Impact of Alkaline Ionized Water on Improving Selected Outcomes for Hemodialysis Patients: A Randomized Controlled Trial

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Abstract

Background: Alkaline ionized water may offer a safe and potentially beneficial strategy for the management of metabolic acidosis in patients with renal failure or undergoing dialysis, but further research is warranted. **Aim**: The aim of the study is to examine the impact of alkaline ionized water on improving outcomes among patients with hemodialysis. **Methods:** A parallel group randomized controlled trial was conducted involving 114 participants aged 18 years or older who had been receiving hemodialysis (HD) three times per week for at least 3 months. Structured Interviewing questionnaire, Assessment follow up tool and Kidney Disease Quality of Life Short Form tools were used to collect pertinent data. **Results**: Regarding the electrolytes measurements and urine output revealed high statistical significance (p = .000*) between the control and study participants except the result of PH has no statistical significance in both groups. As well as there was high statistical difference (p = .000*) regarding the study participants' quality of life measurements at different times, especially after the intervention. **Conclusions**: The current study demonstrated significant improvements in primary clinical outcomes, including sodium, potassium, calcium, urea, creatinine, albumin, glomerular filtration rate, urine output, and blood pressure. Furthermore, significant improvements were observed in secondary outcomes, such as medical burden, disease symptoms, and quality of life scores. The study recommended to Develop evidence-based clinical guidelines for the safe and effective use of alkaline ionized water in hemodialysis patients, considering individual patient needs and potential contraindications.

Keywords: Alkaline water – outcomes – patients with hemodialysis

Introduction

Water is the ultimate vital element of the human body. Water current account for 60-65% of an adult's body mass, 55% or less for women, and up to 75% for children. A recognized hydration state is critical for whole health **(Munteanu et al, 2021),** Several processes in our bodies are performed by intra and extracellular water. Water stimulates most metabolic activities, permits various fragments and molecules to dilute, aids in the movement of metabolites, and accelerates the usage of by-products. Water is essential for thermoregulation because it nourishes and hydrates tissues and organs. The appropriate functioning of the entire body is determined by effective hydration **(Song, et al, 2024).**

Chronic kidney disease (CKD) is well-defined as the existence of kidney impairment or a predictable glomerular filtration rate of less than 60 ml/min per that continues for three months or extended more. It is a slow decline of kidney function that ultimately requires renal replacement treatment (dialysis or transplantation). Kidney disease has numerous causes; Scientific research indicates that 35% of what happens in the body is inherited, with the remaining 65% being controllable by lifestyle choices **(Vaidya & Aeddula, 2024).** An antidiuretic hormone that controls thirst, water conservation and is vital for water regulation. Antidiuretic hormone has vasoconstrictive characteristics, which impair renal hemodynamics, blood pressure, and ventricular function (**Yoshimura, Campbell & Ueta 2021).**

Alkaline water gives a higher pH than ordinary drinking water, as well as alkaline basics and the capability to reduce oxidation. Water can be initiated using a variety of approaches, involving electrolysis, light radiation, ultrasonication, magnetic field handling, bubbling with gases, and treatment with specific minerals or rocks **(Chan et al, 2022).** Alkaline water has an alkaline pH (Power of Hydrogen). Because this water molecule is a micro cluster, it is easily absorbed and penetrates the cells to hydrate intracellularly **(Muncan, et al, 2024).** Earlier studies found that regular drinking of mineral water or liquid refreshment with added bicarbonate has been shown to have useful effects in terms of rising urinary pH **(Mansouri, et al,2024).**

According to scientific studies, it had been assumed to determine the efficacy of alkaline water in lowering the risk of metabolic syndrome or other health problems **(Tanaka et al, 2019).** The ORP value (Oxidation Reduction Potential) is quite negative. The greater the ORP score, the higher the antioxidant and dissolved hydrogen content, capable of protecting and preventing oxidative damage. As a result, to enhance Fe absorption. **(Handayani & Widyawati_2020).** On the other hand, Nutritional acid load is linked to bone loss; to maintain a steady pH, the body employs buffer mechanisms such as bone, CO_2 expiration, and renal acid excretion. In healthy patients, potassium bicarbonate, potassium citrate, and even bicarbonate-rich mineral water reduced calciuria and bone resorption indicators **(Frassetto, et al, 2018).**However, specific structured studies of alkaline water (ALK) found that Alkaline water (ALK) has been greater to average purified water in reestablishing rehydration and high blood viscosity during two hours after recovery period following exercise induced thirst **(Wu, et al, 2024).**

Patients with chronic kidney disease are at risk for abundant nutritional and metabolic irregularities. These include protein-energy waste, obesity, nutrient deficiencies, undesirable electrolytes imbalances, and metabolic abnormalities. Clinical practice guidelines 2020, endorse initiation of alkali treatment is specifically serious for those who (CKD), and especially for Metabolic acidosis, which is one of the utmost predominant significances of CKD, particularly in patients with a glomerular filtration rate to a lesser extent of 25 mL/min/1.73 m2 **(Akchurin, 2019).** To avoid or treat problems of metabolic acidosis, including aggravation of bone disorders, amplified muscle abnormalities with consequential reduced albumin synthesis, and amplified inflammation, trials aim to explore the rapid and extended effects of alkali water in patients with CKD on hemodialysis, as related to ordinary care and treatment. (**Ikizler & Cuppari_2021).**

