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Prevalence of Cognitive Impairment and Its Associated Factors in Elderly Patients under Chronic Hemodialysis Treatment

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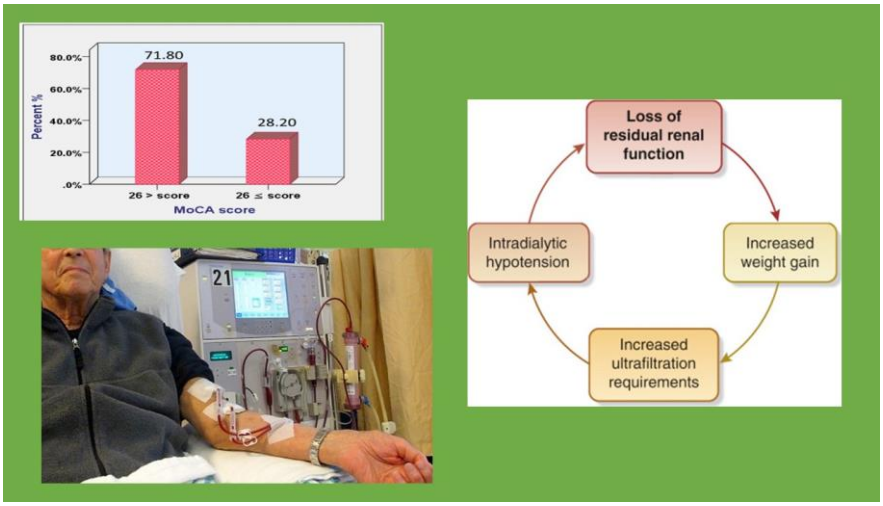
ABSTRACT

The present study was a cross-sectional investigation carried out on elderly patients under chronic hemodialysis who referred to Firoozabadi Hospital during 2019- 2020. The study population was 80 patients ≥ 60 years. The patients' cognitive status was determined using MMSE and MOCA tools. The mean age of the candidate patients was 71.71 ± 6.28 years old. Cognitive function was assessed by MMSE and MoCA tests and the mean score of the MMSE test was 20.05 ± 3.50 with the highest score being 26 and the lowest score being 12. Based on the results, these patients were divided into three groups with normal cognitive function, mild cognitive impairment, and severe cognitive impairment. According to the results of the MMSE test, 19 patients (23.75%) had a normal cognitive function and 45 patients (56.25%) had impairment. In other words, the older patients, the lower level of education, the longer duration of hemodialysis, and the patients with a history of diabetes were more susceptible to cognitive impairment. Subsequently, there was a positive correlation between the levels of BUN, creatinine, uric acid, and PTH, which means that the higher level of these variables in patients was related to the higher risk of cognitive impairment. The findings of the present investigation revealed that the cognitive function and the studied variables including age, level of education, history of diabetes, hemodialysis duration, BUN, Creatinine, Uric Acid, PTH, Sodium, and Kt/V had a significant difference in patients undergoing hemodialysis.

GRAPHICAL ABSTRACT



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Introduction

Based on a comparison of the world aging distribution map in 2015 and 2050, we have found that Iran will change from a young country to a definitive aging country in just the next 30 years [1-3]. In other words, while in 2020, the elderly over 60 years old constituted only 10% of the population of Iran, but as a result of the rapid phenomenon of population aging, in 2050 about 33% of the total population of the country will be elderly [4]. Despite the fact that Iran has not yet followed the path of technological progress and economic dynamism, it will lose a significant percentage of its population in the work and production cycle. In the present age, it is not a secret to any demographer and analytical thinker that population in all quantitative and qualitative dimensions is one of the most decisive and strategic strategic components of national authority and continuity of civilization [5-7]. Attempts are made to increase the population and promote the pattern of childbearing, and in about 75% of the countries of the world, there are targeted programs to maintain the internal authority of the population and the continuation of a sustainable population [8-10]. It is also clear that changes in demographic structures in any society can be the source of many economic, social, cultural, family and security developments, as the experience of the West confirms. Population is quantitatively and qualitatively effective in all components of national security of human societies; therefore, today in the prestigious international universities, the chair of population-based security studies has been established. Pattern of population density and geographical distribution, age composition and population structure, ethnic and religious ratio in different cities, border and centralization, internal and external migration, presence of foreign immigrants and age composition of military and law enforcement forces are among the categories that are strategic concepts of population, interwined with National security. The relationship between population and security is a two-way relationship, but the role and impact of demographic change in security issues will be much more important and tangible. Unmanaged changes in demographic structures have the potential to create cultural, sexual, family, etc. revolutions by affecting social, economic, and lifestyle phenomena, and these phenomena are directly determinants of variables affecting national security [11-13]. In the current situation, the security threats that will arise due to falling fertility rates and Iran's entry into the population crisis are very serious and it is necessary for the country's security experts and officials to work together with a group of demographers and demographers of all patterns to predict the interaction of population and security [14-16]. Population aging is one of the most important social developments of the 21st century. In other words, aging is an important and sensitive stage of human development, in which the needs of the elderly should be considered to improve their health and life quality [17-19]. According to a demographic index, more than 12% of the total population is 60 years and older which is considered the elderly population [20]. The United Nations (U.N.) estimates that the world's elderly population will reach 1.2 billion in 2025. Moreover, the growth rate of people ≥ 80 years is higher than other ages, so that the number of these population groups will increase from 143 million in 2019 to 426 million in 2050 [21].

