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# Depression among end-stage renal disease patients undergoing hemodialysis: a cross-sectional study from Palestine

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## Abstract

**Background:** The impact of end-stage renal disease on the patient's psychological status necessitates the value of increasing depression awareness. The current study aimed to assess the depression prevalence among Palestinian hemodialyzed patients and its association with patients' characteristics.

**Methods:** A convenience clustered sampling technique was followed. Sample was collected from ten hemodialysis centers in the West Bank, Palestine, during 3 months in 2015. We used the Beck Depression Inventory-II scale (BDI-II) to evaluate depression among participants. All data were analyzed using Statistical Package for the Social Sciences version 16.0.

**Results:** Two hundred and eighty-six hemodialyzed patients were interviewed. The mean age ( $\pm$  standard deviation) of the patients was  $52.0 \pm 14.3$  years, and most participants were males 172 (60.1%). Regarding the dialysis characteristics, the median of years of dialysis was 2 years (1–4). The prevalence of depression was 73.1%. Elderly patients ( $p = 0.001$ ), female ( $p = 0.036$ ), living in rural areas or camp ( $p = 0.032$ ), low income ( $p = 0.041$ ), unemployment ( $p = 0.001$ ), not doing regular exercise ( $p = 0.001$ ), and having multi comorbidities ( $p = 0.001$ ) were significantly associated with more depression scores. The results of binary logistic regression showed that only patients who were living in camps, patients who were previously employed, and patients who were not practicing exercise remained significantly associated with a higher depression score.

**Conclusions:** This study is the first one confirmed about depression and its prevalence among hemodialyzed patients in the West Bank, Palestine. Compared to other communities, the study found a higher depression prevalence rate. There is a need to offer psychological interviews and non-pharmacological and pharmacological interventions.

**Keywords:** Beck Depression Inventory-II scale, Depression, End-stage renal disease, Hemodialysis, Palestine

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## Background

The incidence of chronic kidney disease (CKD) worldwide has been increasing annually by 8%, with a total number of more than 1.4 million patients being on renal replacement therapy (RRT) [1]. According to the 2015 Palestinian Ministry of Health Annual Report (MOH), the number of hemodialyzed patients in the West Bank was 1014, who are undergoing dialysis by 175 machines distributed over 11 units [2]. At the time of the study, there were 175 machines in West Bank found in 11 kidney dialysis units in the Ministry of Health hospitals and one unit in An-Najah National University hospital. And there were 139,736 hemodialysis (HD) sessions in total [2].

With the dramatic increase in the incidence of HD, the impact of psychosocial factors on end-stage renal disease (ESRD) patients' outcomes has been lately receiving more consideration. Depression has been recognized to be the most common psychological problem in ESRD patients, which may affect treatment outcomes. According to the World Health Organization report in 2015, 350 million people were depressed [3]. Additionally, the depression prevalence among patients undergoing HD is ranging from 20 to 90% [4].

To the best of the authors' knowledge, in Palestine, no previous study has been conducted to assess depression status among patients undergoing HD. In addition, few studies were published in Palestine that assessed depression among patients with other diseases [5]. Moreover, some studies have focused on other issues among HD patients [6–10]. Sweileh et al. [5] found that the prevalence of depression among diabetic patients was higher than that observed in other countries, with 40.2% of patients scored  $\geq 16$  according to the Beck Depression Inventory-II (BDI-II) scale. A previous study conducted in Nazareth by Armaly et al. [11] concluded that 43.7% of HD patients were depressed, and there was a significant difference between cortisol level and depression among the selected subjects.

In Saudi Arabia, AlDukhayel [12] and Turkistani et al. [13] concluded that depression was significantly found in patients with HD. Furthermore, in a previous study, Saeed et al. [14] found that married and unemployed patients on HD were twice more depressed than their caregivers. Moreover, 30% of Jordanian patients on HD had depression [15].

Furthermore, higher levels of depressive symptoms were observed among HD female patients compared to males [16]. And a previous study found that unemployed and widowed patients who underwent HD had experienced severe depression [17]. In addition, according to BDI-II, 80% of Iraqi patients on HD had been experiencing depression, with mean score of 17.1. In addition, this study found that Iraqi married unemployed females were significantly more depressed [18].

An Indian study found that the most common psychiatric problem among ESRD patients was depression. Moreover, patients with depression had low quality of life score. Also, those patients needed high burden of care by their clinical staff [19]. Furthermore, an Australian concluded that depression was an independent factor of mortality and morbidity in CKD prior to RRT either in the form of dialysis or transplantation [20].

