Prevalence of anemia in primary care patients with Type 2 diabetes mellitus and chronic kidney disease in Oman

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Abstract:

BACKGROUND: Previous research has highlighted potential associations between anemia, diabetes, and worsening kidney disease. The aim of this study, therefore, was to determine the prevalence of anemia in patients with both chronic kidney disease (CKD) and Type 2 diabetes mellitus (T2DM) at a primary care center in Oman.

MATERIALS AND METHODS: A cross-sectional study was conducted at the Primary Care Clinic of Sultan Qaboos University Hospital, Muscat, Oman. All patients with established diagnoses of CKD and T2DM who attended appointments at the clinic in 2020 and 2021 were included. Data concerning the patients' sociodemographic characteristics, medical history, clinical findings, and laboratory results during past six months were retrieved from the hospital's information system. Patients were contacted via telephone for clarification in the event of any missing data. SPSS version 23 was used for Statistical analyses of the data. Frequencies and percentages were used to present categorical variables. Chi-squared tests were used to determine association between anemia and demographic and clinical variables.

RESULTS: A total of 300 patients with T2DM and CKD were included in the study; 52% were male, 54.3% were 51–65 years of age, and majority (88%) were either overweight or obese. The majority of patients (62.7%) had Stage 1 CKD followed by Stage 2 (34.3%) and Stage 3 (3%). The total prevalence of anemia was 29.3%, with 31.4%, 24.3%, and 44.4% of Stage 1, Stage 2, and Stage 3 CKD patients being anemic, respectively. The frequency of anemia was significantly higher in female than male patients (41.7% vs. 17.9%; $P < 0.001$). No associations were observed between anemia status and other sociodemographic or clinical characteristics.

CONCLUSION: The prevalence of anemia in CKD and T2DM primary care patients in Oman was 29.3%, with gender as the only factor significantly associated with anemia status. Routine screening of anemia in diabetic nephropathy patients is highly recommended.

Keywords:

Anemia, chronic kidney disease, Oman, prevalence, risk factors, Type 2 diabetes mellitus

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Introduction

Both anemia and chronic kidney disease (CKD) are global problems affecting all age groups with a significant impact on health as well as other social and economic consequences.[1,2] Alarmingly, the prevalence of CKD is increasing worldwide.

By 2017, it was estimated that over 8 million individuals worldwide were afflicted.[3] A diagnosis of CKD is established on estimated glomerular filtration rate (eGFR), with the disease categorized into five distinct stages according to the severity of kidney dysfunction.[3,4] Most patients with early stages of CKD are asymptomatic; however, even early-stage CKD is still associated with serious comorbidities and increased

cardiovascular impairment.[5] Therefore, to prevent mortality and avoid the need for dialysis and kidney transplantation, timely diagnosis and the prompt provision of quality care are crucial.[1,2]

Anemia is a common condition in which the concentration of hemoglobin (Hb) in the blood falls below the mean; in CKD, the main cause of anemia is inadequate production of erythropoietin as a result of functional or absolute iron deficiencies.[6] Previous research has shown that the prevalence of anemia increases with the progression of the disease, although it remains high from Stage 1 until the final stage of nondialysis CKD and end-stage renal disease (ESRD).[7] Factors associated with the development of anemia in CKD include low levels of serum albumin, high leukocyte count, increased body mass index (BMI), smoking, and diabetic nephropathy.[8-11] In addition, the prevalence of anemia itself increases in older people and those with concomitant diabetes, cardiovascular disease, and hypertension.[12]

Type 2 diabetes mellitus (T2DM) is one of the most predominant causes of both CKD and ESRD. It has also been suggested that it raises the risk of anemia even in the absence of renal impairment.[2,13-15] According to data from the International Diabetes Federation, 4 out of the 16 countries with the highest rates of adult diabetes in 2012 were located in the Gulf Cooperation Council region, including Kuwait (24.9%), Qatar (19.5%), Saudi Arabia (18.7%), and the United Arab Emirates (16.4%).[16] In addition, Oman and Bahrain represent 13.8% and 11.3%, respectively.[16] A recent systematic review and meta-analysis indicated that the pooled average of CKD in diabetic patients in Oman was 50.46% (95% confidence interval: 32.69%–68.23%).[17] However, research regarding the prevalence of anemia in patients with both CKD and T2DM in Oman is limited. This study, therefore, was to investigate the prevalence and associated risk factors of anemia in primary care patients in Oman with T2DM and CKD. The findings may be potentially useful to healthcare providers by enabling the development of targeted screening initiatives to identify patients at higher risk of anemia.