According to the U.N. reports on 2019 that have published in UN site, nowadays, a large number of developed countries are an aging population. In the following, ountries are on the verge of entering an aging population, and a few countries have a young population [22]. In other words, the phenomenon of population aging is a pervasive phenomenon that will affect all countries with intensity and weakness. Although aging is developing rapidly in the developed regions of the world, less developed regions will experience this phenomenon faster and in a shorter period. Iran, as a developing country, will have faced the phenomenon of the aging population by 2030, there will be an explosion of aging, which is 25-30% of the country's population aged 50 and older. In this regard, according to the statistics of the Civil Registration Organization, the growth rate of the Iran population over 60 years old

(2011-2050) is predicted to be more than 26%-33% of the population [25-27].

Chronic kidney disease (CKD) is a progressive and irreversible deterioration of renal function that lasts for three months or more [28-30]. The classification of this disease is based on glomerular filtration rate (GFR) and is divided into five stages, accordingly. In the first stage of the disease, the patient's GFR is normal or slightly increased (GFR ≥ 90 ml/min) and the patient may also have hematuria or proteinuria. In the second stage, GFR is reduced (GFR = 89-60 ml/min). During the third stage, the GFR reaches 30-59 ml/min. GFR in the fourth stage is 15-29 ml/min. In the fifth stage, GFR is < 15 ml/min that is considered as the final stage of kidney disease (ESRD). In this stage, the kidneys lose their ability to maintain water/electrolyte balance, resulting in uremia, with a very poor prognosis for the patient [31]. Due to the annual growth of approximately 5-6% of ESRD patients in the world compared with the population growth in the world, this disease is one of the major therapeutic problems in all countries of the world. In Iran, the average prevalence of ESRD is higher than the global average (680 people per million) [32]. The global growth forecast for dialysis patients by 2020 shows that the population of these patients will reach 4 million [33].

To prevent uremia and its complications, ESRD patients need one of the kidney replacements therapies (RRT) including dialysis or transplantation. The availability of these two methods, the quality of dialysis, and how to support patients' post kidney transplantation are entirely dependent on the socio-economic structure and health care facilities in the community. In Iran, due to problems of access to the transplanted kidney, until the transplant, all patients will be treated with dialysis. Hemodialysis treatment of CKD, in addition to imposing high costs on society, causes many physical/mental problems for patients [34-36]. Recent studies have reported a prevalence of cognitive impairment in ESRD patients undergoing hemodialysis between 30 and 60%, which is at least twice as high as in age-adjusted control groups [37].

Epidemiological findings suggest that people with CKD at all stages have a higher risk of developing cognitive impairment and dementia. This risk is mainly explained by the high prevalence of vascular and ischemic events, but other mechanisms, including direct damage to neurons by uremic toxins, are also effective. Cognitive impairment in CKD is not limited to stage 5 patients. The cross-sectional studies have reported CKD occurrence in the early stages. However, the pattern of cognitive impairment in CKD patients with a GFR < 30 is different from other CKD groups. Especially, the attention, executive function, and latency were higher [38].