The current study aimed to assess the prevalence of depression among Palestinian hemodialyzed patients and to assess its association with patients' sociodemographic and clinical characteristics. Depression is widely considered to be the most common psychological problem that can influence the clinical outcomes in patients with ESRD.

Furthermore, identification of depressed ESRD patients and improving the health system in these patients should be considered to improve their outcomes. It is hoped that this study would increase the knowledge about the disease and its benefits, aiding both the medical staff and the patients to improve patients' quality of life. Moreover, this study may help in decreasing therapeutic failure, the need for hospitalization, and even death.

## Methods

### Study design and settings

This study was conducted through a convenience clustered sampling technique to address the research goals. The sample was recruited from dialysis centers at Palestinian Governmental Hospitals (Al-Husein Hospital, Beit-Jala; Khalil Suliman Hospital, Jenin; Thabit Thabit Hospital, Tulkarm; Alia Hospital, Hebron; Abu Al hasan Al kasem Hospital, Yatta; Darwish Nazal Hospital, Qalqilya; An-Najah National University Hospital, Nablus; Jericho Hospital, Jericho; Yasser Arafat Hospital, Salfit; and Palestine Medical Complex, Ramallah). The Ministry of Health provides the main health services in Palestine. Socio-demographic and some clinical-related data were obtained by patients' interview and from the review of their medical records. The data were collected during 4 months, from June 2015 to September 2015.

### Sample size

The number of patients who undergo dialysis by data provided in 2013 was 800 patients [21]. Raosoft sample size calculator (<http://www.raosoft.com/samplesize.html>) was used to determine the size of the sample needed. In the calculator, the 800-patient figure was used. In addition, the response distribution was set to be 50%, and a margin of error 5% was allowed at 95% confidence interval. From these figures, 260 patients were the minimum sample size needed. To enhance reliability and reduce the erroneous results, the target sample size

was increased, and 286 patients were included. Patients who were 18 years and above, diagnosed and treated at dialysis centers, agreed to participate, and can communicate well with the researcher were included. However, patients who were using medications for depression and/or psychosis, and those with cognitive impairment or exhausted were excluded. Furthermore, a pilot study of 15 patients was used to modify the data collection form before starting the real and final sample that was used in the analysis. The internal consistency for the part of the BDI-II instrument was assessed using Cronbach's  $\alpha$  test. The internal consistency of the BDI-II instrument was measured to be 0.857 which shows a good reliability of the BDI-II instrument.

#### Data collection

Face-to-face interview was used to collect the data. The structured data collection form that was used to obtain the intended sets of variables consisted of open-ended and close-ended questions. It consisted of many parts:

- 1) Patient demographic characteristics which include questions about age, gender, body mass index (BMI), level of education, monthly income, locality, employment status, marital status, and family history of renal failure.
- 2) Clinical questions about history and related disease comorbidities which include number of dialysis per week, years of suffering from renal failure, years of undergoing HD, the interval of dialysis session, smoking status, exercise, using herbal remedies, and comorbidities present (such as hypertension, diabetes mellitus, ischemic heart diseases).
- 3) Medication and management.
- 4) Beck Depression Inventory (BDI-II) scale which is used to identify depressive symptoms and the depression intensity, manifested through the person's behavior.

The scale consists of 21 dimensions: sadness, pessimism, past failure, loss of pleasure, guilty feelings, punishment feelings, self-dislike, self-criticalness, suicidal thoughts, crying, agitation, loss of interest, indecisiveness, worthlessness, loss of energy, changes in sleeping patterns, irritability, changes in appetite, concentration difficulty, tiredness, loss of interest in sex. In addition, BDI-II scale assesses symptom intensity, and each item is classified from 0 to 3 (i.e., absent to severe symptoms; almost unbearable). The score was calculated through summation of the responses for the 21 items, and the score of the degree of depression was classified as follows: 0 to 13 (minimal depression), 14 to 19 (mild depression), 20 to 28 (moderate depression), and 29 to 63 (severe depression) [22–24]. The BDI-II scale was translated into Arabic and validated to be used to

assess depression. Additionally, permission to use this edition was obtained from the author [25, 26]. In addition, the cutoff point score used for depression was 16 and higher, which was used in some previous studies [5, 27], one of which was previously published in Palestine [5]. Furthermore, Lustman et al. [27] concluded that the best balance between positive predictive value and sensitivity was shown by a cutoff score of  $>$  or  $=$  16 for the entire 21-item scale. In addition, internal consistency was ensured using Cronbach's alpha; the Cronbach's alpha value was 86% for the BDI-II scale used in the study.