In dialysis setting quality of care is very essential because such setting require competent nurses have entirely concerned of patient comprehensive care. In adding, quality of care is continuously appreciating by patients with hemodialysis by giving actual and effective care accordingly the most up to date standards of wholistic care, which meet the patient needs and gratify health care health team. Furthermore, healthcare management must have the magnitude to converge the expectancies of both the patients with hemodialysis and the healthcare team. **(Saleh, Ali, & Afifi, 2018)**.

In current years, energies to enhance quality of life in hemodialysis patients were measured as one of the important aims of treatment in the end stage renal disease (ESRD) having encouraged health care providers to assume more research to find different magnitudes of quality of life and effective ways to improve these. Nurses are an influential member of the health care team and have a pointed role in caring for patients with hemodialysis, in identifying the needs of patients and their families. Reducing complications of the disease and advancing quality of life. The quality of life given a main point in any evaluative research. **(Porter, 2018).**

Nursing managing in utilizing alkaline ionized water in patients with hemodialysis involves a comprehensive, evidence-based method about assessment, planning, implementation, and evaluation. While specific, universally accepted guidelines for alkaline ionized water use in hemodialysis are still evolving, nursing management would draw upon values of fluid and electrolyte balance, acid-base regulation, patient education, and research incorporation. Detailed intake and output monitoring, daily weights, assessment for edema, blood pressure measurement. Nursing management utilizing alkaline ionized water for hemodialysis patients is a dynamic process that requires a strong foundation in nephrology nursing principles, meticulous assessment and monitoring skills, effective patient education, interprofessional collaboration, and a commitment to evidence-based practice. As more research emerges, nursing management protocols will likely become more refined and standardized. **(Masià-Plana, & Alhameedi, 2024).**

Significant of the Study

The nurse's role is considerable in utilizing alkaline ionized water to potentially improve the outcomes of patients with hemodialysis. Their involvement bridges across multiple hemodialysis areas, ensuring safe, effective, and patient-centered implementation of this adjunctive therapy. Nurses are the primary healthcare professionals who constantly assess the patient's overall condition, including fluid balance, electrolyte levels, acid-base status, and any co-morbidities. This thorough assessment is crucial to identify patients who might benefit from alkaline water and require careful monitoring. Nurses are accountable for the regular monitoring of key indicators that alkaline water is intended to influence, such as fluid balance, electrolyte levels as potassium, acid-base balance, and patient reported outcomes like quality of life.

Nurses have a dynamic position in educating patients and their families about alkaline ionized water its potential benefits and how to use it correctly. This education fosters understanding and encourages adherence to the prescribed regimen. Nurses provide hands-on advice on combining alkaline water into the patient's daily routine, addressing any challenges related to taste, timing, or storage. Nurses can provide ongoing support and encouragement to patients, reinforcing the potential benefits of alkaline water and helping them stay motivated to adhere to the therapy. Detailed and precise documentation of alkaline administration, patient reactions, and any observed variations is essential for evaluating the efficiency of the therapy and detecting potential concerns. Nurses serve up as a key communication connection between the patient, nephrologist, dietitian, and other members of the healthcare team, spreading important information about the patient's response to alkaline ionized water.

In research settings, nurses are often fundamental to the precise and consistent collection of data related to alkaline ionized water outcomes. Their direct patient interaction can clue to the recognition of important research questions and areas for further investigation regarding alkaline water. By staying updated about the latest research and contributing to data collection, nurses contribute in the direction of the evidence based supporting interventions or refuting consumption of alkaline water for patients with hemodialysis.

There is a climbing both incidence and prevalence rate of patients with hemodialysis. The mortality rate of patients with hemodialysis is high and remarkable more of any other disorders. End Stage renal disease (ESRD) holds significantly high numbers in developing countries such as Egypt. ESRD of hospitalized in-patients is around 1.68% of total hospitalized Egyptian patients and meant that, Egypt is the front-runner of the slope of countries of high mortality rate of patients with kidney impairments , as 25% of patients die every year, While the worldwide death percentage of this disease is only 10%. **(Saleh, Ali, & Afifi, 2018).**

Aim of the Study

The aim of the study is to examine the impact of alkaline ionized water on improving selected outcomes among patients with hemodialysis.

Operational definition of outcomes

- The current study evaluated both *clinical outcomes*, and *patient-reported quality of life outcomes*. The clinical outcome is measured through the international normal values of the following blood biomarkers; sodium, potassium, calcium, urea, creatinine, albumin, Ph, glomerular filtration rate in addition to urine output, change in body weight measured and blood pressure measurement.

