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Investigating polymorphisms related to chronic kidney disease and the effect of health and nursing education on self-management ability and quality of life in hemodialysis patients

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ABSTRACT

The effects of health and nursing education are fundamental and essential in achieving the desired quality of life. In recent years, the impact of health and nursing education and self-management ability in many diseases, including kidney patients and those undergoing dialysis and hemodialysis, have been highly regarded. Studies have shown that modern nursing training and self-management ability have an influential role in the treatment process of hemodialysis patients. In general, self-management is a common term in health education and includes symptom management, treatment principles, consequences, and lifestyle changes to maintain and improve quality of life. Planning and continuity of care are necessary for self-management, and the set of these factors is an important and effective issue in kidney and hemodialysis patients and has caused hope, encouragement, and encouragement to more and more patients, improving their quality of life and correct use of healthcare services. In this study, we investigated some health management parameters in the quality of life of hemodialysis patients. The results of this study showed that family support, self-management of personnel, and the nursing system have a positive and significant correlation with the quality of life in these patients ($p=0.002$). This means that family and social support along with the modern nursing system and self-management can lead to an increase in the quality of life in hemodialysis patients. Also, the results of polymorphism analysis in the GATM locus related to chronic kidney disease showed that the frequency of the A allele in SNP rs2453533-GATM is higher in CKD patients independent of dialysis (non-dialysis) compared to healthy people. Also, the intronic C allele of SNP rs4293393 (UMOD) was more common in healthy subjects than in CKD patients, and the intronic T allele of SNP rs9895661 (BCAS3) is associated with a decrease in eGFRcys and eGFRcrea.

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Introduction

Various studies show that single nucleotide polymorphisms can be effective in the occurrence and development of various diseases by changing the function and nature of the interaction of biological molecules. Polymorphism is a nucleotide change in the sequence of genes, the frequency of which is more than 1% in societies. Polymorphisms can change or destroy the recognition site of an enzyme and create different genotypes. Considering the epidemiological importance of chronic kidney diseases and taking into account the high economic costs and many problems of hemodialysis patients, it seems necessary to investigate the relationship between different gene polymorphisms (1).

Chronic kidney disease is a serious concern worldwide. In 2021, more than 520,000 people with kidney failure and treated with maintenance dialysis were identified in the United States (2). The incidence rate of this disease is 16.8% in the United States, 5% in Iceland, 10% in Norway, 20% in India, and 14% in Pakistan (3). The most common treatment method for kidney failure patients is hemodialysis, and each patient undergoes dialysis 3 times a week for 4 hours (4). In the last decade, home dialysis methods have been increasing due to cost reduction and patient-centered care, and the effort to understand and induce the issue that home dialysis methods provide similar clinical results at a much lower cost continues. In parallel with the growing acceptance of home dialysis methods, doctors, nurses, and treatment staff provide recommendations, incentive programs, quality of patient care, and modern education systems to patients undergoing hemodialysis treatment (5). In general, hemodialysis patients experience a wide range of lifestyle changes that affect their social and mental health. In general, the process of treating hemodialysis patients has a long-term process in which the patient must manage his chronic disease to improve his condition (6).

Hemodialysis

Hemodialysis is the most common method for treating advanced kidney failure. The kidneys keep the blood clean by removing excess fluids, minerals, and waste materials. At the same time, they make hormones that keep bones strong and help to produce blood in the body. When the

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kidneys fail, harmful waste materials and fluids accumulate in the body, blood pressure may rise, and red blood cells may not be produced enough in the body (7-8).

Hemodialysis was used for the first time in 1960 AD as a practical treatment for kidney failure and until today this treatment method has been combined with these more efficient methods and its side effects have been minimized (9). In recent years, dialysis machines have become smaller and more portable, simpler and more advanced, and as a result, they have become more attractive to patients. But even with the best methods and equipment, hemodialysis is still a complex treatment that requires the planning and coordination of a complete healthcare team, including a kidney specialist (urologist), a dialysis nurse, a dialysis technician, a nutritionist, and a social worker. But the most important factor that is very effective in the treatment process is self-management and support of family members (10).

How hemodialysis works

Hemodialysis is a process in which blood is removed from the body of a patient suffering from kidney failure and returned to the body after being filtered in the dialysis machine. A dialysis machine or an artificial kidney is a machine that can remove waste materials from the blood, or add necessary materials to it. By performing this procedure, the dialysis machine controls the balance of acid and base and the amount of water and soluble substances in the body. In hemodialysis, blood is gradually removed from the body, passes through a special filter that separates waste materials and excess fluid, and the purified blood is returned to the body. The removal of harmful waste materials and excess salt and fluids from the body controls blood pressure and maintains the balance of chemicals such as potassium and sodium (Figure 1). Of course, it should be noted that this artificial kidney cannot perform an important task of the natural kidney, that is, the production of hormones that affect blood pressure and hematopoiesis (11-16).