#### Ethical approval

Before the beginning of this study, the protocol was approved by the An-Najah National University Institutional Review Board (IRB) with an archived approval number of 38/April/2015, in addition to the local health authorities. Furthermore, the purposes and procedures of the study were explained by the interviewer before commencing the interview, and a verbal consent was obtained.

#### Statistical analysis

The data gathered were quantitatively analyzed by utilizing Statistical Package for the Social Sciences (SPSS version 16). The categorical variables were illustrated as frequencies with their percentages. Kolmogorov-Smirnov test was used to test the normality of continuous variables; those variables that were distributed normally were expressed as mean  $\pm$  standard deviation (SD). However, continuous variables that were not normally distributed were expressed as the median with their interquartile range. Further statistical analysis was used to determine the association between demographic characteristics, clinical characteristics, patients' comorbid diseases, and patients' medications with depression. The Chi-square was used to test the significance between the categorical variables. In addition, Student's *t*-test or Mann-Whitney *U* test, whichever is appropriate, was used to compare the means of continuous variables. Furthermore, to test the significant correlations between continuous variables, Spearman's correlation was used. A *p* value  $<$  0.05 was considered significant. In addition, all of the significant variables in the univariate analysis were included in the binary logistic regression model to control for the possible impact of any candidate confounding factors. Binary logistic regression was used to determine which variables were significantly correlated with higher depression levels.

#### Results

##### Socio-demographic characteristics

In total, 298 patients were interviewed, and 286 approved to participate with a response rate of 95%. Their

distribution from the 10 HD centers were as follows: 55 (19.2%) from Alia Hospital, Hebron; 55 (19.2%) from An-Najah National University Hospital, Nablus; 40 (13.9%) from Palestine Medical Complex Hospital, Rammalah; 38 (13.3%) from Khalil Suliman Hospital, Jenin; 28 (9.8%) from Al-Husein Hospital, Beit Jala; 25 (8.8%) from Thabit Thabit Hospital, Tulkarm; 16 (5.6%) from Darwish Nazal Hospital, Qalqilya; 12 (4.2%) from Abu Alhasan Al kasem Hospital, Yatta; 9 (3.2%) from Jericho Hospital, Jericho; and 8 (2.8%) from Yasser Arafat Hospital, Salfit.

Table 1 shows the patients' socio-demographic characteristics. The patients' mean age ( $\pm$  SD) was  $52.8 \pm 14.3$  years, with a range from 19 to 84 years. Among the 286 patients included, 172 (60.1%) were male. According to the patient's BMI, most of the patients (118, 41.3%) have normal weight. Furthermore, the majority of those patients interviewed (200, 69.9%) were married. Regarding the level of education, 132 (46.2%) patients completed primary education. Furthermore, most of the patients were living in village 185 (64.7%) followed by 85 (29.7%) living in urban areas. Regarding the monthly income of the patients, most of the patients (167, 58.4%) have monthly income less than 2000 NIS. Regarding their employment status, 133 (46.5%) previously worked, and only 42 (14.7%) were still working.

Moreover, out of 286 patients, 73 (25.5%) have a family history of renal disease. In addition, regarding their smoking habits, 59 (20.6%) are smokers with a median smoking year of 20 (9–29). When the patients were asked about exercise, the majority 219 (76.6%) did not do exercise.

#### History of renal disease

The median (interquartile range) of the years that the patients had been suffering from renal failure and the years in which those patients underwent HD was 4.0 (2.0–8.0) and 2.0 (1.0–4.0), respectively. In addition, the median number of dialysis per week was 3.0 (3.0–3.0) and the median of hours of dialysis session was 3.5 (3.0–3.5).

#### Comorbid diseases among the study patients

The majority of patients suffered from hypertension 233 (81.5%), followed by diabetes mellitus 138 (48.3%) and anemia 131 (45.8%).

#### Chronic medications used by the study patients

According to patient's medications, calcium carbonate, 272 (95.1%); alfalcidol, 252 (88.1%); amlodipine, 171 (59.8%); and furosemide, 152 (53.1%), were the most commonly used medications.

#### Depression among the studied patients using Beck (BDI-II) scale

The reported depression score as measured by the mean ( $\pm$ SD) BDI-II score was  $23.66 \pm 10.87$ . Furthermore, regarding the classification of depression scores, 97 (33.9%) participants were moderately depressed followed by 83 (29%) severely depressed. In addition, 55 (19.2%) patients were minimally and 51 (17.8%) patients were mildly depressed. Furthermore, the majority of participants 209 (73.1%) had their depression score more than 16, while 77 (26.9%) patients scored less or equal to 16 in the depression scale.