- Patient-reported quality of life of kidney disease is measured by Kidney Disease Quality of Life-Short Form (KDQOL-SF) which is a validated questionnaire assessing various aspects of quality of life related to kidney as medical outcome, burden of disease, symptoms and problems, effect of disease quality of life.

Research Hypothesis

H_1: Hemodialysis patients consuming alkaline ionized water will demonstrate significantly improved clinical outcome compared to those consuming regular drinking water.

H_2: Hemodialysis patients consuming alkaline ionized water will demonstrate significantly improved patients' reported quality of life outcome compared to those consuming regular drinking water.

Methods:

Research Design

Random control trail design (RCT) parallel double blind was used to fulfill the aim of proposed study.

Setting

The study was conducted in Nasser Institute allied to the Secretariat of Specialized Medical Centers, Ministry of health, Cairo. The nephrology department consists of a kidney disease unit, kidney transplantation unit and hemodialysis unit. The hemodialysis unit serves 70-90 patients daily through 46 dialysis machines.

Sample

A random sampling of (114) Patients were incorporated in the study if they were over 18 years old and had received HD three times a week over 3 months. The sample is calculated by power analysis N=160, Z=1.96, d=.05 according to steven equation. Subjects were randomly assigned into two groups; a study group (A) receiving alkaline ionized water (57); and (B) a control group receiving conventional protocol (57). Potentially eligible patients were requested by researchers who clarified the study, confirmed eligibility, and obtained written informed consent.

Inclusion criteria included end stage kidney failure and glomerular filtration is around 30 to 60 mL/min per 1.73 m2 and an albumin-to-creatinine ratio of greater than 25 mg/g for female or greater than 18 mg/g for male. Urine output is more than 500 cc/24 hours. *Exclusion criteria* included a 24-hour urine amount less than 500 ml, have kidney calculi in the past 5 years, diabetic, or heart disease patients, currently ton a diuretic therapy, and any patient with a documented history of mental or cognitive disorder was excluded.

After providing written informed consent, patients required a pre-randomization 24-hour urine collection to verify their urine volume was more than 500 ml per 24-hour which was an eligibility condition for randomization.

Randomized Allocation

Once study eligibility was established, concealed randomized allocation was executed by computer-based randomization, was created by a expert statistician using SAS statistical software version 9.3 and was stratified by sex with a 1:1 allocation using random permuted block sizes of 4 and 6.

Intervention Group

Patients in the alkaline ionized consumption group were instructed to the importance of drinking their alkaline water consumption by 1.0 to 1.5 Liter every day depending on urine output per day and according to physician instruction.

Control Group

Patients in the control group were instructed to continue with their usual fluid intake of 1.0 L per day with normal water and according to physician instruction.

Tools for Data Collection

Three tools were used for data collection: The tools were constructed by the researcher through extensive review of the relevant literature **(Paul, O'Connor, Elinor, 2022).** All tools were filled by the investigator. Tools were agreed by a panel of experts in the field for content validity.

A) *Structured Interviewing questionnaire tool* included two parts: Part I: Demographic characteristics such as, age, residence, education, marital status, and occupation. Part II: Biomedical data such as cardiac disease, chronic hypertension, diabetes mellitus, respiratory asthma, anemia, liver disease, and many others.

B) *Assessment follow up tool* included: serum sodium, serum calcium, serum urea, serum creatinine, serum albumin, pH of the blood, variations in body weight, systolic and diastolic blood pressure and in 24-hour urine volume and glomerular filtration.

C) *Kidney Disease Quality of Life Short Form (KDQOL- SF 36).* Kidney disease quality of life short form is developed by RAND to evaluate the QOL in CKD patients (RAND 2018). The KDQOL survey is designed for quick administration, typically taking between 3 and 5 minutes to complete. Each subscale is scored on a range from 0 to 100, with higher aggregate values indicating better health. The initial section of the KDQOL (items 1–12) focuses on medical outcomes, while the subsequent part (items 13–16) comprises the "burden of kidney disease" subscale. This latter section includes questions assessing the extent to which kidney disease impacts daily life, consumes time, causes frustration, or makes the respondent feel like a burden.

The third part of Kidney Disease Quality of Life-36 (KDQOL-36) instrument, utilized in its linguistically and conceptually equivalent Arabic version, assesses various aspects of a participant's well-being. Items 17 through 28 form the "symptoms and problem list" subscale, gauging concerns related to physical symptoms such as muscle soreness, chest pain, cramps, skin issues, respiratory difficulties, faintness, fatigue, numbness, nausea, and dialysis access problems. Following this, the "effect of kidney disease" subscale (items 29–36) explores how participants are concerned about the impact of their condition on daily life, including fluid and dietary restrictions, ability to perform household tasks or travel, reliance on medical professionals, stress, sexual life, and personal appearance. This instrument demonstrated strong internal reliability, evidenced by a Cronbach's alpha of 0.81, along with significant inter-item correlation across its five subscales. **(Elamin et al 2019).**

Data Collection Procedure:

Alkaline Ionized Water Machine Approved by US FDA ISO 13485 Medical Grade Approved, that provided alkaline water (PH Levels: 2.5 PH TO 11.5 PH Highest Ever with Hydrogen Boost Technology Up to 1600 PPB) used in preparing alkaline water to the study group participants. Patients in the alkaline hydration group were equipped with three reusable 3-liter drinking containers and directed to refill them with alkaline water obtained from the filter within the dialysis unit at each session.

