy); iii) anaemia-related symptoms and assessment: Presence and severity of fatigue, dizziness, shortness of breath, weakness and history of blood transfusion or iron supplementation. Apart from the interviews, data were also collected from the medical records and laboratory reports of the patients covering the period from December 10, 2025, to March 10, 2026. The questionnaires received were on sociodemographic and clinical data, data on the clinical and laboratory indicators of the various levels of anaemia, and data on the symptom burden, which was measured through a physical examination. The haemoglobin concentration was used to classify the severity of anaemia according to the WHO criteria (2). Anaemia was classified according to sex-specific haemoglobin concentrations. In males, mild anaemia was defined as 11.0-12.9 g/dl, moderate anaemia as 8.0-10.9 g/dl and severe anaemia as <8.0 g/dl. In females, mild anaemia was defined as 11.0-11.9 g/dl, moderate anaemia as 8.0-10.9 g/dl and severe anaemia as <8.0 g/dl (2). Therefore, the individual symptom severity category and the overall percentage-based symptom category represent different measures. The Edmonton Symptom Assessment System (ESAS) was used to assess nine symptoms, each scored from 0 to 10 (11). Individual symptom scores were categorised as none (score, 0), mild (score, 1-3), moderate (score, 4-6) and severe (score, 7-10). In addition, the total score for each symptom across the 254 participants was calculated as a percentage of the maximum possible score (254x10) and categorised as no/minimal (0-24%), mild (25-49%), moderate (50-74%), or severe (75-100%) (Data S1).

Data collection procedure. Data were collected from eligible participants during individual face-to-face interviews in a designated private space in the hospital. Each patient was provided with a study information sheet containing the objectives of the study, the procedures and approximate time commitment prior to study participation. Consent to participate was obtained in writing. The data collection questionnaire was read to the participants, and responses were documented by the researcher. The average time allocated for the interview was between 10 and 15 min. Sociodemographic information and symptoms were self-reported by the participants. Clinical and laboratory data were acquired by the researcher through a records and laboratory reports review.

Validity, pilot study and reliability. To ensure the face and content validity of the questionnaire, it was sent to a panel of 15 specialists, including experts in oncology, nursing, research methodology, and biostatistics. Experts commented on relevance, clarity, coverage and fit to study objectives for appropriate adjustments to be made. The comments were used to rephrase the questionnaire and improve its validity and precision. A pilot study was performed with 10 patients with cancer who were included in the criteria, but were excluded from the primary sampling study. This pilot study tested the clarity and feasibility of the questions, the interview time, and potential data-collection issues. A small number of adjustments were made based on the pilot results. Instrument reliability was measured with a Cronbach's alpha score of 0.849, representing strong internal consistency, which is an effective reliability score.

Ethical considerations. Ethical approval was granted by the Research and Ethics Committee of the College of Nursing, University of Sulaimani, with approval no. 2/1 dated November 17, 2025. Prior to commencing data collection, additional permission was requested from the administration of Hiwa

Hospital. Participation was voluntary, and written informed consent was obtained from all participants. Their confidentiality was protected through the use of identification numbers. Participants were informed of their rights to withdraw from the study at any time without any repercussions for their care or treatment. All procedures were carried out in compliance with the Declaration of Helsinki.

Statistical analysis. Data coding, entry and statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 27 (IBM Corp.). Descriptive statistics included frequencies, percentages, means, standard deviations (SDs), minimums and maximums. The normality of continuous variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests prior to statistical analysis. The assessed continuous variables were normally distributed (P>0.05) and were therefore presented as the mean ± SD. For inferential analysis, Pearson's Chi-square test was used to assess the associations between the severity of anaemia and categorical clinical and symptom-related variables when the expected cell frequencies met the assumptions of the test. Fisher's exact test was used when expected cell frequencies were very low, where applicable. Mean haemoglobin levels across symptom burden categories were compared using one-way analysis of variance (ANOVA) followed by Tukey's post-hoc test. A P-value of ≤0.05 was considered to indicate a statistically significant difference. As the anaemia severity outcome was highly unbalanced, with only 2 patients classified as having mild anaemia compared with 222 patients with moderate anaemia and 30 patients with severe anaemia, multivariable modelling of the three-category severity outcome was considered likely to produce unstable estimates and limited interpretability. Therefore, categorical analyses were retained as the primary analytical approach.