#### Factors associated with depression

As shown in Table 2, patients who were 60 years old and more were more depressed (40.2% versus 22.1%,  $p = 0.001$ ). Moreover, significantly, gender was associated with depression; female patients were more depressed (43.5% versus 29.9%,  $p = 0.036$ ). Regarding income status, there was a significant association between income and depression ( $p = 0.041$ ). Patients with low income have a higher depression score compared to patients with moderate to high income (62.7% versus 46.8%).

In addition, there was a significant association between locality and depression ( $p = 0.032$ ). Patients who were living in rural areas (66.5% versus 59.7%) and in camps (7.2% versus 1.3%) were more depressed than those living in urban areas.

Regarding employment status, participants who are previously employed before renal failure (50.7% versus 35.1%) and unemployed patients (40.7% versus 33.8%) were significantly more depressed ( $p = 0.001$ ). In addition, 179 (85.6%) of the patients who did not make any exercise had experienced a higher depression score (85.6% versus 51.9%,  $p = 0.001$ ).

Furthermore, there was a significant association between the number of medications used and depression score; patients with higher median number of medications were having higher depression scores ( $p = 0.039$ ). In addition, regarding the comorbid diseases, there was a significant association between depression score and higher number of disease comorbidities. Patients with three or more chronic comorbid diseases were significantly more depressed (72.7% versus 35.1%,  $p = 0.001$ ), (Table 3).

However, there was no significant difference between years of dialysis and depression ( $p = 0.223$ ), number of dialysis per week and depression ( $p = 0.680$ ), and between duration of dialysis session and depression ( $p = 0.414$ ). In addition, no significant difference was found between patients who had hemodialysis sessions of less than 3.5 h or who had hemodialysis session of 3.5 h and more and the depression score level ( $p = 0.273$ ).

**Table 1** Sociodemographic characteristics of the study patients

Variables	Mean ( $\pm$ SD ), frequency (%), median (interquartile range) (N=286)
<b>Gender</b>	
Male	172 (60.1)
Female	114 (39.9)
<b>Age</b>	
	52.8 $\pm$ 14.3
<b>Age category</b>	
< 30	28 (9.8)
30–60	157 (54.9)
> 60	101 (35.3)
<b>BMI category</b>	
Normal (< 25)	118 (41.3)
Overweight (25–30)	96 (33.6)
Obese (> 30)	72 (25.2)
<b>Education</b>	
No formal education	29 (10.1)
Primary	132 (46.2)
Secondary	86 (30.1)
University	22 (7.7)
Post-graduate	17 (5.9)
<b>Income</b>	
High (more than 5000 NIS )	9 (3.1)
Moderate (2000–5000 NIS )	110 (38.5)
Low (less than 2000 NIS)	167 (58.4)
<b>Marital status</b>	
Married	200 (69.9)
Single	45 (15.7)
Divorced	7 (2.4)
Widowed	34 (11.9)
<b>Locality of patient</b>	
Urban	85 (29.7)
Rural	185 (64.7)
Camp	16 (5.6)
<b>Worship</b>	
Not practice	7 (24)
Seldom practice	29 (10.1)
Regular practice	250 (87.4)
<b>Employment status</b>	
Unemployed	111 (38.8)
Employed	42 (14.7)
Previously employed	133 (46.5)
<b>Family history</b>	
Yes	73 (25.5)
No	213 (74.4)

**Table 1** Sociodemographic characteristics of the study patients (Continued)

Variables	Mean ( $\pm$ SD ), frequency (%), median (interquartile range) (N=286)
<b>Smoking</b>	
Current smoking	59 (20.6)
Previously smoked	67 (23.4)
Nonsmoker	160 (55.9)
<b>Years of smoking</b>	
	20 (9–29)
<b>Exercise</b>	
Yes	67 (23.4)
No	219 (76.6)
<b>Times of exercise</b>	
None	219 (75.9)
Once weekly	10 (3.5)
Twice weekly	14 (4.9)
Three times weekly	10 (3.5)
Four times weekly	4 (1.4)
Five times weekly	1 (0.3)
Six times weekly	4 (1.4)
Seven times weekly	24 (8.4)

NIS New Israeli Shekel (1 NIS = 0.31 US dollars), SD standard deviation

The binary logistic regression model results are clarified in Table 4. We used the BDI-II depression score cutoff of 16 as a dependent variable, and age, gender, income, locality, employment status, practicing exercise, number of chronic diseases, and number of medications as independent variables. The results showed that only patients who were living in camps (odds ratio (OR) = 9.91; 95% confidence interval (CI) = 1.10–89.19;  $p = 0.041$ ), patients who were previously employed (OR = 3.95; 95% CI = 1.61–9.67;  $p = 0.003$ ), and patients who were not practicing exercise (OR = 4.43; 95% CI = 2.19–8.96;  $p < 0.001$ ) remained significantly associated with higher depression score (Table 4).