Data was collected from all participants including demographic data such as age, level of education, marital status and so on. In addition to data related to blood pressure, body weight, calculated body mass index, other blood biomarkers as Na, K, CA, Ur, Cr, Alb, Ph of the blood, glomerular filtration rate, in addition to urine output and quality of life of kidney disease as baseline data; then follow up for patients after week and month were done. Blood pressure was assessed at baseline and then measured on three subsequent occasions.

Ethical Considerations

An authorized ethical permission was taken from the ethical committee of faculty of nursing, MTI University number (FAN/137/2024) and the hospital administrative personnel in the recommended setting to grant to collect the data. Participants were fully informed about the study's purpose and significance. The research investigators point out the voluntary nature of contribution, assuring complete anonymity and confidentiality during data coding. Furthermore, participants were informed of their absolutely freedom to withdraw from study at any time without needing to provide a reason. Written informed consent was secured from all participants who met the inclusion criteria and approved to participate.

Statistical analysis

The analysis subjects involve of all patients in study and control groups who were randomized and have valid data for baseline and follow-up after week and month using tool II and tool III. Upon completion of data collection, the information will be tabulated and analyzed using Statistical Package for Social Science (SPSS) program, version 20. The analysis will include both descriptive and inferential statistics. Descriptive statistics will involve calculating means and standard deviations for each component of the dependent variables, along with frequencies and percentages. Inferential statistics, such as ANOVA, T-test, and Chi-square, will be employed to examine differences and similarities between the study groups, with a set level of significance at 0.05.

Results

Table (1) presents the demographic data of the study participants. (80.8%, 73.7%) of the participants' Age ranged from 20 - 39 years old for the control and study groups respectively. (54.3%) were male in both study and control groups. In relation to place of residence, 68.4% and 75.4% live in urban areas. 54.4% of the control group participants get secondary education degree while 43.9% of the study group had primary educational level. As for working status, (56.1% & 59.6%) of both groups' participants were working.

Fig (1- 4) percentage distribution of the medical and health-related data among the study participants. The figures show that (61.40%, 64.90%) of both groups' participants have no other co-morbid diseases. Regarding the years of hemodialysis, (73.7%) of the control group depend on hemodialysis for less than 2 years while (49.2%) of the study group for the same range and most of them (89.5%, 87.7%) in both groups had 3 sessions/week. In relation to the participants BMI, 50.9% of the control and 71.9% of the study participants were overweight.

Table (2 & 3) illustrates that there is no statistical difference in both groups' body weight before the intervention, while there is marked decline in the study group participants' body wight after the intervention. Regarding the electrolytes measurements and urine output, the ANOVA test shows high statistical significance (p = .000*) between the control and study participants results except the result of PH has no statistical significance in both groups

Table (4) shows that there is high statistical difference (p = .000*) regarding the study participants blood pressure measurements at different times especially after the intervention.

Table (5) highlights the study participants' quality of life (QoL) scores; there is no marked change at the different QoL domains for the control group at the tree times while on the other hand; the study group QoL domains showed notable severity decline which refers to accepted quality of life improvement, especially at the domains of: the disease burden (7% , 28.1%, 29.8%) for the control group and (70.25 % , 52.6% , 36.8%) for the study group throughout the follow up periods. As well as signs and symptoms (84.2 %, 86%, 77.2%) for the control group and (91.2 %, 47.4%, 10.5%) for the study group throughout the follow up periods.

Tables (6-7) the ANOVA test reveal that there is high statistical difference (p = .000*) regarding the study participants QoL measurements at different times, especially after the intervention.

Section 1: Demographic and Health-related data

Table (1): Distribution of Demographic data among the Study Participants (n=114)

Demographic data	Control(n=57)		Study(n=57)		X^2	p
	No.	%	No.	%		
Gender					0.03	0.85
Male	32	56.1	33	57.9		
Female	25	43.9	24	42.1		
Age					1.4	0.7
20-29	23	40.4	24	42.1		
30-39	23	40.4	18	31.6		
40-49	5	8.8	8	14.0		
50-60	6	10.5	7	12.3		
Mean ± SD	33.8 ± 10.1		34.9 ± 11.3			
Residence					0.69	0.4
Urban	39	68.4	43	75.4		
Rural	18	31.6	14	24.6		
Education					5.2	0.15
Read and write	2	3.5	4	7.0		
Primary	15	26.3	25	43.9		
Secondary	31	54.4	22	38.6		
University	9	15.8	6	10.5		
Occupation					0.14	0.7
Working	32	56.1	34	59.6		
Not working	25	43.9	23	40.4		

