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Diabetes-related knowledge in diabetic haemodialysis patients: a cross-sectional study from Palestine

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Abstract

Background: Diabetes mellitus is the leading cause of end-stage renal disease. Monitoring and controlling normal blood sugar levels play a critical role in slowing the progression of micro- and macrovascular complications of diabetes. This study was conducted to measure glycaemic control and diabetes-related knowledge in diabetic patients on maintenance haemodialysis and to assess any relationship between these two variables.

Methods: This cross-sectional study was conducted at six dialysis centres in the north of the West Bank. Blood samples were collected to measure glycated haemoglobin (HbA1c) levels, while the Michigan Diabetic Knowledge Test (MDKT) was employed as a measure tool of diabetes-related knowledge. Patients were also asked to fill in a questionnaire in order to determine their sociodemographic characteristics. Finally, univariate analyses were used to measure the associations between the clinical and sociodemographic data, and diabetes knowledge and glycaemic control.

Results: A total of 147 haemodialysis patients with diabetes were included in this study. The mean age of the cohort was 60.12 (SD = 10.28). Males accounted for 51.7% of the cohort. The HbA1c levels (%) and MDKT scores were 6.89 ± 1.72 and 9.19 ± 1.7 (mean ± SD), respectively. 36.1% of the patients had poor glycemic control. The study showed that residency and household income were associated with diabetes knowledge ($P < 0.05$). However, the study did not show a significant association between diabetes-related knowledge and glycaemic control overall, nor did it show a significant association between the clinical and sociodemographic factors and glycaemic control ($P > 0.05$).

Conclusions: This study showed that patients living in refugee camps as well as those with low income had low diabetes-related knowledge and needed extra care. This study also revealed that a relatively high proportion of diabetic patients on maintenance haemodialysis suffered from poor glycemic control. Here, we recommend to put greater emphasis on better diabetes-related knowledge as a means to achieve better diabetes care with improved glycemic control for all haemodialysis patients

Keywords: Glycaemic control, MDKT, Haemodialysis, Diabetes mellitus, Palestine

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Background

Type 2 diabetes mellitus is a serious long-term illness that can affect the health system of communities in general and the personal health of patients in particular [1, 2]. It causes many complications that can affect several organs in the human body, such as the brain, heart, eyes and kidneys [3]. End-stage renal disease (ESRD) has many causes; however, the most common one (30–50%) is type 2 diabetes mellitus [4]. Of other causes, hypertension should receive special attention as well because it can accelerate the progression of chronic renal disease when it coexists with diabetes mellitus [5, 6]. This holds true in diabetic patients as hypertension affects ~ 70% of them [7].

The progression of diabetes complications cannot be stopped; however, one of the most important methods for delaying disease progression is the maintenance of normal blood glucose levels [8]. In addition, controlling blood pressure also leads to reduction in diabetes mellitus complications and diabetes-related deaths [6]. The risk of cardiovascular complications, deaths from cardiovascular events and life expectancy may be improved by enhanced glycaemic control [9]. The Kidney Disease Outcomes Quality Initiative and the Kidney Disease Improving Global Outcomes guidelines recommended that patients with chronic kidney disease or ESRD should maintain their glycated haemoglobin (HbA1c) readings below 7% [10]; however, maintaining optimum blood glucose levels is troublesome for haemodialysis patients with diabetes as they may also suffer from other diseases and comorbidities that can contribute to impaired glycaemic control [11].

Fully understanding the sociodemographic and clinical factors that modulate glycaemic control in haemodialysis patients with diabetes would be of great benefit. These valuable results would guide future studies and interventions and help clinicians and healthcare decision makers to improve patient outcomes and their access to quality care. A total of 382 million people had diabetes in 2013, and this number is expected to increase to 592 million in 2035 [12]. The Middle East had the highest prevalence (10.9%) and the second highest proportional increase after Africa [12]. In Palestine, the prevalence was 9.8% in rural areas and 12% in urban areas [13, 14].

The Palestinian Ministry of Health's annual 2015 mid-year health analysis reported that 5761 new diabetic cases were discovered in the West Bank, with an incidence rate of 201.3 per 100,000 of population. The total population of Palestinians was 4.6 million with 2.8 million living in the West Bank. The rate of reported diabetes deaths was 6.8% of all deaths. Moreover, 1014 patients were receiving regular haemodialysis [15].