Taken together, due to the high prevalence of cognitive disorders in ESRD patients, undergoing hemodialysis and its negative impacts on the life quality, recognizing the factors affecting cognitive disorders, its timely diagnosis, and treatment in dialysis wards are the fundamental parameters. Therefore, the present paper aimed to determine the prevalence of cognitive disorder in hemodialysis patients and identify the factors affecting it in Firoozabadi Hospital [39].

Importance and necessity

The progressive increase in the elderly population, especially in developing countries, has led to more attention being paid to the health of this sensitive age group. Accordingly, as life expectancy in societies increases, policies and practical programs should be adopted to maintain and promote their physical and mental health. During the last two decades, the number of elderly people with chronic kidney disease has increased in most countries, including our country, and the age pattern of this disease has tended towards aging. About 40% of patients on dialysis are over 65 years old. The growing number of chronic kidney diseases in the elderly population led to March 13, 2014 being designated as "World Kidney Day and Chronic Kidney Disease in the Elderly" to highlight the importance of aging and the possibility of developing chronic kidney disease [40]. And if people do not pay attention to the health of their

kidneys, especially in people over 50, in the coming years, we will see a dramatic increase in the number of patients with chronic kidney disease [41-44]. Studies show that hemodialysis patients are at risk for cognitive impairment and the prevalence of cognitive impairment in ESRD patients undergoing hemodialysis is reported to be between 30-60%. The prevalence of cognitive impairment and dementia in patients with end-stage renal disease is twice as high as in the elderly who do not have chronic renal failure. Cognitive impairment in these patients is not limited to stage 5 disease and may occur in the early stages of the disease [42-44]. Early detection of cognitive disorders and timely treatment in the early stages of the disease can largely prevent possible consequences by slowing its progression, reducing treatment costs, and reducing the pressure and burden of the disease on others. Also, due to the fact that in previous studies, hemodialysis elderly people have received less attention and studies in this field are few and less attention has been paid to the problems of this sensitive group, while this age group is increasing day by day. It is increasing in our country; therefore, this study was conducted to determine the prevalence of cognitive disorders in the elderly on hemodialysis and to identify the factors affecting it [45].

Material and methods

The present investigation is of a cross-sectional design. The study was conducted on the elderly patients undergoing chronic hemodialysis who referred to Firoozabadi Hospital in 2019-2020. The sample of the study included 80 patients selected randomly and entered the study with informed consent. The inclusion criteria were: 1. The patients' age was ≥ 60 years old; 2. CKD diagnosis was performed by a nephrologist; 3. The patient should be on hemodialysis for at least 3 months. Patients with a definitive diagnosis of dementia, debilitating neurological/orthopedic diseases, and depression based on GDS criteria were exclusion criteria items. After providing adequate explanations and training to the participants, consent forms were provided. Demographic information of patients included age, gender, body mass index (BMI), history of smoking/alcohol. Besides, the medical history information such as CKD-associated diseases (e.g. diabetes, hypertension) as well as variables related to patients' hemodialysis including duration of dialysis, blood pressure of patients before and after dialysis was gathered. The laboratory parameters including hemoglobin, renal and hepatic function tests, lipid profile, mineral metabolism, albumin, serum electrolytes, TSH, PTH, Kt/V were measured in candidate patients. Patients' cognitive status was assessed with MMSE and Montreal cognitive assessment (MoCA) tools. MMSE is an acceptable tool for dementia screening, and since it is less valid for MCI and has a sensitivity of 18%, MoCA as a better tool for MCI screening was also used. The cognitive domains of attention, focus, executive function, visual-spatial, memory, language, computation, and orientation were checked. A MoCA score of less than 26 indicated the cognitive impairment and higher than or equal to 26 is normal. It is necessary to mention that the cognitive function significantly worsens during the dialysis session. As a result, the best time to perform a cognitive test was before dialysis or the day after dialysis [46].

Statistical analysis

The data of the current study were analyzed employing SPSS software (version 22). Accordingly, the number and percentage of studied variants were calculated and reported using multiple regression analysis (e.g. T-test, Mann-Whitney, and Friedman test). Statistically, $P < 0.05$ was considered a significant difference.

Result and Dissection

According to MMSE test results, patients were divided into three groups with normal cognitive function, mild and severe cognitive impairment. 19 patients (23.75%) had a normal cognitive function, 45 patients (56.25%) had mild cognitive impairment, and 16 people (20%) had severe cognitive impairment. Furthermore, the mean of cognitive score was 20.05 % ± 3.5 among the patients (minimum: 12% ± 3.5 and maximum: 26% ± 3.5).