Side effects in hemodialysis patients

Many factors are effective in patients with kidney failure who are undergoing hemodialysis, and it seems necessary to pay attention to these cases by nurses, treatment staff, and even the patient himself to improve the treatment conditions. Among these cases, we can mention depression, which will cause many psychological problems and sometimes lead to suicide or stopping dialysis (17). Malnutrition is another factor that is very common in patients who undergo hemodialysis for a long time and almost one-third of hemodialysis and peritoneal dialysis patients suffer from it (18). A significant percentage of hemodialysis patients develop diabetes after the treatment process. In this case, the use of natural sweeteners that lead to the regulation of sugar, cholesterol, and blood pressure will be very effective (19). People undergoing hemodialysis suffer from anemia compared to other people with chronic kidney failure. This anemia is mainly caused by a decrease in the production of erythropoietin by sick kidneys (20). Other cases such as blood disorders (21), endocrine (22), bone diseases (23), and cardiovascular diseases (24) have also been seen in patients undergoing hemodialysis treatment, which should be taken into account in the nursing and self-management program in order to ensure proper prevention.

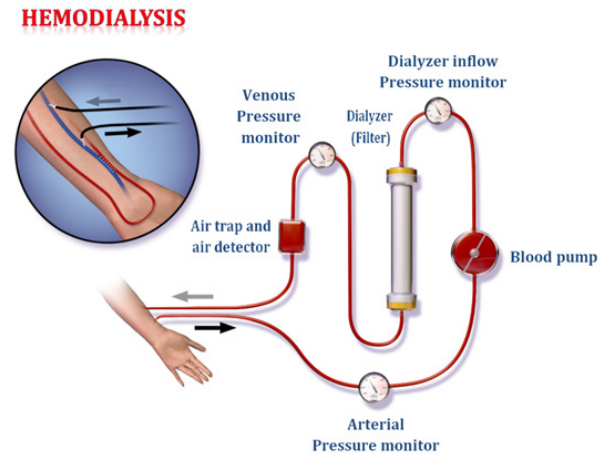

Figure 1. The method of performing hemodialysis with different components (16).

Patients should follow a strict schedule when starting hemodialysis treatment. Most of the patients should undergo dialysis three times a week and each time for 3 to 5 hours or more, by referring to the clinic. Researchers are investigating whether shorter dialysis sessions or longer nocturnal dialysis sessions (while the patient sleeps) can be equally effective in removing waste materials. However, newer dialysis machines that can be used at home have made these alternatives more practical. On the other hand, with a short training course, one of the patient's family members or friends can be prepared to perform dialysis at home. Dialysis at home allows the patient to organize his daily plans better. In this case, the duration of each dialysis session or the number of sessions per week may be different from dialysis in the clinic, but in any case, there must be a regular plan for dialysis.

Polymorphism in GATM locus associated with chronic kidney disease (CKD)

Many studies investigate the genetic difference between dialysis-independent chronic kidney disease and dialysis-dependent kidney failure. Overall, ten gene loci associated with glomerular filtration rate and genetic eGFRcys and eGFRcrea have been identified from genome-wide association studies (GWAs) for association with chronic kidney disease (CKD), including dialysis-independent and dialysis-dependent end-stage CKD (Table 1). Salamon et al.'s results showed that the frequency of the A allele in SNP rs2453533-GATM is higher in CKD patients independent of dialysis (non-dialysis) compared to healthy individuals. On the other hand, the frequency of the A allele did not increase significantly in dialysis-dependent kidney failure patients who needed hemodialysis. The intronic C allele of SNP rs4293393 (UMOD) was more frequent in healthy subjects than in CKD patients, and the intronic T allele of SNP rs9895661 (BCAS3) is associated with a decrease in eGFRcys and eGFRcrea. GATM risk allele carriers in the non-dialysis group may have a genetic predisposition to higher creatinine production rather than increased serum creatinine due to impaired renal function, and therefore, do not progress to dialysis-dependent renal failure (25).

Table 1. Associations in Fisher's exact case-control analysis between chronic kidney disease (CKD) patient groups and the healthy control group (25).