Glycaemic control and its associated factors are not new concepts, and many studies have shown the relationship between glycaemic control and clinical and sociodemographic factors; however, these studies were conducted in different countries [16–19]. A considerable amount of literature has been published regarding haemodialysis patients in Palestine [20–29]; however, no single study of that population has investigated the relationship between glycaemic control and diabetes-related knowledge in haemodialysis patients with diabetes. Therefore, the present study was carried out to determine the relationship between glycaemic control and diabetes-related knowledge in haemodialysis patients with diabetes, and to assess the clinical and sociodemographic factors that affect both of these variables.

Methods

Study design

The research approach employed a multicentre, cross-sectional design for diabetic patients on maintenance haemodialysis > 6 months (duration of dialysis), in the West Bank, Palestine.

Study setting

This study was conducted at six dialysis centres in the north of the West Bank, in Nablus, Tulkarem, Jenin, Qalqilya, Tubas and Salfeet. All centres are located in governmental hospitals, except in Nablus, where the location is a teaching hospital [30]. Patients were requested to complete a questionnaire and to provide a blood sample to check HbA1c levels during their routine visits to the centre.

Study population

According to the 2015 mid-year annual health analysis from the Palestinian MOH, 507 patients were receiving haemodialysis in the six dialysis centres [15]. A recent study suggested that approximately 45% of haemodialysis patients in these centres were also diabetic; therefore, our available population was approximately 230 individuals [24]. Patients were included in the study if (1) they were older than 18 years; (2) they were confirmed to have ESRD (by a clinician); (3) they had previously been diagnosed with type 2 diabetes mellitus; (4) they had been regularly receiving haemodialysis for at least 6 months; and (5) they had diabetes for ≥ 1 year. Patients with cognitive or mental restrictions to fill out the questionnaire were excluded from the study. From the six dialysis centres, 147 haemodialysis patients were selected.

Data collection instrument

The instrument was composed of three sections. The first section contained sociodemographic data about each participant, including their age, gender, weight and height (to calculate body mass index (BMI)), residency (city, village or refugee camp), living status (with family or alone), education level, marital status, occupation (employed or unemployed), household income and smoking status (smoker or nonsmoker). The second section contained clinical data, including duration of dialysis per year, duration of diabetes per year, number of dialysis sessions per week, total treatment hours per session, kidney transplant (yes or no), total number of chronic medications including anti-diabetic and haemodialysis medication (e.g. insulin, heparin, diuretics and anti-hypertensive drugs); total number of chronic diseases, which included any disease that lasted for a long time or at least 3 months, other than diabetes (e.g. osteoarthritis, hypertension, heart failure and COPD); and drug administration (alone or by other people). Blood samples were also taken by experienced nurses at the dialysis centres, to measure HbA1c levels; the results were subsequently classified as controlled (≤ 7%) or uncontrolled (> 7%) according to a previous study [18]. This classification is also used by health workers to give different management plans according to the patient's classification.

The third section contained the Arabic-translated version of the Michigan Diabetic Knowledge Test (MDKT). This test was previously assessed for its validity and reliability [31], and that Arabic translation was also used in another study [32]. Permission to use MDKT was obtained from the developer. The first 14 items in the English version's online questionnaire (http://diabetesresearch.med.umich.edu/peripherals/profs/documents/svi/DKT2_with_answers.pdf) are appropriate to assess knowledge of diabetes. The modified MDKT contained 14 multiple choice questions with only one correct answer for each. Every question in this test evaluated the patient's knowledge about a particular aspect concerning diabetes. With one point given for a correct answer, none for an incorrect answer, and a total score of 14; thus, more correct answers corresponded to greater knowledge.

Data collection procedure

Permission to interview the patients at the MOH and An-Najah National University Hospital (ANNUH) was obtained before the onset of data collection. The computerised data systems at each dialysis centre were then used to identify the patients who met the study criteria. Those who did were informed of the study and verbal informed consent was obtained. Face-to-face interviews were conducted by medical students to complete the study questionnaire. Qualified nurses working in the dialysis centres then took blood samples, which were refrigerated and sent to the ANNUH laboratory department for measurement of HbA1c levels. The data collection instrument(s) were initially tested on a pilot sample, of just 10 haemodialysis patients with diabetes, to evaluate the response burden as well as comprehension. This pilot sample was not part of the final study sample.