## Discussion

Depression is a psychiatric condition that affects the diagnosis of a variety of medical conditions, including ESRD [11]. However, compared to the general population, patients on HD have higher incidence of depression. Moreover, depression is underdiagnosed in HD patients because of dealing with patients with depressed mood and because of the nature of their illness [13].

To the best of the authors' knowledge, this study is the first one in the West Bank, Palestine, that assesses depression and its associated factors among ESRD patients.

Past studies have reported that depression in HD patients ranges from 25.3 to 60.5% using different scales and populations [13]. In Palestine, there is a lack of data

**Table 2** Factors associated with depression

Variable	Total	BDI-II depression score		p value
		≤ 16	> 16	
<b>Age category</b>				0.001 <sup>a</sup>
Less than 30	28 (9.8%)	14 (18.2%)	14 (6.7%)	
30–60	157 (54.9%)	46 (59.7%)	111 (53.1%)	
More than 60	101 (35.3%)	17 (22.1%)	84 (40.2%)	
<b>Gender</b>				0.036 <sup>a</sup>
Male	172 (60.1%)	54 (70.1%)	118 (56.5%)	
Female	114 (39.9%)	23 (29.9%)	91 (43.5%)	
<b>BMI category</b>				0.147 <sup>a</sup>
Normal (less than 25)	118 (41.3%)	35 (45.5%)	83 (39.7%)	
Overweight (25–30)	96 (33.6%)	29 (37.7%)	67 (32.1%)	
Obese (over than 30)	72 (25.2%)	13 (16.9%)	59 (28.2%)	
<b>Level of education</b>				0.073 <sup>b</sup>
No formal education	29 (10.1%)	4 (5.2%)	25 (12%)	
Primary	132 (46.2%)	29 (37.7%)	103 (49.3%)	
Secondary	86 (30.1%)	30 (39%)	56 (26.8%)	
University	22 (7.7%)	8 (10.4%)	14 (6.7%)	
Postgraduate	17 (5.9%)	6 (7.8%)	11 (5.3%)	
<b>Income</b>				0.041 <sup>b</sup>
Low (less than 2000NIS)	167 (58.4%)	36 (46.8%)	131 (62.7%)	
Moderate (2000–5000NIS)	110 (38.5%)	37 (48.1%)	73 (34.9%)	
High (more than 5000NIS)	9 (3.1%)	4 (5.2%)	5 (2.4%)	
<b>Marital status</b>				0.119 <sup>b</sup>
Married	200 (69.6%)	54 (70.1%)	146 (69.9%)	
Single	45 (15.7%)	17 (22.1%)	28 (13.4%)	
Divorced	7 (2.4%)	1 (1.3%)	6 (2.9%)	
Widowed	34 (11.9%)	5 (6.5%)	29 (13.9%)	
<b>Locality of patients</b>				0.032 <sup>b</sup>
Urban	85 (29.7%)	30 (39.0%)	55 (26.3%)	
Rural	185 (64.7%)	46 (59.7%)	139 (66.5%)	
Camp	16 (5.6%)	1 (1.3%)	15 (7.2%)	
<b>Employment status</b>				0.001 <sup>a</sup>
Unemployed	111 (38.8%)	26 (33.8%)	85 (40.7%)	
Employed	42 (14.7%)	24 (31.2%)	18 (8.6%)	
Previously employed before renal failure	133 (46.5%)	27 (35.1%)	106 (50.7%)	
<b>Family history of renal failure</b>				0.084 <sup>a</sup>
Yes	73 (74.5%)	14 (18.2%)	59 (28.8%)	
No	213 (25.5%)	63 (81.8%)	150 (71.8%)	
<b>Herbal use</b>				0.261 <sup>a</sup>
Yes	159 (44.4%)	47 (61.0%)	112 (53.6%)	
No	127 (55.6%)	30 (39.0%)	97 (46.4%)	
<b>Smoking</b>				0.721 <sup>a</sup>
Current smoker	59 (20.6%)	15 (19.5%)	44 (21.1%)	
Previously smoked	67 (23.4%)	16 (20.8%)	51 (24.4%)	