In addition to the MMSE test, the MoCA assessment was carried out in which, the 8

cognitive domains were assessed through a variety of skills including short-term memory (delayed recall), visual-spatial skills (cube drawing, clock drawing), executive functions (following numbers and letters, speech, and abstraction), attention, focus, working memory (omission, subtraction, counting capacity), language (naming, repetition), and awareness of time and place. Compared with MMSE, the MoCA test was more sensitive and complicated. Of course, it should be noted that many of the questions in this test were highly dependent on education. Since the literacy rate in 34 patients (42.5%) of candidate patients was 5 classes, it was not possible to perform the MoCA test in all members of the study population. The results of this test revealed that the mean cognitive score was 21.94 % ± 3.09 among the patients (minimum: 18% ± 3.5 and maximum: 26% ± 3.5) (Figure 1).

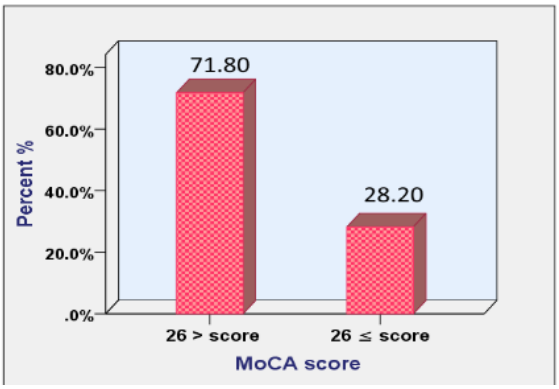

Figure 1: Relative frequency distribution of patients based on cognitive function according to MoCA test results

In terms of age frequency distribution, the highest frequency was in the age group of 84 years old. The minimum age of patients was 60 and the maximum age was 84 years old. The mean age of candidate patients was 71.71 ± 6.28 years old (Table 1). According to the findings of the current study, there was a significant difference between the ages of patients (P < 0.001) (Table 1).

Table 1: Frequency distribution of age in the studied patients

		Age (year)			Total
		<70	70-80	>80	
Cognitive dysfunctions	Severe	4	7	5	16
	Mild	16	21	8	45
	Normal	12	5	2	19
Total		32	33	15	80

According to the findings of the current study, there was no significant difference between the genders of patients (Table 2).

The mean of BMI in the patients was 27.27 ± 3.88 (minimum: 19% ± 3.8 and maximum: 36% ± 3.5) that there was no significant difference between groups (Table 3). Subsequently, the mean education level in the patients was 7.32 ± 2.41 (minimum: 5% ± 2.41 and maximum: 12% ± 2.41) that there was a significant difference between groups (P < 0.001) (Table 4).

Table 2: Frequency distribution of gender in the studied patients

		Gender		**Total**
		Female	**Male**	
Cognitive dysfunctions	**Severe**	**8**	**8**	**16**
	Mild	**19**	**26**	**45**
	Normal	**10**	**9**	**19**
Total			**43**	**80**

Table 3: Frequency distribution of BMI in the studied patients

		BMI (kg/m²)			Total
		<25	**25-30**	**>30**	
Cognitive dysfunctions	**Severe**	8	7	1	16
	Mild	10	24	11	45
	Normal	8	8	3	19
Total			39	15	80

Table 4: Frequency distribution of education level in the studied patients

		Education level (year)			Total
		5	6-10	>10	
Cognitive dysfunctions	Severe	11	4	1	16
	Mild	23	19	3	45
	Normal	0	11	8	19
Total			34	12	80

Concerning smoking and alcohol consumption, the results indicated that there was no significant difference between groups (alcohol: Table 6) (smoking: Table 5).

Table 5: Frequency distribution of smoking in the studied patients

		Smoking		Total
		No	Yes	
Cognitive dysfunctions	Severe	9	7	16
	Mild	24	21	45
	Normal	10	9	19
Total			37	80

Table 6: Frequency distribution of alcohol consumption in the studied patients

		Alcohol		Total
		No	Yes	
Cognitive dysfunctions	Severe	14	2	16
	Mild	35	10	45
	Normal	17	2	19
Total		66	14	80

About life situations, there was no significant difference between groups (Table 7).