Test	SNP	Gene	Effect allele
All CKD patients vs. controls	rs1047891	CPS1	A
	rs2453533	GATM	C
	rs1145084	GATM	G
	rs4293393	UMOD/PDILT	C
	rs11864909	UMOD/PDILT	C
CKD dialysis-independent vs. controls	rs1047891	CPS1	A
	rs2453533	GATM	C
	rs1145084	GATM	G
	rs4293393	UMOD/PDILT	C
Kidney failure vs. controls	rs11864909	UMOD/PDILT	C
Kidney failure vs. CKD dialysis-independent	rs1145084	GATM	G

Materials and Methods

The research method used was descriptive and correlational, and the statistical population included 60 patients with kidney failure who underwent hemodialysis treatment. In these questionnaires, various parameters such as family support, social support, self-management, drug management, life management, disease limitations, emotional role, personnel and nursing, and mental health were examined. To measure the desired variables, 60 series of questionnaires were given to 60 hospitalized patients, which were completed by the patient himself or his companion. In order to comply with ethical principles, the identity of the person was not included in any of the questionnaires, and only demographic information such as age and gender were recorded in the questionnaires. After data collection, the statistical information was analyzed by SPSS software, and the mean standard deviation, correlation level, and significance level in the studied parameters were statistically analyzed.

Results

The statistical sample studied in this research included 60 patients with kidney failure who underwent hemodialysis treatment with an average age of 37.13; of which 32 people were women (53.3%) and 28 people were men (46.7%). Table 2 shows the mean, standard deviation, and correlation of parameters affecting the quality of life such as family support, social support, life management, disease limitations, emotional role, personnel and nursing, medication management, self-management, and mental health in patients with kidney failure who underwent hemodialysis treatment. According to these results, it was found that the highest average is related to personnel and the nursing system (121.08±15.08) and the lowest average is related to mental health (3.08±5.78). The results of the correlation of the examined parameters with the quality of life in hemodialysis patients showed that social support (**0.50) and mental health (**0.49) show the highest correlation with the quality of life at α=0.05% level and family support (*0.33) and disease limitations (*0.33) at α=0.01% level have the highest correlation with the quality of life in patients. According to these results, family and community support along with other investigated parameters have a great impact on the quality of life and the treatment process.

Discussion

Health education, continuity of care, and safe and timely transfer of the patient from the hospital to home or other care centers has played an important role in improving the quality of life, reducing hospitalization costs, reducing health care costs in patients undergoing hemodialysis, chronic obstructive pulmonary disease, stroke, and heart failure patients. In the studies conducted by Li et al. on 100 kidney transplant recipients, it was found that health and nursing education and continuous care, and improvement of self-management knowledge have increased

Table 2. Mean, standard deviation, and correlation of parameters affecting the quality of life in patients undergoing hemodialysis treatment.

Variables	Average	standard deviation	Correlation (R)
mental health	5.78	3.08	0.49**
Disease limitations	7.29	3.56	0.33*
social support	13.12	5.29	0.50**
Medication management	38.88	6.59	0.16
Life management	17.97	4.65	0.26
self-management	30.46	4.13	0.08
Emotional role	19.93	4.60	0.15
Family support	13.80	2.88	0.33*
Personnel and nursing	121.08	15.08	0.24

** α=0.01; * α=0.05; p=0.002; R^2=22.8.

the patient's quality of life and improved their treatment process (26). Hong et al examined 89 patients with acute kidney injury who were undergoing long-term treatment, and their results showed that modern nursing methods along with self-management training facilitated their recovery process (27). In general, continuity of care and self-management has become a new therapeutic strategy to increase the confidence of hemodialysis patients in-home treatments. The results of this study also showed that self-management interventions are effective in improving the quality of life of dialysis patients due to the shortage of personnel and nurses, which is consistent with the results of Wong et al (28). Also, Kemmerer et al. have introduced the active participation of patients and the continuous cooperation of patients and health care providers as a successful strategy to achieve treatment goals in hemodialysis patients (29). It should be noted that hemodialysis is a special condition caused by a wide range of other diseases. Therefore, the degree of disease control is influenced by other diseases, which should be taken into account in the self-management program. The genotypic frequency of polymorphisms is related to the occurrence of kidney diseases. In the meantime, investigating the correlation of these polymorphisms with chronic kidney disease shows that GATM risk allele carriers in the group independent of dialysis may have a genetic predisposition to higher creatinine production instead of increasing serum creatinine due to kidney dysfunction. Therefore, when using eGFR-crea to diagnose CKD, clinicians should have information about creatinine-enhancing loci.

According to the results of this research, the need for proper support from society and family is felt. Also, it is necessary to teach self-management solutions to the patients to ease the problems caused by the treatment process.

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Statements and Declarations
The author declares that no conflict of interest is associated with this study.

Authors' contribution
This study was done by the authors named in this article, and the authors accept all liabilities resulting from claims which relate to this article and its contents.

Conflicts of interest
There are no conflicts of interest.

Availability of data and materials
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