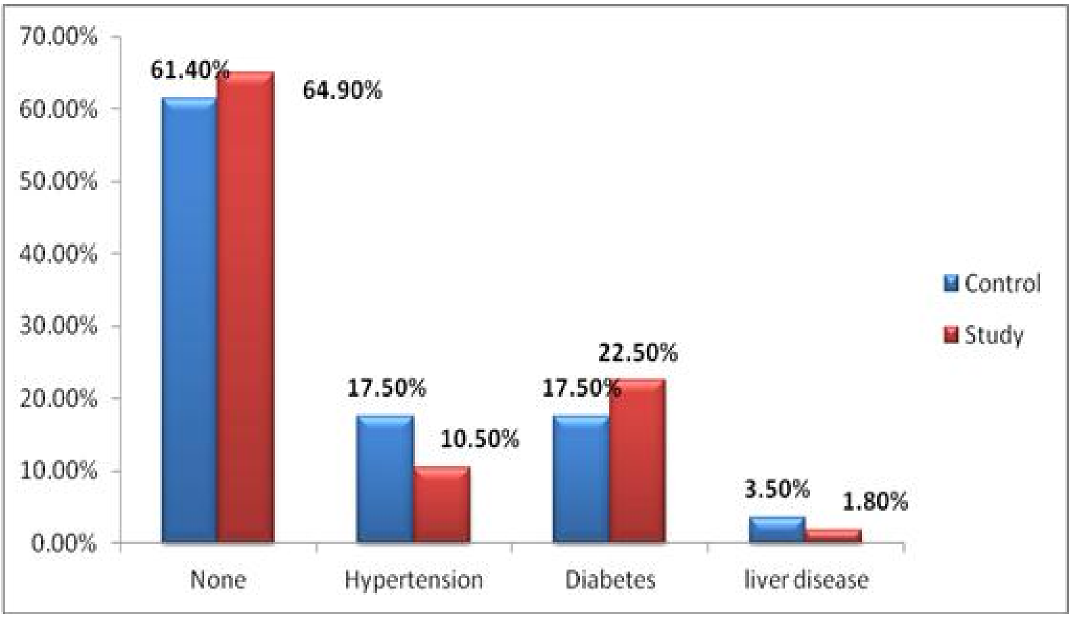

Fig. (1): Distribution of Study Participants ‘as regards Co-Morbid Diseases (n= 114)

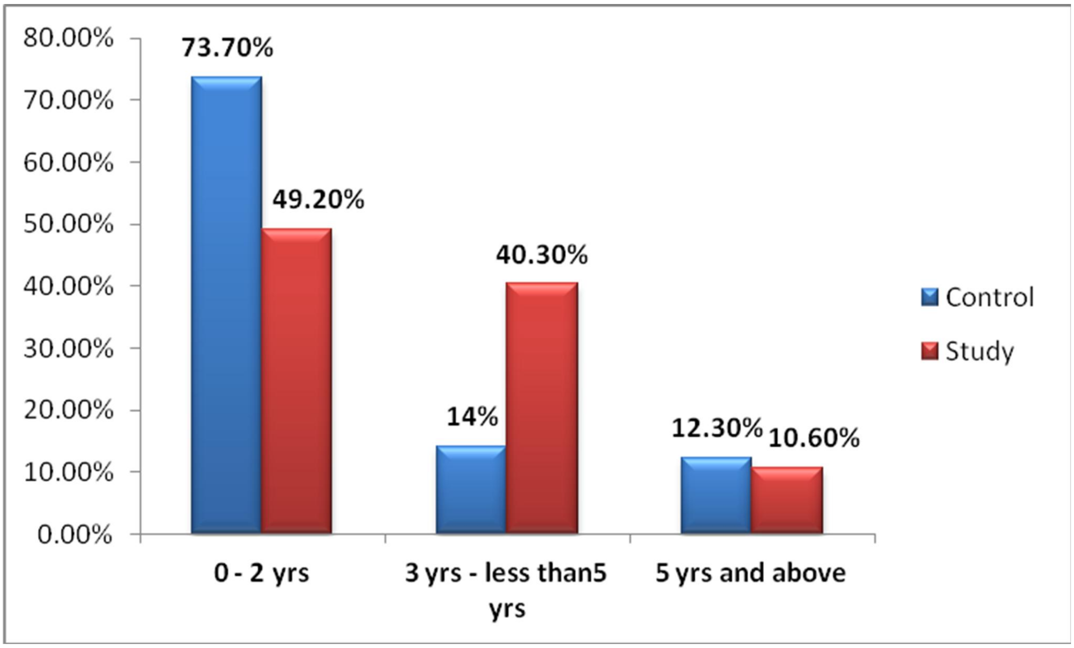

Fig. (2): Distribution of Study Participants' as regards Years of Hemodialysis (n= 114)