**Table 2** Factors associated with depression (*Continued*)

Variable	Total	BDI-II depression score		p value
		≤ 16	> 16	
Non-smoker	160 (55.9%)	46 (59.7%)	114 (54.5%)	
<b>Exercise</b>				0.001 <sup>a</sup>
Yes	67 (23.4%)	37 (48.1%)	30 (14.4%)	
No	219 (76.6%)	40 (51.9%)	179 (85.6%)	
<b>Number of medications</b>	7 (6–9)	7 (6–9)	8 (6–9)	0.039 <sup>c</sup>

BDI-II Beck Depression Inventory-II scale, BMI body mass index, NIS New Israeli Shekel (1 NIS = 0.31 US dollars)

<sup>a</sup>Statistical significance of differences calculated using the chi-square test

<sup>b</sup>Statistical significance of differences calculated using Fisher's exact test

<sup>c</sup>Statistical significance of differences calculated using Mann-Whitney U test

about depression; one study showed that depression occurs in 40.2% of diabetic patients [5]. In addition, 15% of Palestinian women randomly selected from Gaza Strip areas had moderate to severe depression [28]. Moreover, the lifetime and 1-month prevalence of major depression episodes in a multi-stage sample of 916 adult Palestinians was found to be 24.3% and 10.6%, respectively [29]. Our study shows a higher incidence of depression among ESRD patients, and the results indicated that the prevalence of depression (i.e., score more than 16) in our patients is 73.1%. Furthermore, in a previous study, Zyoud et al. [10] reported that health-related quality of life of Palestinian hemodialyzed patients according to EuroQOL-5 Dimension instrument was found to be  $0.37 \pm 0.44$ , and their Euro QOL visual analog scale score was  $59.38 \pm 45.39$ . This may be related to multiple factors, such as disease-related factors, patient-related factors, community-related ones, stressful life, and the lack of entrainment activities. This result is consistent with a study in Pakistan that showed that depression occurs in 72% of patients on HD [18].

The participants of our study were moderately to severely depressed with an incidence of more than 60%. This result is consistent with a previous study conducted by Nabolsi et al. [16]. Our explanation may be due to high incidence of chronic comorbidities, long dialysis sessions, far distance between locality of the patients and dialysis centers, and the absence of social and psychiatric support.

Furthermore, the current study found a significant relationship between age and depression, which is

consistent with that observed in other studies. However, this study shows that patients 60 years old and more were more depressed; this may be related to physiological changes and prevalence of comorbidities. This result agreed with the result done by Turkistani et al. [13] which showed that older patients were significantly depressed. However, another study found that the prevalence of depression was found to be higher among younger patients (20 to 40 years) [18]. On the other hand, previous studies showed that there was no significant association between depression and patients' age [30, 31].

Regarding depression and gender association, a previous study found that there was no relation between gender and depression [30] while others found that females had more depression than males [5, 11, 16, 17, 32], which is consistent with the results found in our study. This may explain that females have more stressors in that they have to play major social roles, such as being a wife, a mother, or a sister.

Furthermore, the current study showed that there is no significant relationship between higher depression scores and patients' marital status ( $p = 0.119$ ). However, Armaly et al. [11] reported that unmarried patients were two-fold depressed more than married ones. In contrast to that result, a study in Saudi Arabia resulted in that married patients were more depressed than single [12]. Furthermore, another study has reported that divorced participants were less likely to have depressive disorder compared to those who are married [33].

**Table 3** Association between depression and number of comorbidities

Variable	Total	BDI-II depression score		P value
		≤ 16	> 16	
<b>None of chronic comorbid disease</b>	5 (1.7%)	3 (3.9%)	2 (1.0%)	0.001 <sup>a</sup>
<b>One chronic comorbid disease</b>	40 (14.0%)	23 (29.9%)	17 (8.1%)	
<b>Two chronic comorbid diseases</b>	62 (21.7%)	24 (31.2%)	38 (18.2%)	
<b>Three or more chronic comorbid diseases</b>	179 (62.6%)	27(35.1%)	152(72.7%)	

BDI-II Beck Depression Inventory-II scale

<sup>a</sup>Statistical significance of differences calculated using Fisher's exact test