Results

Socio-demographic characteristics of the patients. As demonstrated in Table I, the socio-demographic profile of the 254 patients involved in the study provides numerous patterns. Females comprised a larger percentage of the sample than males (57.09 vs. 42.91%). The majority of the participants were aged 55-66 years (46.06%), followed by 43-54 years (35.83%), with an average age of 51.19±10.79 years, indicating a predominantly middle-to-late-adult cohort. The majority were married (89.76%), while being single, divorced, or widowed was less common. As regards education, many were illiterate (22.44%), some graduated from elementary school (40.55%), and some had graduated from college or higher (13.78%), with no one having graduated from postgraduate school. As regards occupation, almost half were homemakers (48.82%), followed by manual labourers (27.56%) and employees (17.32%). Regarding the place of residence, the majority resided in suburban communities (53.54%), urban communities (41.34%), and, lastly, rural areas (5.12%). With respect to monthly income, the vast majority reported that their income was barely adequate (64.57%), while only 13.39% reported having an adequate monthly income. Finally, a large percentage of the participants had a normal body mass index (42.13%); yet 32.28% were overweight and 19.69% were obese, indicating an average body mass index of 25.58±5.39, suggesting that this sample has moderate risks of developing health-related issues due to body weight.

Table I. Socio-demographic characteristics of the patients.

Socio-demographic characteristics	Frequency	%
Sex		
Male	109	42.91
Female	145	57.09
Age (years)		
19-30	11	4.33
31-42	35	13.78
43-54	91	35.83
55-66	117	46.06
Mean ± SD	51.19±10.79	
Marital status		
Single	21	8.27
Married	228	89.76
Divorced	1	0.39
Widowed	4	1.57
Education level		
Illiterate	57	22.44
Able to read and write	3	1.18
Primary school graduated	103	40.55
Intermediate school	33	12.99
Secondary/high school	23	9.06
Graduate (institute/university)	35	13.78
Postgraduate	0	0.0
Occupation		
Employee	44	17.32
Manual work (worker)	70	27.56
Student	3	1.18
Housewife	124	48.82
Retired	13	5.12
Residency		
Urban	105	41.34
Suburban	136	53.54
Rural	13	5.12
Monthly income		
Sufficient	34	13.39
Barely sufficient	164	64.57
Insufficient	56	22.05
BMI		
Underweight	15	5.91
Normal	107	42.13
Overweight	82	32.28
Obese	50	19.69
Total	254	254

The table presents descriptive statistics only: Frequencies, percentages, mean and standard deviation. BMI, body mass index.

Table II. Laboratory test results of the patients.

Items	Mean	SD	Min	Max
RBCs	3.2141	0.61564	1.40	5.58
WBCs	5.6618	4.90075	0.10	54.20
Haemoglobin (HB)	9.1394	1.01621	3.80	11.80
Haematocrit (HCT)	27.4587	3.60140	9.80	38.30
Mean corpuscular volume (MCV)	85.4051	10.34285	43.90	106.20
Mean corpuscular haemoglobin (MCH)	28.6579	3.84863	13.40	36.50
Red cell distribution width (RDW)	15.2146	2.24698	10.40	23.40
Platelet	205.6850	152.23475	6.00	1421.00
Ferritin (ng/ml)	311.7650	102.76004	2.70	826.90
Iron (μg/dl)	33.1493	13.27630	8.91	91.68
C-reactive protein (CRP; mg/l)	61.2540	30.333	2.07	243.90

The table presents descriptive statistics only: Mean, standard deviation, minimum and maximum.

Table III. Symptom burden of the patients.

	None (0)	Mild (1-3)	Moderate (4-6)	Severe (7-10)	Total	Total	
Symptom burden	Fr (%)	Fr (%)	Fr (%)	Fr (%)	score	score %	Results
Pain	4 (1.57)	78 (30.71)	125 (49.21)	47 (18.50)	1,148	45.20	Moderate
Tiredness	1 (0.39)	30 (11.81)	160 (62.99)	63 (24.80)	1,336	52.60	Moderate
Drowsiness	1 (0.39)	46 (18.11)	142 (55.91)	65 (25.59)	1,323	52.09	Moderate
Nausea	6 (2.36)	112 (44.09)	116 (45.67)	20 (7.87)	934	36.77	Mild
Lack of appetite	3 (1.18)	108 (42.52)	111 (43.70)	32 (12.60)	1,023	40.28	Mild
Shortness of breath	15(5.91)	178 (70.08)	46 (18.11)	15 (5.91)	652	25.67	Mild
Depression	0 (0.00)	1 (0.39)	57 (22.44)	196 (77.17)	1,785	70.28	Moderate
Anxiety	0 (0.00)	0 (0.00)	53 (20.87)	201 (79.13)	1,832	72.13	Moderate
Well-being (overall)	1 (0.39)	35 (13.78)	131 (51.57)	87 (34.25)	1,446	56.93	Moderate

The table presents descriptive statistics only: Frequencies, percentages, total score, and total score percentage for ESAS symptoms. ESAS, Edmonton Symptom Assessment System.