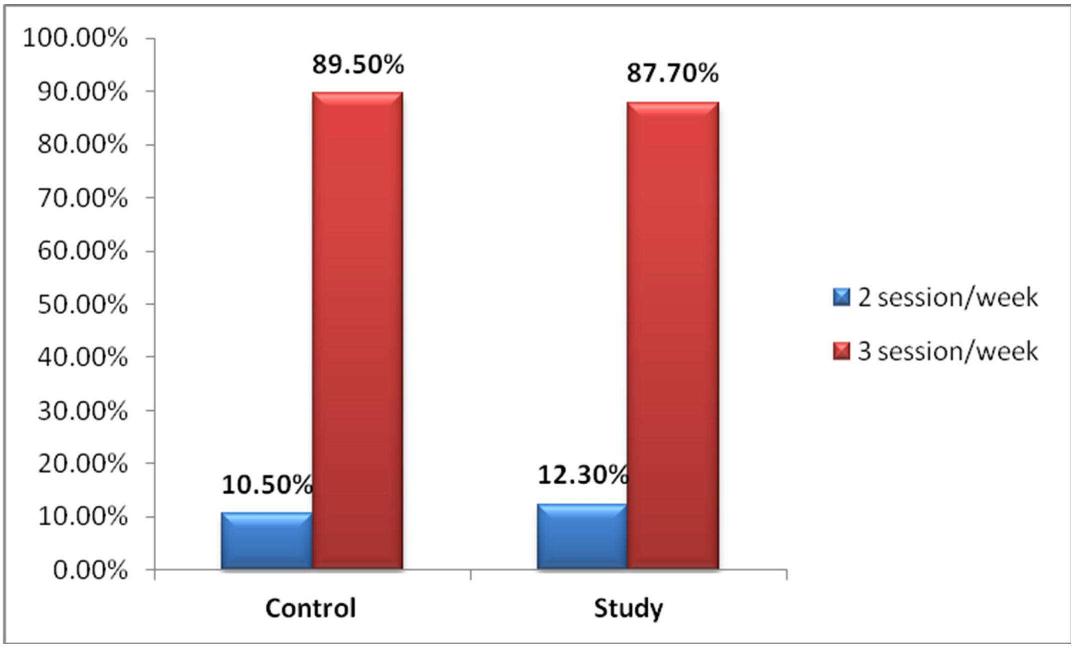

Fig. (3): Study Participants' Number of Hemodialysis Sessions/week (n= 114)

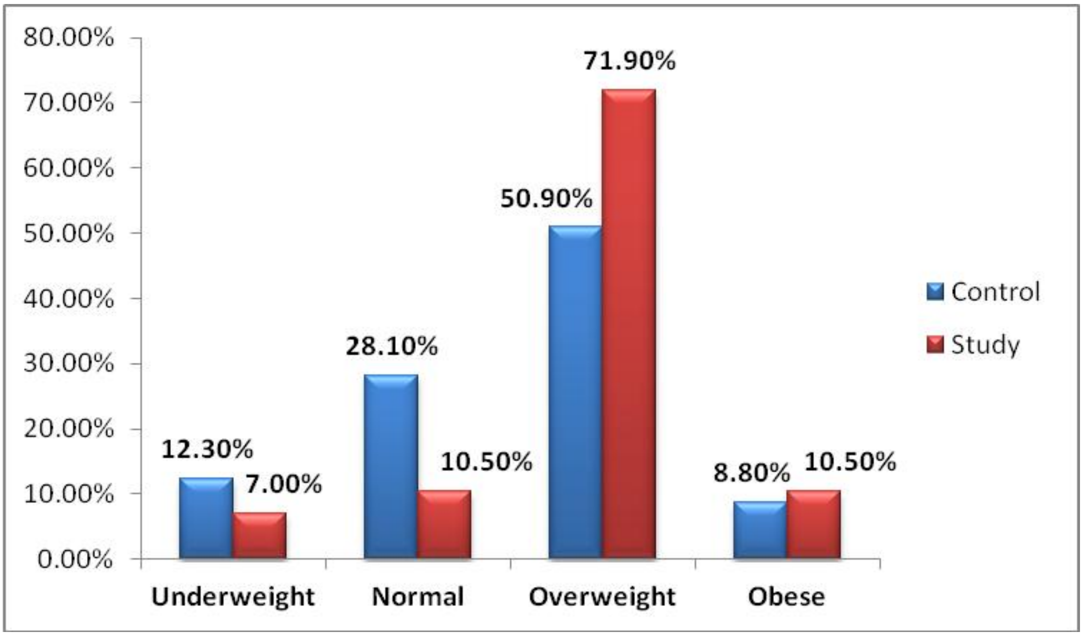

Fig. (4): Study Participants' Body Mass Index (n= 114)

Section II: follow-up data

Table (2): ANOVA test of Measurements of Study and Control Groups of Certain Clinical Parameters at Different Times of Assessment