Table 7: Frequency distribution of life situation in the studied patients

		Life situation			Total
		Retirement home	Single	With family	
Cognitive dysfunctions	Severe	3	6	7	16
	Mild	8	8	29	45
	Normal	2	5	12	19
Total			19	48	80

Table 8 the frequency distribution of diabetes among candidate patients in which there was a significant difference between groups ($P < 0.05$).

Table 8: Frequency distribution of diabetes in the studied patients

		diabetes		Total
		No	Yes	
Cognitive dysfunctions	Severe	3	13	16
	Mild	18	27	45
	Normal	11	8	19
Total			48	80

The results of hypertension, systolic/diastolic pressures before and after dialysis revealed that there was no significant difference between groups (data not shown). In contrast, the mean of

hemodialysis duration in the patients was 46.33 ± 16.62 (minimum:8 ± 16.62 and maximum: 89 ± 16.62) that there was a significant difference between groups (P < 0.01) (Table 9). Moreover, the mean of BUN serum level in the patients was 47.63 ± 12.69 (minimum: 30 ± 12.69 and maximum: 85 ± 12.69) that there was a significant difference between groups (P < 0.05) (Table 10).

Table 9: Frequency distribution of hemodialysis duration in the studied patients

		Hemodialysis duration (month)			Total
		<30	30-50	>50	
Cognitive dysfunctions	Severe	3	5	8	16
	Mild	9	17	19	45
	Normal	7	8	4	19
Total			30	31	80

Table 10: Frequency distribution of BUN in the studied patients

		BUN (mg/dl)			Total
		<40	40-60	>60	
Cognitive dysfunctions	Severe	2	9	5	16
	Mild	15	23	7	45
	Normal	9	7	3	19
Total			39	15	80

According to the obtained results of creatinine serum level, its mean in the patients was 4.03 ± 1.15 (minimum: 2.1 ± 1.15 and maximum: 7.9 ± 1.15) that there was a significant difference between groups (P < 0.01) (Table 11). Besides, the mean of Kt/V was 1.09 ± 0.28 (minimum: 0.5 ± 0.28 and maximum: 2.1 ± 0.28) that there was a significant difference between groups (P < 0.01) (Table 12).

Table 11: Frequency distribution of creatinine serum level in the studied patients

		Ferritin (ng/dl)			Total
		<50	50-80	>80	
Cognitive dysfunctions	Severe	9	5	2	16
	Mild	11	22	12	45
	Normal	3	11	5	19
Total		23	38	19	80

Table 12: Frequency distribution of Kt/V serum level in the studied patients

		Kt/V		
		Kt /V<1.2	1.2 ≤Kt /V	
Cognitive dysfunctions	Severe	10	6	16
	Mild	26	19	45
	Normal	9	10	19
Total			35	80

About other laboratory factors, including Hemoglobin, ferritin, AST, and ALT, there was no significant difference between groups. The results are presented in Tables 13-16, respectively.

Table 13: Frequency distribution of Hemoglobin serum level in the studied patients

		Hemoglobin (gr/dl)			Total
		<10	10-11	>11	
Cognitive dysfunctions	Severe	4	9	3	16
	Mild	7	20	18	45
	Normal	2	8	9	19
Total			37	30	80

Table 14: Frequency distribution of Ferritin serum level in the studied patients

		Ferritin (ng/dl)			
		<50	50-80	>80	
Cognitive dysfunctions	Severe	9	5	2	16
	Mild	11	22	12	45
	Normal	3	11	5	19
Total			38	19	80

Table 15: Frequency distribution of AST serum level in the studied patients

		AST (IU/Lit)			Total
		<40	40-80	>80	
Cognitive dysfunctions	Severe	11	4	1	16
	Mild	30	13	2	45
	Normal	11	7	1	19
Total			24	4	80

Table 16: Frequency distribution of ALT serum level in the studied patients

		ALT (IU/Lit)			Total
		<40	40-80	>80	
Cognitive dysfunctions	Severe	10	5	1	16
	Mild	29	13	3	45
	Normal	12	6	1	19
Total		51	24	5	80

Subsequently, between studied groups, there was a significant difference in acid uric serum level ($P < 0.01$). More data are presented in Table 17.

Table 17. Frequency distribution of Acid uric serum level in the studied patients

		Acid uric (mg/dl)			Total
		<6.5	6.5-8.5	>8.5	
Cognitive dysfunctions	Severe	4	3	9	16
	Mild	17	19	9	45
	Normal	13	4	2	19
Total			26	20	80

Comparison of the results related to the factor serum levels such as Triglyceride, Cholesterol, LDL, HDL, Phosphorus, and Calcium determined that there was no statistical difference between groups. The relevant Tables of mentioned factors are shown below (Tables 18-22, respectively).