Ethical approval

The Institutional Review Board (IRB) at An-Najah National University approved this study and both the MOH and ANNUH gave permission to perform interviews and withdraw blood samples at their haemodialysis centres. Before any interview or withdrawing blood, every patient's verbally informed constant insured that their identity would not be revealed and that their information would be protected and coded, so that only the authors would have access to them. The purpose of the study, the authors' titles/qualifications and the funding agency itself were all explained to the patients, too.

Statistical analysis

Each questionnaire was coded from 1 to 147 and inserted into SPSS version 21 for analysis. Data were expressed as frequency (percentage), mean ± SD or median (interquartile range Q1–Q3) depending on whether it was categorical or continuous. Fisher's exact test and the chi-square test were used, where appropriate, to test the significance of HbA1c (≤ 7 and > 7), sociodemographic, clinical and MDKT categorical variables. Furthermore, the MDKT was set as the dependent variable, whereas sociodemographic and clinical variables were set as the independent ones. Non-normally distributed variables were represented using the median and interquartile range (IQR). Additionally, the non-normally distributed data were compared, using either the Kruskal–Wallis test or the Mann–Whitney *U* test, where appropriate, to measure the association between MDKT score and sociodemographic and clinical variables. The significance level (*P* value) was set to be less than 0.05.

Results

Clinical and sociodemographic characteristics

Of the 147 patients, 76 (51.7%) were male and 71 (48.3%) were female. The average age was 60.12 years (SD = 10.28), with 78 (53.1%) individuals ≤ 60 years and 69 individuals (46.9%) > 60 years of age. Only 38 (25.9%) of the subjects were within the normal BMI range (18.5–24.9), whereas 65 (44.2%) were obese. The cohort contained patients from different regions, but most (57.8%) came from villages. In general, the cohort was poorly educated, with only 28 (19.0%) patients who completed college or had a higher degree. With regards to their socioeconomic status, 118 (80.3%) patients were married and 141 (95.9%) lived with their families; however, 132 (89.8%) were unemployed and 77 (52.4%) had a low household income. Only 32 (21.8%) patients were smokers and only 43 (29.3%) had three or more chronic diseases. Most patients (92.5%) suffered from diabetes for > 5 years, and 56 (38.1%) patients had been receiving haemodialysis for ≥ 4 years (dialysis vintage); further, 128 (87.1%) had three or more sessions per week. Only 3 (2.0 %) patients had undergone kidney transplantation in the past. Ninety (64.6%) patients took their drugs alone and, coincidentally, 95 (64.6%) took less than eight chronic medications. Further information about the clinical and sociodemographic features of the cohort are provided in Table 1.

MDKT values

The average MDKT score in this cohort was 9.19 (SD = 1.7). Patients with low household income and those living in Palestinian refugee camps had significantly lower MDKT scores (*P* value for both variables was < 0.05). Other sociodemographic and clinical factors were not associated with diabetes knowledge (all *P* values were > 0.05). These factors were age, gender, BMI, living status, education level, marital status, occupation, smoking, duration of dialysis per year, duration of diabetes per year, frequency of dialysis per session/week, treatment hours per session, kidney transplant status, total chronic diseases, total chronic medications, drug taking and HbA1c levels (all *P* values were > 0.05). Table 1 shows the associations between MDKT scores and sociodemographic and clinical variables.

HbA1c level as a measure of glycaemic control

Analysis of HbA1c levels in this cohort showed that 94 (63.9%) patients showed good glycaemic control (≤ 7%) while 53 (36.1%) patients showed poor control (> 7%). The mean HbA1c was 6.9 ± 1.7. None of the sociodemographic and clinical factors included in our study were found to be significantly associated with glycaemic control. These factors were similar to those noted above: age, gender, BMI, residency, living status, household income, marital status, occupation, smoking, treatment hours per session, duration of diabetes per year, frequency of dialysis per session/week, duration of dialysis, kidney transplant status, total chronic medications, education level, total chronic diseases, drug taking (alone or by others) and diabetes knowledge. Table 2 shows all the associations between HbA1c and sociodemographic, and clinical factors.