Materials and Methods

This cross-sectional study was conducted from October 2021 to January 2022 at the Primary Care Centre of the Sultan Qaboos University Hospital, a tertiary care hospital in Muscat, Oman. The records of all patients diagnosed with T2DM and CKD who had attended appointments at the clinic in 2020 and 2021 were reviewed and assessed for eligibility for inclusion in the study. Ethical Approval was obtained from the Institutional Review Board vide

Letter No. SQU-EC/451/2021 dated September 26, 2021, and written informed consent was taken from all participants in the study.

The inclusion criteria consisted of adult patients (>18 years of age) with established diagnoses of T2DM (regardless of control status and type of medication used) and CKD (Stages 1 to 5). Patients who were pregnant or had recently delivered in the preceding 3 months were excluded from the study, as were those with known psychiatric illnesses or with anemia secondary to another disorder.

Data concerning the patients' sociodemographic and medical history were retrieved from the hospital's information system, and patients were contacted via telephone for clarification in the event of any missing data. The results of clinical and laboratory tests performed in the preceding 6 months were retrieved from patients' medical records that included eGFR, albumin-to-creatinine ratio (ACR) (male <2.5, female <3.5 (mg/mmol), Hb level, mean corpuscular volume (78–96 fL), and mean corpuscular Hb (26–33 pg). Staging of CKD was based on the kidney disease improving global outcomes clinical practice guidelines, and anemia defined as Hb levels of <13.0 and <12.0 g/dL in men and women, respectively.[4]

The Statistical Package for the Social Sciences (SPSS), version 23 (IBM Corp., Armonk, New York, USA) was used for Statistical analyses of the data. Frequencies and percentages were used to present categorical variables. Chi-squared tests were used to determine significant predictive factors of anemia. $P < 0.05$ was considered statistically significant.

Results

A total of 300 patients records were included in the study, 156 (52%) belonged to male and 144 (48%) to female patients. More than half were aged 51–65 years old ($n = 163$; 54.3%). Most of the patients ($n = 264$, 88%) had a high BMI, where 115 (38.3%) were classified as overweight at 25–29.9 kg/m² and 149 (49.7%) as obese at ≥30 kg/m². Only 35 patients (11.7%) were of normal weight. More than two-thirds of patients had been diagnosed with T2DM for more than 5 years ($n = 208$; 69.3%). With regard to CDK progression, the most prevalent stage was Stage 1 ($n = 188$; 62.7%), followed by Stage 2 ($n = 103$; 34.3%) and Stage 3 ($n = 9$; 3%). None of the patients had Stage 4 or Stage 5 disease. Nearly two-thirds of patients had dyslipidemia ($n = 201$; 67%) and 140 (46.7%) were hypertensive. A total of 119 patients (39.7%) were taking angiotensin-converting enzyme inhibitors (ACEIs) [Table 1].

Table 1: Sociodemographic and clinical characteristics of primary care patients with chronic kidney disease and type 2 diabetes mellitus in Muscat, Oman (*n*=300)

Characteristic	*N* (%)
Gender	
Male	156 (52.0)
Female	144 (48.0)
Age (years)	
20–35	15 (5.0)
36–50	122 (40.7)
51–65	163 (54.3)
BMI (kg/m²)	
<18.5	1 (0.3)
18.5–24.9	35 (11.7)
25–29.9	115 (38.3)
≥30	149 (49.7)
Duration of T2DM (years)	
<3	47 (15.7)
3–5	45 (15.0)
5–10	117 (39.0)
>10	91 (30.3)
Stage of CKD	
Stage 1	188 (62.7)
Stage 2	103 (34.3)
Stage 3	9 (3.0)
Stage 4	0
Stage 5	0
ACR	
Normal	200 (66.7)
Abnormal	83 (27.7)
Hypertension	
Yes	140 (46.7)
No	160 (53.3)
Dyslipidemia	
Yes	201 (67.0)
No	99 (33.0)
Taking ACEIs	
Yes	119 (39.7)
No	181 (60.3)