Items	Control group								Study group							
	Time 1		Time 2		Time 3		ANOVA	p	Time 1		Time 2		Time 3		ANOVA	p
	Mean	SD	Mean	SD	Mean	SD			Mean	Sd	Mean	SD	Mean	SD		
Body weight before	82.54	13.32	83.07	13.18	83.91	13.29	.154	.857	82.26	11.33	80.89	11.07	80.05	10.69	.583	.559
Body weight after	80.44	13.14	80.58	13.54	81.26	13.16	.063	.939	80.05	11.25	77.79	10.89	76.54	10.36	1.535	.218
Na	139.56	2.05	139.23	1.74	138.96	1.49	1.615	.202	139.63	2.09	136.47	1.71	136.25	1.56	62.810	.000*
K	5.48	0.35	5.56	0.29	5.48	0.33	1.113	.331	5.57	0.29	5.03	0.33	4.57	0.29	153.176	.000*
Ca	8.69	0.19	8.68	0.21	8.71	0.16	.192	.826	8.70	0.20	8.49	0.19	8.54	0.16	19.596	.000*
Ur	58.74	2.89	58.65	2.32	58.63	2.77	.025	.975	57.82	3.42	53.28	3.81	48.74	3.30	95.109	.000*
Cr	4.78	0.14	4.76	0.14	4.77	0.13	.380	.684	4.78	0.14	4.41	0.20	4.20	0.28	106.462	.000*
Alb	3.47	0.32	3.26	0.16	3.41	0.29	9.428	.000	3.37	0.23	4.32	0.35	4.66	0.39	233.611	.000*
PH	7.36	0.04	7.36	0.04	7.36	0.04	.032	.969	7.36	0.04	7.37	0.03	7.37	0.04	.947	.390
GFR	3.99	0.43	4.00	0.42	3.96	0.41	.155	.856	4.00	0.42	4.67	0.56	5.70	0.55	160.833	.000*
Urine output	0.73	0.03	0.73	0.02	0.73	0.02	.256	.775	0.73	0.02	0.80	0.04	0.85	0.04	127.929	.000*

*Significant at p-value<0.05

Table (3): Difference between Measurements of Study and Control Groups at Different Times of Assessment.

Items	Difference					
	Time 1		Time 2		Time 3	
	F	p	F	p	F	p
Body weight before	.015	.904	.910	.342	2.918	.090
Body weight after	.028	.867	1.468	.228	4.527	.036*
Na	.033	.857	72.451	.000*	90.612	.000*
K	2.132	.147	82.077	.000*	245.428	.000*
Ca	.056	.813	26.073	.000*	31.647	.000*
Ur	2.361	.127	82.543	.000*	300.983	.000*
Cr	.004	.948	109.659	.000*	191.251	.000*
Alb	3.792	.054	430.435	.000*	371.221	.000*
PH	.001	.980	1.778	.185	.238	.627
GFR	.008	.930	52.721	.000*	374.124	.000*
Urine output	.173	.679	142.231	.000*	324.957	.000*

*Significant at p-value<0.05

Table (4): Difference Between Blood Pressure of Study and Control Groups

Blood pressure	Before				After 1				After 2				After 3			
	Control(n=57)		Study(n=57)		Control(n=57)		Study(n=57)		Control(n=57)		Study(n=57)		Control(n=57)		Study(n=57)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
130/90	2	3.5	4	7.0	6	10.5	3	5.3	0	0.0	28	49.1	0	0.0	22	38.6
140/90	5	8.8	7	12.3	11	19.3	5	8.8	6	10.5	1	1.8	0	0.0	1	1.8
140/95	0	0.0	0	0.0	0	0.0	1	1.8	21	36.8	22	38.6	9	15.8	34	59.6
145/90	0	0.0	0	0.0	2	3.5	0	0.0	0	0.0	6	10.5	9	15.8	0	0.0
145/95	6	10.5	0	0.0	3	5.3	1	1.8	3	5.3	0	0.0	2	3.5	0	0.0
150/80	15	26.3	10	17.5	0	0.0	18	31.6	25	43.9	0	0.0	37	64.9	0	0.0
150/90	15	26.3	20	35.1	33	57.9	29	50.9	2	3.5	0	0.0	0	0.0	0	0.0
160/90	14	24.6	16	28.1	2	3.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
X^2	11.3				27.5				37.5				85.5			
P	0.07				0.00*				0.00*				0.00*			

*Significant at p-value<0.05

Section III: Quality of life

Table (5): The Frequency and Percentage Distribution of The Quality-Of-Life Domains among The Study Participants (n=114)

Items	Control group						Study group					
	Time 1		Time 2		Time 3		Time 1		Time 2		Time 3	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Medical outcome												
Mild	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Moderate	7	12.3	7	12.3	11	19.3	7	12.3	9	15.8	19	33.3
Severe	50	87.7	50	87.7	46	80.7	50	87.7	48	84.2	38	66.7
Burden of disease												
Mild	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Moderate	53	93.0	41	71.9	40	70.2	17	29.8	27	47.4	36	63.2
Severe	4	7.0	16	28.1	17	29.8	40	70.2	30	52.6	21	36.8
Symptoms and problems												
Mild	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	11	19.3
Moderate	9	15.8	8	14.0	13	22.8	5	8.8	30	52.6	40	70.2
Severe	48	84.2	49	86.0	44	77.2	52	91.2	27	47.4	6	10.5
Effect of disease												
Mild	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Moderate	0	0.0	0	0.0	1	1.8	2	3.5	11	19.3	35	61.4
Severe	57	100.0	57	100.0	56	98.2	55	96.5	46	80.7	22	38.6