Discussion

This study used the MDKT scores and HbA1c levels to assess the diabetes-related knowledge and to measure glycaemic control, among haemodialysis patients with diabetes, respectively. We also aimed in this study to make correlations between these two variables. This study was the first of its kind in Palestine to use both the MDKT and HbA1c levels in haemodialysis patients with diabetes. Previously, similar studies used only the MDKT in patients with diabetes in Palestine [32], Malaysia [17], Kuwait [16], Turkey [33], South Africa [34] and Nigeria [35].

The median MDKT score was 9 (SD = 1.7), and most patients (70.1%) achieved an acceptable score (e.g. 7–10). These scores are considered higher than those seen in other studies [12, 16, 17, 32, 36], which were performed on diabetic patients who were not dependent on haemodialysis. This could be because diabetes is less problematic in its early stages, which makes it less likely for diabetic patients to perceive their condition as thoughtfully as those with more advanced or complicated illness, such as those with diabetes and on haemodialysis, as in our study [37]. Different variables affected knowledge among haemodialysis patients; for example, refugee camp residents exhibited lower knowledge than those who lived in villages or cities. This could be due to poor health services in refugee camps [38] or because refugees have a lower education level [39]. This study also showed that low income was associated with poor knowledge, which is similar to findings in other studies that were carried on diabetic patients who were not dependent on haemodialysis [16]. Moreover, a study in a low-income population showed that there was a positive association between health literacy and diabetes knowledge [40]. This could explain how poor knowledge may correlate with low income levels in our study.

In our study, gender had no significant association with diabetes knowledge, which is consistent with the results of other studies [16, 35]. These studies showed higher, but not statistically significant, scores in males, as it is the case in our study. However, one investigation showed that South African females had higher knowledge pass rates, when compared with South African males [34]. Moreover, a study in Pakistan showed a significant association between gender and diabetes knowledge, with men scoring significantly higher than women [36]. In our project, there was an increase in diabetes-related knowledge with longer duration of the disease, but it was statistically not significant enough to assume an association, and this was similar to other studies [16, 41]. A plausible explanation could be that the longer patients suffer from diabetes, the more experience they will gain from their disease and the more educational programmes they will attend. Although decreasing age and increasing education levels significantly increased diabetes knowledge in some studies [16, 36], we found no significant associations in our study. Other studies carried out in communities similar to ours

Table 1 The relation between MDKT and sociodemographic and clinical factors

Variable	Number (%), *n* = 147	Median scores of MDKT (1st percentile–3rd percentile)	*P* value
Age category			
Age ≤ 60	78 (53.1)	9.0 (8.0–10.0)	0.126 [a]
Age > 60	69 (46.9)	10.0 (8.0–11.0)	
Gender			
Male	76 (51.7)	10.0 (8.0–11.0)	0.078[a]
Female	71 (48.3)	9.0 (8.0–10.0)	
Body mass index			
Underweight (< 18.5)	1 (0.7)	NA	0.528[b]
Normal range (18.5–24.9)	38 (25.9)	9.5 (8.0–10.0)	
Preobese (overweight) (25–29.9)	43 (29.3)	10.0 (8.0–11.0)	
Obese (≥ 30)	65 (44.2)	9.0 (8.0–10.0)	
Residency			
Village	85 (57.8)	9.0 (8.0–10.0)	0.002[b]
City	47 (32)	10.0 (9.0–11.0)	
Palestinian refugee camp	15 (10.2)	8.0 (7.0–10.0)	
Living status			
Live with family	141 (95.9)	9.0 (8.0–10.5.0)	0.062[a]
Live alone	6 (4.1)	8.5 (6.8–9.0)	
Education level			
No formal education	18 (12.2)	9.0 (7.0–10.0)	0.251[b]
Finished Primary school	37 (25.2)	9.0 (8.0–10.0)	
Finished high school	64 (43.5)	9.0 (8.0–11.0)	
College, university or post graduate	28 (19)	10.0 (8.3–11.0)	
Marital status			
Single, widow, divorced	29 (19.7)	9.0 (8.0–10.0)	0.527[a]
Married	118 (80.3)	9.0 (8.0–11.0)	
Occupation			
Unemployed	132 (89.8)	9.0 (8.0–10.0)	0.612[a]
Employed	15 (10.2)	9.0 (8.0–11.0)	
Household income (month)			
Low (less than 550 US$)	77 (52.4)	9.0 (7.5–10.0)	0.023[b]
Moderate (550–1400 US$)	57 (38.8)	10.0 (8.0–10.5)	
High (more than 1400 US$)	13 (8.8)	11.0 (8.0–11.0)	
Smoking			
Not smoker	115 (78.2)	9.0 (8.0–10.0)	0.294[a]
Smoker	32 (21.8)	10.0 (8.0–11.0)	
Duration of dialysis (year)			
Less than 4 years	91 (61.9)	9.0 (8.0–10.0)	0.878[a]
4 years or more	56 (38.1)	9.0 (8.0–10.8)	
Duration of diabetes (year)			
1–3 years	8 (5.4)	7.5 (7.0–11.3)	0.509[b]
4–5 years	3 (2)	8.0 (7.0–NA)	
More than 5 years	136 (92.5)	9.0 (8.0–10.0)	
Frequency of dialysis (session/week)			