Laboratory test results of the patients. The findings presented in Table II demonstrated that the mean red blood cell (RBC) count was 3.21±0.62x$10^6/\mu$l (range, 1.40-5.58), consistent with anaemia in numerous patients. The mean haemoglobin level was 9.14 g/dl (range, 3.8-11.8 g/dl), and the mean haematocrit was 27.46% (±3.6%), indicating that patients in this group were, for the most part, anaemic. The mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) were within moderate ranges (85.41±10.34 fl and 28.66±3.85 pg, respectively), while the red cell distribution width (RDW) was elevated (15.21±2.25%), suggesting variability in red cell size. The mean platelet count was 205.69±152.23x$10^3/\mu$l, with a wide range of 6 to 1,421x$10^3/\mu$l, indicating that some patients had thrombocytopenia or reactive thrombocytosis. The average serum iron level was low (33.15±13.28 μg/dl). By contrast, the mean ferritin level (311.77±102.76 ng/ml) suggested that iron was being sequestered due to inflammation or that iron-restricted erythropoiesis was occurring. The mean C-reactive protein (CRP) level (61.25±30.33 mg/l; range, 2.07-243.90 mg/l) indicates an ongoing inflammatory or disease process in the majority of patients in this group.

Symptom burden of the patients. The symptom burden of the 254 surveyed patients across various domains is presented in Table III. Almost half of the patients reported moderate pain (49.21%), while 18.50% of patients classified their pain as severe. The measured pain score across the respondents was 1,148 (45.20%), indicating a moderate symptom burden. Other symptoms resulted in similar levels of burden; for example, 62.99% of the respondents reported being moderately fatigued or tired, and 24.80% reported being severely fatigued or tired, yielding an overall score of 1,336 (52.60%), indicating a moderate burden from fatigue or tiredness. In addition, 55.91% reported moderate drowsiness, while 25.59% reported severe drowsiness. The total drowsiness score among respondents was 1,323 (52.09), indicating a moderate impact.

Table IV. Association between the severity of anaemia and the clinical characteristics of the patients with cancer.

	Mild	Moderate	Severe	
Clinical characteristics	Fr (%)	Fr (%)	Fr (%)	P-value
Type of cancer				
Breast	1 (50.0)	50 (22.5)	7 (23.3)	0.007
Gastrointestinal	0 (0.0)	53 (23.9)	2 (6.7)	
Respiratory	0 (0.0)	14 (6.3)	0 (0.0)	
Genitourinary	1 (50.0)	5 (2.3)	1 (3.3)	
Haematological	0 (0.0)	55 (24.8)	11 (36.7)	
Gynaecological	0 (0.0)	15 (6.8)	2 (6.7)	
Other	0 (0.0)	30 (13.5)	7 (23.3)	
Time since cancer diagnosis (years)				
1-2	0 (0.0)	139 (62.6)	17 (56.7)	0.158
3-4	0 (0.0)	24 (10.8)	2 (6.7)	
>4	2 (100.0)	59 (26.6)	11 (36.7)	
Stage at diagnosis				
Not detected	0 (0.0)	39 (17.6)	5 (16.7)	0.345
Stage I	0 (0.0)	1 (0.5)	1 (3.3)	
Stage II	1 (50.0)	50 (22.5)	4 (13.3)	
Stage III	0 (0.0)	101 (45.5)	13 (43.3)	
Stage IV	1 (50.0)	31 (14.0)	7 (23.3)	
Current treatment				
Chemotherapy	0 (0.0)	78 (35.1)	11 (36.7)	0.573
Combination	2 (100.0)	144 (64.9)	19 (63.3)	
Total	2 (100)	222 (100)	30 (100)	

Data were analysed using the Chi-squared test or Fisher's test.

Although 45.67% and 43.70% of the respondents, respectively, reported mild nausea and a lack of appetite, the total scores were still relatively low, at 934 (36.77%) and 1,023 (40.28%), respectively. There was also a low frequency of shortness of breath, with 70.08% reporting it mildly, for a total score of 652 (25.67%). Psychological symptoms were very numerous; depression was reported as severe by 77.17% of patients and accounted for a total score of 1,785 (70.28%), while anxiety was reported as severe by 79.13% of patients and contributed to a total score of 1,832 (72.13%). Overall well-being was rated moderate by 51.57% of patients, while 34.25% rated it severe, with a total score of 1446 (56.93%).