**Table 4** Independent factors associated with depression using binary logistic regression analysis

Variable	B	S.E.	Wald	Sig.	Odds ratio (95% C.I.)
<b>Age category</b>					
Less than 30				Ref.	
30–60	– 0.53	0.55	0.93	0.334	0.59 (0.20–1.73)
More than 60	0.07	0.62	0.01	0.914	1.07 (0.32–3.59)
<b>Gender</b>					
Male				Ref.	
Female	0.54	0.45	1.45	0.228	1.72 (0.71–4.13)
<b>Income</b>					
High (more than 5000 NIS)				Ref.	
Moderate (2000–5000 NIS)	0.76	0.89	0.71	0.398	2.13 (0.37–12.29)
Low (less than 2000 NIS)	0.17	0.89	0.04	0.845	1.19 (0.21–6.86)
<b>Locality of patients</b>					
Urban				Ref.	
Rural	0.67	0.35	3.63	0.057	1.94 (0.98–3.85)
Camp	2.29	1.12	4.19	0.041	9.91 (1.10–89.19)
<b>Employment status</b>					
Employed				Ref.	
Unemployed	0.66	0.56	1.37	0.242	1.93 (0.64–5.83)
Previously employed	1.37	0.46	9.03	0.003	3.95 (1.61–9.67)
<b>Exercise</b>					
Yes				Ref.	
No	1.49	0.36	17.13	0.000	4.43 (2.19–8.96)
<b>Chronic comorbid disease</b>					
None				Ref.	
One	– 0.60	1.19	0.25	0.616	0.55 (0.05–5.67)
Two	0.01	1.21	0.00	0.990	1.02 (0.10–10.82)
Three or more	1.25	1.22	1.04	0.309	3.47 (0.32–38.17)
<b>Number of medications</b>					
	– 0.04	0.08	0.26	0.610	0.96 (0.82–1.13)

B coefficient of predictor variables, CI confidence interval, NIS New Israeli Shekel (1 NIS = 0.31 US dollars), S.E standard error

Some researchers concluded that patients who were not working or had low income had a higher level of depression [5, 11, 12, 14]. Nearly more than half of the study population had a low monthly income, which was associated with increased depression scores. In addition, when the employment status was analyzed, we found out that employed patients were significantly less depressed than previously employed or not employed patients. Although, the causes of why they left their jobs were not assessed, the significantly higher scores of depression among patients who were not working may be due to the following reasons. Previous studies have reported that prolonged unemployment was associated with increased stress in individuals [33, 34]. Moreover, nearly 40% of patients who were not working were more than 60 years old, and this age is the age that most institutions rely on for retirement. In addition, a previous

study has found that a higher proportion of HD patients reflects increased fatigue and debility that renders them incapable of working effectively [14]. In addition, concerning the patients who were not working, the median number of dialysis per week was 3.0 with the median hours of dialysis session of 3.5 h; this may make them unable to contribute to their work and may make some restrictions for them to work such as limitation of workload and decline of working hours [35].

The study also shows that there is no relation between depression and either BMI or educational level. However, a previous study found that patients with abnormal high BMI had more depression [5]. Additionally, some studies found that patients with a low level of education were more depressed [5, 11, 12].

The results of the current study indicate higher depression scores among patients who were living in rural



areas and in camps more than those living in urban areas. Usually, people living in villages or camps have less income than people living in urban areas. In addition, when the income status was examined for rural and camp patients, we found out that almost 60% of rural and camp patients had a low monthly income. Furthermore, this difference may be attributed not only due to low income but also to other factors, such as the far distance between their living places, transportation difficulties, and absence of appropriate health services near to their living.

According to exercise practicing, this study shows a significant association between exercising regularly and depression. Patients who did not make any exercise had higher depression levels than those who exercise regularly. The mechanism for exercise–depression relationship is still unclear. The most logical hypothesis is that exercise increases the availability of neurotransmitters (serotonin, norepinephrine, and dopamine) which oppose depression, known as monoamine hypothesis. Furthermore, psychological exercise amuses from solitude and depression [36]. In addition, it can be difficult for patients with depression to start and maintain an exercise regimen. Depressive symptoms such as tiredness, indecisiveness, low self-esteem, loss of interest and pleasure, and poor sleep can affect motivation for exercise [37]. Higher anxiety levels in those patients may be at particular risk for noncompliance with exercise [38]. However, as this study was cross-sectional, this may prevent cause–effect relationship between exercise and depression to be identified.