Table 1 The relation between MDKT and sociodemographic and clinical factors *(Continued)*

Variable	Number (%), *n* = 147	Median scores of MDKT (1st percentile–3rd percentile)	*P* value
2 sessions or less	19 (12.9)	9.0 (7.0–11.0)	0.301[a]
3 sessions or more	128 (87.1)	9.0 (8.0–10.0)	
Treatment hours per session			
Less than 4 hours	125 (85)	9.0 (8.0–10.5)	0.177[a]
4 hours or more	22 (15)	9.0 (7.0–10.0)	
Kidney transplant			
Yes	3 (2)	9.0 (7.0–NA)	0.967[a]
No	144 (98)	9.0 (8.0–10.0)	
Total chronic diseases			
None	7 (4.8)	10.0 (9.0–10.0)	0.946[b]
One	49 (33.3)	9.0 (8.0–11.0)	
Two	48 (32.7)	9.0 (8.0–10.0)	
Three or more	43 (29.3)	9.0 (8.0–11.0)	
Total chronic medications			
Less than 8	95 (64.6)	9.0 (8.0–10.0)	0.719[a]
8 or more	52 (35.4)	9.5 (8.0–10.0)	
Drugs taking			
Takes drugs alone	95 (64.6)	9.0 (8.0–11.0)	0.235[a]
Takes drugs by others	52 (35.4)	9.0 (8.0–10.0)	
HbA1c			
Controlled	94 (63.9)	9.0 (8.0–11.0)	0.630[a]
Uncontrolled	53 (36.1)	9.0 (8.0–10.0)	

US$, US dollars; *NA*, not available; *HbA1c*, glycated haemoglobin; *MKDT*, Michigan Diabetic Knowledge Test
[a]Statistical significance of differences was calculated by using the Mann–Whitney *U* test
[b]Statistical significance of differences was calculated by using the Kruskal–Wallis test

attributed this to the cultural environment, which could affect diabetes knowledge by providing wrong information, regardless of the age and level of education [42, 43].

Although many studies suggested using glycated albumin as a more accurate measure than HbA1c to measure blood glucose levels in haemodialysis patients [44–46], other studies recommended to depend HbA1c levels as a reliable measurement to assess glycemic control in haemodialysis patients, especially those with values of 6–7% [47, 48]. Moreover, glycated albumin represents blood glucose levels during the previous 7–14 days, which is a much shorter interval than what is provided by HbA1c (60 to 120 days). In addition, there are no long-term studies that investigate the relationship between glycated albumin and the risk of diabetes chronic complications [49–51]. Therefore, our project employed HbA1c as a more meaningful measure of glycaemic control. That said, we discovered that there was no significant correlation between glycaemic control and diabetes knowledge, which is in contrast to multiple studies [17, 33, 52] that have documented a significant correlation between these variables. In Nashville, Tennessee (USA), 83 patients were allocated to either a control group or a study group, and participants were followed for 1 year. The authors found that the provision of an educational programme to the study group led to a decline in HbA1c levels, from 6.9 to 6.3%, while the control group showed no change in HbA1c levels [53]. This indicated that prior acquired knowledge had no effect on glycaemic control, whereas an effective and intensive diabetes educational programme at the dialysis unit would be of great benefit. However, this discrepancy could also be due to the difference between what the patients were taught and what they were actually doing (the knowledge-action gap), as reported in a Chinese study which, similar to the Nashville undertaking, did not show an association between HbA1c and diabetes knowledge [54].