BMI=Body mass index, T2DM=Type 2 diabetes mellitus, CKD=Chronic kidney disease, ACR=Albumin-to-creatinine ratio, ACEIs=Angiotensin-converting enzyme inhibitors

The overall prevalence of anemia in the study population was 29.3%. Stratified by CKD stage, the prevalence of anemia was 31.4%, 24.3%, and 44.4% in patients with Stage 1, Stage 2, and Stage 3 CKD, respectively. The frequency of anemia was significantly higher in female patients than male patients (41.7% vs. 17.9%; *P* < 0.001). However, apart from gender, no other statistically significant associations were identified between anemia status and various sociodemographic and clinical factors, including age, BMI, ACR, and hypertension [Table 2].

Discussion

To the best of the authors' knowledge, no previous studies have reported data on the prevalence of anemia in diabetic patients with CKD in Oman. Therefore, this study was undertaken to establish the prevalence of anemia and associated risk factors in patients with T2DM and CKD at varying degrees of kidney dysfunction. In the current study, the overall number of male diabetic patients with CKD was slightly higher compared to female patients (56% vs. 48%). This finding is consistent with those reported in two previous national studies that indicated a slight male predominance.[17-19] Moreover, most of the participants in the present study had been diagnosed with diabetes several years before (>5 years). This finding was expected given that nephropathy is more frequently encountered as diabetes progresses.[20]

The overall prevalence of anemia found in the study population of the current study was 29.3%. A previous study of patients with CKD and T2DM attending primary care settings in Malaysia reported the prevalence of anemia as 31.7%, the majority of cases of which were mild (61.5%).[20] Furthermore, morphological characteristics of normocytic normochromic anemia were identified in 58.7% of anemic patients. A multinational study of 1205 patients with T2DM and CKD attending primary, secondary, and tertiary hospitals in 11 European countries identified a similar prevalence of anemia (34.0%).[21] Both of these studies utilized the same diagnostic definition of anemia as was used in the present study.[21,22]

Other studies done in the UK and Japan of patients with diabetic nephropathy identified slightly lower prevalence rates of anemia (26.0%).[23,24] In contrast, higher prevalence rates have been reported elsewhere around the world.[25-28] A cross-sectional study conducted in India found that up to 70.27% of patients with diabetic kidney disease were anemic.[25] A multicenter study from Italy reported the prevalence of anemia in individuals with diabetes and CKD as 61%.[26] Similarly, Chen *et al*. reported that 54% of Chinese patients with T2DM and CKD were anemic. In addition, the researchers noted that the frequency of anemia was significantly higher for those with CKD than those without CKD (*P* < 0.001).[27] Finally, a cross-sectional study performed in Egypt indicated the prevalence of anemia as 39% in 307 patients with T2DM and CKD.[28]

The reasons for the higher prevalence rates of anemia observed in the above-mentioned studies could include possible variations in population sample size, geographical location, lifestyle, and racial and genetic makeup. The disparity in the findings could also be explained by differences in the severity of diabetes and CKD, given that more stable diabetic nephropathy patients were more likely to be managed in primary care settings, thereby resulting in a lower reported prevalence of anemia than patients managed in secondary or tertiary settings.