Association between the severity of anaemia and clinical characteristics of the patients with cancer. The association between the anaemia status (mild, moderate, severe) and clinical characteristics of the patients, including cancer type, time since cancer diagnosis, stage at diagnosis and current treatment is reported in Table IV. The majority of the patients had moderate anaemia, while mild and severe anaemia were less frequent, indicating that moderate anaemia was the predominant condition among these patients with cancer.

The severity of anaemia and cancer type were significantly associated, based on frequency distributions (Fr%; P-value=0.007; <0.05), indicating differences in the severity of anaemia across the cancer types. By comparison, there were no statistically significant differences in the severity of anaemia by time since cancer diagnosis (P-value=0.158; >0.05), the stage of cancer when diagnosed (P-value=0.345; >0.05), or current cancer treatment (P-value=0.573; >0.05), suggesting that these variables are not significantly associated with the severity of anaemia (Table IV).

Association between the severity of anaemia and the symptom burden of the patients. The association between anaemia status (mild, moderate, severe) and symptom burden, including pain, tiredness, drowsiness, nausea, lack of appetite, shortness of breath, depression, anxiety and overall well-being is presented in Table V. Moderate anaemia was the most frequent severity, while mild and severe anaemia were less common, indicating that moderate anaemia predominates across all symptom categories.

The P-values for frequency distribution (Fr%) revealed no statistically significant associations for the majority of symptoms, as follows: Pain (P-value=0.554; >0.05), tiredness (P-value=0.887; >0.05), drowsiness (P-value=0.27; >0.05), nausea (P-value=0.37; >0.05), lack of appetite (P-value=0.72; >0.05), shortness of breath (P-value=0.35; >0.05), depression (P-value=0.408; >0.05), anxiety (P-value=0.344; >0.05) and overall well-being (P-value=0.733; >0.05) (Table V). A statistically significant difference was observed in the

Table V. Association between the severity of anaemia and symptom burden of the patients.

	Mild	Moderate	Severe	
Symptom burden	Fr (%)	Fr (%)	Fr (%)	P-value
Pain				
None	0 (0.0)	4 (1.8)	0 (0.0)	0.554
Mild	1 (50.0)	67 (30.2)	10 (33.3)	
Moderate	0 (0.0)	113 (50.9)	12 (40.0)	
Severe	1 (50.0)	38 (17.1)	8 (26.7)	
Tiredness				
None	0 (0.0)	1 (0.5)	0 (0.0)	0.887
Mild	0 (0.0)	27 (12.2)	3 (10.0)	
Moderate	1 (50.0)	142 (64.0)	17 (56.7)	
Severe	1 (50.0)	52 (23.4)	10 (33.3)	
Drowsiness				
None	0 (0.0)	1 (0.5)	0 (0.0)	0.27
Mild	0 (0.0)	43 (19.4)	3 (10.0)	
Moderate	2 (100.0)	126 (56.8)	14 (46.7)	
Severe	0 (0.0)	52 (23.4)	13 (43.3)	
Nausea				
None	0 (0.0)	6 (2.7)	0 (0.0)	0.37
Mild	1 (50.0)	98 (44.1)	13 (43.3)	
Moderate	0 (0.0)	101 (45.5)	15 (50.0)	
Severe	1 (50.0)	17 (7.7)	2 (6.7)	
Lack of appetite				
None	0 (0.0)	3 (1.4)	0 (0.0)	0.72
Mild	0 (0.0)	97 (43.7)	11 (36.7)	
Moderate	2 (100.0)	94 (42.3)	15 (50.0)	
Severe	0 (0.0)	28 (12.6)	4 (13.3)	
Shortness of breath				
None	0 (0.0)	15 (6.8)	0 (0.0)	0.35
Mild	1 (50.0)	156 (70.3)	21 (70.0)	
Moderate	1 (50.0)	40 (18.0)	5 (16.7)	
Severe	0 (0.0)	11 (5.0)	4 (13.3)	
Depression				
Mild	0 (0.0)	1 (0.5)	0 (0.0)	0.408
Moderate	1 (50.0)	53 (23.9)	3 (10.0)	
Severe	1 (50.0)	168 (75.7)	27 (90.0)	
Anxiety				
Moderate	1 (50.0)	48 (21.6)	4 (13.3)	0.344
Severe	1 (50.0)	174 (78.4)	26 (86.7)	
Well-being (overall)				
None	0 (0.0)	1 (0.5)	0 (0.0)	0.733
Mild	0 (0.0)	33 (14.9)	2 (6.7)	
Moderate	1 (50.0)	116 (52.3)	14 (46.7)	
Severe	1 (50.0)	72 (32.4)	14 (46.7)	
Total	2 (100)	222 (100)	30 (100)	