Factors that did not affect glycaemic control in this study include education level, diabetes duration and BMI. However, a significant association between these factors and glycaemic control were present in a Jordanian undertaking, carried out on patients with type 2 diabetes mellitus [11]. In our study, there was no association between glycemic control and marital or

Table 2 The relation between HbA1c and sociodemographic and clinical factors

Variable	Total N=147 (%)	Controlled N=94 (%)	Uncontrolled N=53 (%)	P value
Age category				
Age ≤60	78 (53.1)	47 (50)	31 (58.5)	0.322
Age >60	69 (46.9)	47 (50)	22 (41.5)	
Gender				
Male	76 (51.7)	50 (53.2)	26 (49.1)	0.630
Female	71 (48.3)	44 (46.8)	27 (50.9)	
Body mass index				
Underweight (<18.5)	1 (0.7)	1 (1.1)	0 (0)	0.880
Normal range (18.5-24.9)	38 (25.9)	25 (26.6)	13 (24.5)	
Preobese (overweight) (25-29.9)	43 (29.3)	27 (28.7)	16 (30.2)	
Obese (≥30)	65(44.2)	41 (43.6)	24 (45.3)	
Residency				
Village	85 (57.8)	54 (57.4)	31 (58.5)	0.580
City	47 (32)	32 (34)	15 (28.3)	
Palestinian refugee camp	15 (10.2)	8 (8.5)	7 (13.2)	
Living status				
Live with family	141 (95.9)	88 (93.6)	53 (100)	0.064
Live alone	6 (4.1)	6 (6.4)	0 (0)	
Education level				
No formal education	18 (12.2)	13 (13.8)	5 (9.4)	0.362
Finshed Primary school	37 (25.2)	24 (25.5)	13 (24.5)	
Finshed high school	64 (43.5)	43 (45.7)	21 (39.6)	
College, university or post gradute	28 (19)	14 (14.9)	14 (26.4)	
Marital status				
Single , widow ,divorced	29 (19.7)	21 (22.3)	8 (15.1)	0.290
Married	118 (80.3)	73 (77.7)	45 (84.9)	
Occupation				
Unemployed	132 (89.8)	85 (90.40)	47 (88.7)	0.737
Employed	15 (10.2)	9 (9.6)	6 (11.3)	
Household income (month)				
Low (less than 550 US$)	77 (52.4)	49 (52.1)	28 (52.8)	0.320
Moderate (550–1400 US$)	57 (38.8)	39 (41.5)	18 (34)	
High (more than 1400 US$)	13 (8.8)	6 (6.4)	7 (13.2)	
Smoking				
Not smoker	115 (78.2)	72 (76.6)	43 (81.1)	0.522
Smoker	32 (21.8)	22 (23.4)	10 (18.9)	
Duration of dialysis (year)				
Less than 4 years	91(61.9)	56 (59.6)	3 5 (66)	0.438
4 years or more	56(38.1)	38 (40.4)	18 (34)	
Duration of diabtes (year)				
1-3 years	8 (5.4)	7 (7.4)	1 (1.9)	0.053
4-5 years	3 (2)	3 (3.2)	0 (0)	
More than 5 years	136 (92.5)	84 (89.4)	52 (98.1)	

Table 2 The relation between HbA1c and sociodemographic and clinical factors *(Continued)*