Table 18: Frequency distribution of Triglyceride serum level in the studied patients

		Triglyceride (mg/dl)			Total
		<150	150-250	>250	
Cognitive dysfunctions	Severe	2	12	2	16
	Mild	7	31	7	45
	Normal	2	14	3	19
Total			57	12	80

Table 19: Frequency distribution of Cholesterol serum level in the studied patients

		Cholesterol (mg/dl)			Total
		<150	150-250	>250	
Cognitive dysfunctions	Severe	3	11	2	16
	Mild	6	32	7	45
	Normal	2	14	3	19
Total			57	12	80

Table 19: Frequency distribution of LDL serum level in the studied patients

		LDL (mg/dl)			Total
		<100	100-150	>150	
Cognitive dysfunctions	Severe	2	12	2	16
	Mild	11	27	7	45
	Normal	3	13	3	19
Total			52	12	80

Table 20. Frequency distribution of LDL serum level in the studied patients

		HDL (mg/dl)			Total
		<40	40-50	>50	
Cognitive dysfunctions	Severe	3	9	4	16
	Mild	5	33	7	45
	Normal	2	12	5	19
Total			54	16	80

Table 21: Frequency distribution of Calcium serum level in the studied patients

		(mg/dl) Calcium			Total
		<8.5	8.5-10.5	>10.5	
Cognitive dysfunctions	Severe	5	9	2	16
	Mild	7	33	5	45
	Normal	3	14	2	19
Total			56	9	80

Table 22. Frequency distribution of Phosphorus serum level in the studied patients

		Phosphorus(mg/dl)			Total
		<3.5	3.5-5.5	>5.5	
Cognitive dysfunctions	Severe	1	7	8	16
	Mild	3	26	16	45
	Normal	1	9	9	19
Total			42	33	80

The serum levels of Potassium (Table 23), TSH (Table 24), and albumin (Table 25) had no statistical difference.

Table 23: Frequency distribution of Sodium serum level in the studied patients

		Sodium (meq/lit)			Total
		<135	135-145	>145	
Cognitive dysfunctions	Severe	5	10	1	16
	Mild	16	27	2	45
	Normal	3	15	1	19
Total		24	52	4	80

Table 24: Frequency distribution of Potassium serum level in the studied patients

		Potassium (meq/lit)			Total
		<3.5	3.5-5.5	>5.5	
Cognitive dysfunctions	Severe	1	13	2	16
	Mild	3	39	3	45
	Normal	1	15	3	19
Total			67	8	80

Table 25: Frequency distribution of TSH serum level in the studied patients

		TSH (micIU/ml)			Total
		<0.5	0.5-5	>5	
Cognitive dysfunctions	Severe	2	11	3	16
	Mild	6	34	5	45
	Normal	2	15	2	19
Total			60	10	80

Table 26: Frequency distribution of Albumin serum level in the studied patients

		Albumin (g/dl)			Total
		<3.5	3.5-5.5	>5.5	
Cognitive dysfunctions	Severe	5	10	1	16
	Mild	11	31	3	45
	Normal	6	12	1	19
Total			53	5	80

Table 27. Frequency distribution of Albumin serum level in the studied patients

		Albumin (g/dl)			Total
		<3.5	3.5-5.5	>5.5	
Cognitive dysfunctions	Severe	5	10	1	16
	Mild	11	31	3	45
	Normal	6	12	1	19
Total			53	5	80

The prevalence of cognitive disorders in candidate patients was significantly higher in the areas of Orientation, Attention (Table 28), Language (Table 29), and Copying (Table 30), but not in Registration and Recall (Table 31).