Data were analysed using the Chi-squared test or Fisher's test.

mean haemoglobin levels across symptom burden categories (P-value=0.003) (Table VI), indicating a statistically significant association between lower haemoglobin concentrations and greater symptom severity.

Table VI. Association between the anaemia status and symptom burden of the patients.

	Mild	Moderate	Severe			
Symptom burden	Fr (%)	Fr (%)	Fr (%)	P-value	Mean ± SD	P-value
None	0 (0.0)	1 (0.5)	0 (0.0)	0.15	9.70 (n=1)	0.003
Mild	1 (50.0)	116 (52.3)	12 (40.0)		9.35±0.94	
Moderate	1 (50.0)	102 (45.9)	15 (50.0)		8.94±1.05	
Severe	0 (0.0)	3 (1.4)	3 (10.0)		8.38±0.97	
Total	2 (100)	222 (100)	30 (100)		9.14±1.02	

Data are expressed as frequency (percentage) or mean ± standard deviation. Categorical variables were analysed using Fisher's exact test or the Chi-squared test. Mean haemoglobin levels across symptom burden categories were compared using one-way analysis of variance (ANOVA) followed by Tukey's post-hoc test (P-value=0.003). Statistical significance was set at $P<0.05$.

Indicating a statistically significant difference. Patients with more severe symptom burden had lower haemoglobin levels compared to those with milder or no symptoms.

Discussion

Socio-demographic characteristics and clinical investigations. In the present study, the predominant age group of the patients with cancer was middle-aged and the older segments of the population, with the average age being 51.19±10.79 years, and a slightly larger proportion being females. This is generally similar to previous studies (4,7,12), which have noted that cancer-related anaemia is more prevalent in the middle and later ages of the adult population. However, the sex distribution is different depending on the predominant cancer types in the respective populations (6,7,12). The high percentage of patients with low educational achievements, housewives or manual workers, and with income barely sufficient to cover basic costs reflects socio-economic vulnerability and probably affects diet quality, health literacy and access to cancer support services. Such factors relate to the risk of developing anaemia, as socio-economic disadvantage impacts nutrition and the ongoing care and timely supportive interventions available to patients with cancer (13-17). The majority of the patients resided in suburban or urban locations, possibly indicating that they have simpler access to specialised oncology services, whereas patients residing in rural areas appear to experience some barriers in terms of referral and treatment access (18-20). Furthermore, a considerable number of the participants were overweight or obese, which is critical for the consideration of inflammation-related disturbances of iron metabolism, even if many participants had a normal BMI (19,20). Anaemia in the present study was significant and likely multifactorial according to the laboratory results. Anaemia was confirmed by a low average RBC count, haemoglobin and haematocrit, while near-normal MCV and MCH pointed to a normocytic, normochromic pattern that is cancer-related. With low serum iron, high ferritin and high CRP levels, the case is made for functional iron deficiency due to inflammation-related iron sequestration and not isolated absolute iron deficiency. The increased RDW and changes in count for both the platelet and white blood cell count combine to suggest several factors at work, among them chronic inflammation, nutritional disturbances, marrow suppression, impaired erythropoiesis and the effects of treatments (3,21-22).

Symptom burden. The findings revealed that the symptom burden was primarily on tiredness and drowsiness, along with noted pain and overall poor well-being, whereas the milder symptoms were related to nausea, loss of appetite, or shortness of breath. This is comparable to the ESAS-based oncology literature (23), where fatigue and pain were the most well-documented and physically burdensome symptoms, while the presence of nausea and dyspnoea remained less noteworthy. Most notably, the prominence of tiredness and poor well-being is of particular concern in the context of cancer-related anaemia, as fatigue is closely associated with anaemia, along with advanced disease and the presence of a comorbidity during the course of cancer treatment. Moreover, the exceptionally high levels of anxiety and depression suggest that the symptom burden in this cohort was multiform, physically as well as psychologically, highlighting the need for integrated supportive care in anaemic patients with cancer (23-26).