Variable	Total N=147 (%)	Controlled N=94 (%)	Uncontrolled N=53 (%)	P value
Frequency of dialysis (session/week)				
2 sessions or less	19 (12.9)	12(12.8)	7 (13.2)	0.940
3 sessions or more	128 (87.1)	82 (87.2)	46 (86.8)	
Treatment hours per session				
Less than 4 hours	125 (85)	81 (86.2)	44 (83)	0.607
4 hours or more	22 (15)	13 (13.8)	9 (17)	
Kidney transplant				
Yes	3 (2)	2 (2.1)	1 (1.9)	0.705
No	144 (98)	92 (97.9)	52 (98.1)	
Total chronic diseases				
None	7 (4.8)	4 (4.3)	3 (5.7)	0.137
One	49 (33.3)	36 (38.3)	13 (24.5)	
Two	48 (32.7)	29 (30.9)	19 (35.8)	
Three or more	43 (29.3)	25 (26.6)	18 (34)	
Total chronic medications				
Less than 8	95 (64.6)	59 (62.8)	36 (67.9)	0.530
8 or more	52 (35.4)	35 (37.2)	17 (32.1)	
Drugs taking				
Takes drugs alone	95 (64.6)	60 (63.8)	35 (66)	0.788
Takes drugs by others	52 (35.4)	34 (36.2)	18 (34)	
MDKT classification				
Less than 7	9 (6.1)	7 (7.4)	2 (3.8)	0.517
From 7 to 10	103 (70.1)	63 (67.0)	40 (75.5)	
11 or more	35 (23.8)	24 (25.5)	11 (20.8)	

US$, US dollars; *HbA1c*, glycated haemoglobin; *MKDT*, Michigan Diabetic Knowledge Test

living status, which was in contrast to a Japanese study, that showed a significant association between glycaemic control and social support [55]. This may indicate that haemodialysis patients with diabetes have additional factors that contribute to this discrepancy, which warrants further investigation. This could also be due to the poor diabetic health programmes in the West Bank.

Strengths and limitations

One strength of our effort here is that it is the first to investigate the association between diabetes knowledge, glycaemic control and clinical parameters in ESRD patients with diabetes who are undergoing haemodialysis. Another advantage of this study is its multicentre design. In addition, it employed the MDKT, which was previously tested and validated [31], and the questionnaire was answered using a face-to-face interview. Of course, it may have had some limitations, such as the fact that the questions were asked by medical students, a process that could have introduced author bias. This study is also a cross-sectional study and, as a result, a cause–effect relationship could not be established. We used the HbA1c to measure the glycaemic level, which would not be 100% reliable in haemodialysis patients. One final limitation is that this project's focus on patients from dialysis centres in the north of the West Bank in Palestine.

Conclusions

In conclusion, our project and analysis showed that prior diabetes-related knowledge in haemodialysis patients with diabetes significantly depended on their residency and household income, but not on their educational level. The results of this study indicated that a relatively high proportion of diabetic patients on maintenance haemodialysis suffered from poor glycemic control. Moreover, this study also demonstrated that glycaemic control was not significantly related to prior diabetes-related knowledge or any of the sociodemographic and clinical factors used. Therefore, it is recommended that clinicians and healthcare workers provide additional attention to haemodialysis' patients who live in refugee camps or receive a low income. They should find new ways to approach these patients, to make sure that the best level of health care is delivered and to prevent any diabetes-related complications. In addition, they should follow them up, to diminish patients' knowledge-action gap. We also recommend that researchers conduct further investigations on differing diabetes education programmes; they would surely benefit from them, through raising knowledge and addressing misconceptions among patients in the early stage of diabetes. The goal would be to prevent diabetes-related complications.

Abbreviations
BMI: Body mass index; ESRD: End-stage renal disease; HbA1c: Glycated haemoglobin; IRB: Institutional Review Board; MKDT: Michigan Diabetic Knowledge Test; MOH: Ministry of Health; ANNUH: An-Najah National University Hospital; SD: Standard deviation

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Authors' contributions
MH collected data, performed the analyses, conducted the literature search and drafted the manuscript. SK also collected data, performed the analyses and conducted the literature search. SH, EK and IT participated in the data collection and literature search. SZ conceptualised and designed the study; coordinated, supervised and analysed the data; critically reviewed the manuscript; interpreted the results and assisted in writing the final manuscript. All authors read and approved the final manuscript.

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Availability of data and materials
The datasets used for the current study are available from the corresponding author upon request.

Ethics approval and consent to participate
The IRB at An-Najah National University approved this study. Verbal informed consent was taken from each patient before the interviews were started. Permission from the MOH and ANNUH was also obtained to perform interviews and withdraw blood samples in their institutions. The study protocol was approved (including the verbal consent process) by the IRB and did not require written consent. Patients were asked to provide blood samples and were informed that their information would be coded and anonymised.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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