Table 28: Frequency distribution of Attention & Calculation in the studied patients

		Attention & Calculation (score)		Total
		<3	3-5	
Cognitive dysfunctions	Severe	16	0	16
	Mild	40	5	45
	Normal	11	8	19
Total			13	80

Table 29: Frequency distribution of Language in the studied patients

		Language (Score)			Total
		<4	4-6	>6	
Cognitive dysfunctions	Severe	6	9	1	16
	Mild	4	23	18	45
	Normal	0	2	17	19
Total			34	36	80

Table 30: Frequency distribution of Copying in the studied patients

		Copying (score)		Total
		0	1	
Cognitive dysfunctions	Severe	11	5	16
	Mild	10	35	45
	Normal	1	18	19
Total			58	80

Table 31: Frequency distribution of Registration & Recall in the studied patients

		Registration & Recall (score)		Total
		<4	4-6	
Cognitive dysfunctions	Severe	4	12	16
	Mild	4	41	45
	Normal	3	16	19
Total			69	80

To determine the prevalence of cognitive disorder and identify the factors affecting it, the present investigation was implemented on 80 elderly hemodialysis patients. Cognitive function in these patients was assessed by MMSE and MoCA tests.

In a study conducted by Dutra et al., the aim was to evaluate the cognitive impairment and related factors in the patients with chronic renal failure undergoing hemodialysis. The results exhibited that older patients, lower education, and longer hemodialysis were more susceptible to develop cognitive impairment [47]. In this investigation, the prevalence of cognitive impairment in elderly CDK patients was 44% and there was a significant relationship between cognitive function and education level, economic, and social status. Besides, a negative relationship between the duration of hemodialysis and cognitive function in these patients was reported. At the end of this study, it was manifested that there was no significant difference between patients' cognitive function with gender, marital status, religion, and job status [48]. In the line with these findings, the results of the current survey showed that there was a significant relationship between cognitive function and the studied variables, e.g. age, education, history of diabetes, duration of hemodialysis, BUN, Creatinine, Uric Acid, PTH, Sodium, and Kt/V, in hemodialysis patients. In other words, the older the patients, lower level of education, longer duration of hemodialysis, and patients with a history of diabetes, were more prone to cognitive impairment. Subsequently, there was a positive relationship between the levels of BUN, Creatinine, Uric Acid, and PTH, which means that the higher level of these variables increased the risk of cognitive impairment in the candidate patients. In contrast, there was an inverse relationship between cognitive function and the level of sodium, which means that the patients with hyponatremia were more prone to cognitive impairment. The other results revealed that inadequate hemodialysis (Kt/ V < 1/2) was higher in patients with cognitive disorders than patients with normal cognitive function. Moreover, Linda Shavit proved that there was a powerful relationship between cognitive function and hyponatremia in these patients [49].

Based on the results of the present study, there was no significant difference between the cognitive function and the studied variables, i.e. gender, BMI, smoking, alcohol consumption, history of hypertension, SBP, and DBP before and after dialysis, in hemodialysis patients. Also, there was no significant relationship between cognitive function in these patients with the studied laboratory variables, e.g. Hemoglobin, Ferritin, AST, ALT, Triglyceride, Cholesterol, LDL, HDL, Calcium, Phosphorus, Potassium, TSH, and Albumin. To investigate hemodynamic changes during dialysis and its effect on cognitive disorders, Wolfgram et al. (2016) established that there was no significant relationship between the cognitive function of patients undergoing chronic hemodialysis and changes in blood pressure during dialysis [50]. These findings are consistent with the results of the current survey [48].

The results of the present investigation indicated that the prevalence of cognitive disorders in patients undergoing chronic hemodialysis was higher in certain areas, e.g. orientation, attention and calculation, language, copying, which there was a significant difference between patients with normal cognitive function and patients with cognitive impairment in these areas. However, in the field of registration and recall, there was no significant difference between these two groups.

Post et al., evaluated the cognitive impairment in hemodialysis patients. The results showed that the prevalence of cognitive impairment in patients undergoing hemodialysis was higher in the areas of concentration, processing speed, executive function, and language compared with the control group. Nevertheless, in the field of memory, there was no significant difference between patients undergoing chronic hemodialysis with the control group [47]. The results of this examination are in line with the findings of the present study.

Conclusion

The results of the present investigation revealed that the cognitive function and the studied variables including age, level of education, history of diabetes, hemodialysis duration, BUN, Creatinine, Uric Acid, PTH, Sodium, and Kt/V had a significant difference in patients undergoing hemodialysis. Likewise, the prevalence of cognitive disorders in candidate patients was higher in the areas of orientation, attention, language, and copying.

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Authors' contributions

All authors contributed toward data analysis, drafting and revising the paper and agreed to be responsible for all the aspects of this work.

Conflict of Interest

We have no conflicts of interest to disclose.

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