Association between the severity of anaemia and clinical characteristics of the patients. In the present study, the only clinical feature linked to the degree of anaemia was cancer type, while the absence of significant associations for time since diagnosis, stage at diagnosis and current treatment suggests that the type of tumour was more important than the other clinical features in explaining the variance of anaemia within this cohort. This assessment is consistent with previous studies noting tumour type and disease status as key variables that determine the degree of anaemia associated with cancer (8-27). Reviews of the European Cancer Anaemia Survey have documented substantial differences in the levels of anaemia that accompany different types of cancer, with more advanced disease carrying a greater anaemia burden and variances related to treatment. Moreover, haematological malignancies are particularly associated with severe anaemia as a result of direct marrow involvement, impaired erythropoiesis and inflammatory mechanisms, compounded by the cumulative effects of therapy (27-29). The dataset of the present study indicates that the majority of cases of anaemia occur in patients with haematological malignancies, as well as in some cases with breast and other solid tumours,

which makes clinical sense. Since blood cancers cause the bone marrow to stop producing blood cells, this often leads to anaemia. Additionally, solid tumours can cause anaemia through chronic inflammation and blood loss, poor nutrition, treatment-induced bone marrow suppression, or some combination of these factors. Similar research performed in Saudi Arabia demonstrated that the burden of anaemia varied with cancer types during active treatment and was particularly high in the genitourinary and gastrointestinal cancers (6,7). Thus, the findings from the present study demonstrate that the type of cancer was the primary clinical factor related to the severity of anaemia in the population examined herein (7,28,30).

Association between the severity of anaemia and symptom burden of the patients. The present study did not reveal any statistically significant association between categorical anaemia severity and overall symptom-burden categories (P=0.150). However, when the haemoglobin concentration was analysed as a continuous variable, mean haemoglobin levels differed significantly across symptom-burden categories (P=0.003), with lower haemoglobin levels observed among patients with a greater symptom burden. This finding suggests that the association between anaemia and symptom burden may be more evident when the haemoglobin concentration is considered as a continuous measure rather than grouped into severity categories. The predominance of moderate anaemia across the symptom categories may partly reflect the highly unbalanced distribution of the severity of anaemia in the present study, particularly the very limited number of patients with mild anaemia (n=2). These findings are partly consistent with those of previous studies using the ESAS, which have reported associations between anaemia, fatigue, dyspnoea, pain, appetite loss and other aspects of quality of life (32-34). Kink *et al* (32) and Barca-Hernando *et al* (33) also reported that lower haemoglobin levels were associated with a poorer quality of life, greater fatigue and depression among patients with solid tumours. The pathophysiological mechanisms underlying these associations may be related to reduced oxygen-carrying capacity and impaired tissue oxygen delivery, which can contribute to fatigue and reduced functional capacity in patients with cancer-related anaemia (32-34).

In conclusion, the present study assessed the severity and symptom burden of anaemia among adult patients with cancer receiving treatment at Hiwa Hospital. The majority of patients had moderate anaemia, with laboratory findings suggesting an inflammatory component. Anaemia severity was significantly associated with cancer type (P=0.007). Although categorical anaemia severity was not significantly associated with symptom burden (P=0.150), lower haemoglobin levels were associated with a greater symptom burden (P=0.003). These findings highlight the importance of regular haemoglobin monitoring and supportive care. The cross-sectional and single-centre design of the present study limits causal inference and generalisability. Further studies are warranted to confirm these findings.

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Availability of data and materials

The worksheets employed and/or assessed throughout the present study are not available publicly due to patient confidentiality. These worksheets can be provided by the corresponding author upon reasonable request. The data generated in the present study may also be requested from the corresponding author.

Authors' contributions

HEA was involved in the study design, data collection and analysis, and the initial writing of the manuscript. DJQ was involved in the supervision of the study, in the study design, and provided critical revision to the manuscript. HEA and DJs confirm the authenticity of all the raw data. Both authors have read and approved the final version of the manuscript

Ethics approval and consent to participate

Approval from the College of Nursing, University of Sulaimani's Research and Ethics Committee was secured (Reference no. 2/1, dated 17 Nov 2025). Hiwa Hospital, located in Sulaymaniyah City, Iraq, also granted permission to carry out the research. Voluntary participation was assured with written informed consent acquired from all participants before data collection commenced. Data collection and management were carried out with complete confidentiality and participant anonymity. All actions complied with the ethical codes of the institutional research committee and the Declaration of Helsinki.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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