Regarding disease comorbidities and medications used, there is a strong association between disease comorbidities and depression. The majority of our patients with three or more chronic comorbid diseases are significantly more depressed compared with patients with one, two, or without any comorbidities. Furthermore, this study shows a significant correlation between depression score and number of medications; patients who took multi-medications were more depressed than others.

Regarding dialysis-related parameters, there was no significant association between years of dialysis, number of dialysis per week, and duration of dialysis session and depression. In the current study, the median number of dialysis per week was 3.0, and the median of hours of dialysis session was 3.5 h. Although the standard duration of hemodialysis sessions is more than 3.5 h per session (4.5–5.0 h) [39], no significant difference was found between patients who had hemodialysis sessions of less than 3.5 h or who had hemodialysis sessions of 3.5 h and more and the depression score level.

The current study is the first of its kind in West Bank, Palestine, regarding depression and its associated factors among HD patients. The study included the appropriate

sample size from all HD centers in West Bank, Palestine. The data were gathered via face-to-face interview, which can result in entire and valid data, can capture verbal and non-verbal cues and emotions, and can make the patient focus while giving their answers. Moreover, the findings of this study will be the base for future studies about depression and other outcomes in HD patients in Palestine.

Furthermore, identification of depressed ESRD patients and improving the health system in these patients should be considered in different ways. These include establishing a program with psychiatric specialists and social support volunteers for the diagnosis and management of depression. In addition, different indicators are to be used to improve patients' mental thoughts, increasing awareness and knowledge towards adherence to their treatment regularly via making meetings and brochures and other advises to improve their quality of life and minimizing complications, costs, medication errors, and even death.

However, the current study had some limitations; face-to-face interviews may introduce a bias in patients who may want to respond in a private way, thus may generate socially desirable answers. Furthermore, the study was cross-sectional in its nature, which may prevent cause–effect relationships to be identified. In addition, the absence of control groups (i.e., hemodialysis depressed patients versus non-hemodialysis depressed patients) limits the interpretation of the hemodialysis burden on depression.

## Conclusions

This study is the first one regarding depression and its prevalence among HD patients in West Bank, Palestine. The incidence of depression is higher than that reported in other communities and has never been measured before. Elderly patient, female, living in rural areas or camp, low income, not doing regular exercise, unemployment, and having multi comorbidities were significantly associated with more depression scores. However, the results of binary logistic regression showed that only patients who were living in camps, patients who were previously employed, and patients who were not practicing exercise remained significantly associated with higher depression score. Our recommendations focused on three axis: hospital staff, patients, and further studies. The governmental hospitals need a multidimensional team of nephrologists, clinical pharmacists, nurses, psychologists, and social workers for early detection of depression. The clinicians must have skills in well-validated screening measurements for improving quality of life, decrease hospitalization and increase survival. Additionally, providing the patient's needs in terms of psychologist interviews and pharmacological and non-pharmacological interventions (family support, patient education, and antidepressant medications) is needed.

### Abbreviations

BDI-II: Beck Depression Inventory-II scale; BMI: Body mass index; BSA: Body surface area; CKD: Chronic kidney disease; CI: Confidence interval; ESRD: End-stage renal disease; GFR: Glomerular filtration rate; HD: Hemodialysis; IRB: Institutional Review Board; MOH: Ministry of Health; KDOQI: Kidney Disease Outcomes Quality Initiatives; NIS: New Israeli Shekel; OR: Odds ratio; RRT: Renal replacement therapy; SD: Standard deviation; SPSS: Statistical Package for the Social Sciences

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### Authors' contributions

SA had the idea for the study and led the study design, data analysis and interpretation, and drafting of the manuscript. AS, FJ, MT, MA, LS, and EL interviewed patients and participated in data interpretation and drafting. SZ and WS had the idea for the study, participated in the study design, and revised the article for important intellectual content. All authors read and approved the final manuscript and agreed on its submission.

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### Availability of data and materials

The datasets supporting the conclusions of this article are included within the article and available upon request.

### Declarations

#### Ethics approval and consent to participate

All aspects of the study protocol were authorized by the An-Najah National University Institutional Review Board (IRB) and Palestinian Ministry of Health (MOH) before initiating this study. Patients were included after we obtained their verbal consent.

#### Consent for publication

Authors' abstract was accepted in The Lancet Palestinian Health Alliance (LPHA) Eighth Annual Conference, 2017. Thereafter, it was published in the Lancet as abstract (2018;391 Suppl 2:S41. doi: 10.1016/S0140-6736(18)30407-0).

#### Competing interests

The authors declare that they have no competing interests.

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