Table 2: Association between sociodemographic and clinical factors and anemia status among primary care patients with chronic kidney disease and type 2 diabetes mellitus in Muscat, Oman (*n*=300)

Factor	Anemia status		P-value
	Present (*n*=88) N (%)	Absent (*n*=212) N (%)	
Gender			
Male	28 (17.9)	128 (82.1)	<0.001
Female	60 (41.7)	84 (58.3)	
Age (years)			
20–35	1 (6.7)	14 (93.3)	0.134
36–50	36 (29.5)	86 (70.5)	
51–65	51 (31.3)	112 (68.7)	
BMI (kg/m²)			
<18.5	1 (100)	0	0.259
18.5–24.9	8 (22.9)	27 (77.1)	
25–29.9	31 (27)	84 (73.0)	
≥30	48 (32.2)	101 (67.0)	
Duration of T2DM (years)			
<3	11 (23.4)	36 (76.6)	0.404
3–5	16 (35.6)	29 (64.4)	
5–10	38 (32.5)	79 (67.5)	
>10	23 (25.3)	68 (74.7)	
Stage of CKD			
Stage 1	59 (31.4)	129 (68.6)	0.266
Stage 2	25 (24.3)	78 (75.7)	
Stage 3	4 (44.4)	5 (55.6)	
Stage 4	0	0	
Stage 5	0	0	
ACR			
Normal	63 (31.5)	137 (68.5)	0.528
Abnormal	23 (27.7)	60 (72.3)	
Hypertension			
Yes	45 (32.1)	95 (67.9)	0.317
No	43 (26.9)	117 (73.1)	
Taking ACEIs			
Yes	32 (26.9)	87 (73.1)	0.451
No	56 (30.9)	125 (69.1)	

BMI=Body mass index, T2DM=Type 2 diabetes mellitus, CKD=Chronic kidney disease, ACR=Albumin-to-creatinine ratio, ACEIs=Angiotensin-converting enzyme inhibitors

The current study also sought to assess relationships between anemia status and selected sociodemographic and clinical variables. Overall, gender was the only variable found to have a significant association with anemia, with a higher prevalence of anemia in female compared to male patients (41.7% vs. 17.9%; *P* < 0.001). This finding supports results reported by Li Vecchi *et al.* in Italian patients with Type 2 diabetic nephropathy.[26] In general, women tended to have a higher risk of anemia than men as a result of their lower mean Hb concentrations; moreover, menstruating women could lose an additional 10–42 mg of iron per menstrual cycle, potentially predisposing them to iron deficiency anemia.[29]

Previous studies have reported a strong association between high incidence rates of anemia and CKD progression in diabetic patients.[23,26,30] In the present study, anemia was more frequent in patients with Stage 3 CKD (44.4%); however, no statistical significant association was observed between anemia status and renal disease progression. These findings are in agreement with those reported by Gu *et al.* in Chinese T2DM patients.[31] In fact, patients with advanced CKD are likely to have lower Hb concentrations as anemia often develops because of CKD, thereby conferring a greater risk of meeting the criteria for disease progression. Thus, while some information regarding the severity of CKD revealed by low Hb levels, the presence of anemia itself does not have a strong direct effect on the development of CKD. While this discrepancy in findings could be because of other confounding factors, such as comorbidities and concomitant medications, the current study identified no significant relationships between anemia status and other factors such as age, BMI, ACR, hypertension, and the administration of ACEIs.

To the best of our knowledge, this is the first study to examine the prevalence of anemia in patients with T2DM and CKD in Oman. The findings highlight the need for routine screening of anemia in patients with diabetic nephropathy and provide a valuable baseline source of information for researchers seeking to improve quality of life in this patient group. However, there are several limitations to this study which should be acknowledged. First, the study was carried out in a single primary care setting with a relatively small sample size. Although a considerable number of patients with T2DM in Oman are followed-up at primary care clinics, the results nevertheless cannot be considered representative of the entire population and the prevalence of anemia may be underestimated. To confirm these findings, additional large-scale prospective studies should be carried out. Second, the study design could not determine true associations between anemia and potential causal factors and the direction of these relationships. Finally, etiology was not investigated to determine actual causes of anemia in the study population other than erythropoietin deficiency.

Conclusion

Anemia was found to be relatively common among patients with T2DM and CKD attending a primary care setting in Muscat, Oman. Nevertheless, this condition most likely remains underevaluated, underrecognized, and undertreated in this population, particularly in female patients, regardless of whether it represents a complication or risk factor for the progression of diabetic nephropathy. Early screening, even at normal eGFR, and more aggressive management of anemia is, therefore,

recommended to improve the quality of life of affected patients and optimize outcomes.

Conflicts of interest
There are no conflicts of interest.

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