Table (6): ANOVA test of the Study Participants' Quality of life at Different Times of Assessment

Items	Control group								Study group							
	Time 1		Time 2		Time 3		ANOVA	p	Time 1		Time 2		Time 3		ANOVA	p
	Mean	SD	Mean	SD	Mean	SD			Mean	SD	Mean	SD	Mean	SD		
Medical outcome	40.72	2.60	40.47	2.28	40.58	2.62	.138	.871	39.72	2.91	40.82	2.90	42.19	3.73	8.536	.000*
Burden of disease	51.95	3.76	53.25	5.46	53.70	6.39	1.672	.191	52.67	2.46	56.54	4.71	58.46	5.84	23.855	.000*
Symptoms and problems	63.37	5.72	64.18	6.42	63.67	6.76	.238	.788	66.07	5.90	56.61	6.52	44.12	8.45	139.428	.000*
Effect of disease	106.51	6.91	107.12	6.45	108.47	7.90	1.140	.322	107.79	7.51	100.37	7.14	91.58	10.80	50.276	.000*
Total	262.54	11.32	265.02	12.27	266.42	14.79	1.324	.269	266.25	10.76	254.35	14.71	236.35	19.34	54.850	.000*

*Significant at p-value<0.05

Table (7): Difference between the Study Participants' Quality of life at Different Times of Assessment

Items	Difference					
	Time 1		Time 2		Time 3	
	F	p	F	p	F	p
Medical outcome	3.742	.056	.515	.474	7.151	.009*
Burden of disease	1.460	.230	11.922	.001*	17.203	.000*
Symptoms and problems	6.169	.014*	38.898	.000*	186.118	.000*
Effect of disease	.898	.345	28.127	.000*	90.855	.000*
Total	3.201	.076	17.673	.000*	86.933	.000*

*Significant at p-value<0.05

Discussion

Metabolic acidosis stands as a prevalent complication in chronic kidney disease (CKD). Clinical guidelines advocate for initiating alkali treatment when blood serum bicarbonate levels fall below 22 mEq/L. This intervention aims to prevent or mitigate severe complications associated with metabolic acidosis, such as bone disease, accelerated muscle degradation, impaired albumin synthesis, and heightened inflammation. **(Moribe et al, 2024).** Alkali therapy has been shown in various studies to decelerate the progression of chronic kidney disease (CKD), with several human trials supporting its beneficial impact on the disease's course. **(Sorohan et al, 2024).** In this study we aimed to examine the impact of alkaline ionized water on improving clinical outcomes among hemodialysis patients.

In this study, all patients with confirmed renal failure were undergoing hemodialysis. Researchers subsequently formed two comparable groups of these patients based on the type of water used during dialysis: one receiving conventional water and the other, alkaline water. At the start of hemodialysis, the groups exhibited similar demographic characteristics, with most participants aged between 20 and 39 years, and males constituting over half of mutually the study and control groups. In relation to places of residence, three quarters live in urban areas. More than half of participants get a secondary education degree and primary educational level. More than half of both groups' participants were working.

The two groups were comparable regarding the medical and health-related conditions and the start of the hemodialysis intervention program. The majority of both groups' participants have no other co morbid diseases. Regarding the years of hemodialysis, most of participants depend on hemodialysis for less than 2 years, they had 3 sessions/week. while the participants' BMI were overweight.

The current study revealed that the two groups were comparable concerning pre and post hemodialysis. Also illustrated that there is no statistical difference in both groups' participants' body weight before the intervention, while there is significant decline in the study group participants' body wight after the intervention. This could be explained by the fact that alkaline water consuming among intervention participants had significantly lower metabolic waste. The present result is in line with a study done by **Yahiro et al (2019),** on their study which related to investigating long-term effects of mineral water on intestinal microbiota, reported that anti-obesity properties of alkaline water. **Choi et al (2020),** studied a randomized, double-blind work related to outcomes of lifestyle modification of drinking electrolyzed-reduced water. The research conveyed that the effect of alkaline water on body weight was positive, while **Weidman et al (2016),** in their study concerned the effect of electrolyzed high-pH alkaline water on blood viscosity in healthy adults. The study reported a neutral effect concerning drinking alkaline water and participants' body weight.

The present study finding showed that the two groups were comparable regarding pre and post hemodialysis, the electrolytes measurements showed high statistical significance (p = .000*). Conversely, significant net decrease of serum potassium, improvement of serum sodium and serum calcium as associated with participants using alkaline water. In the same stream with this finding, **Chycki, et**

al (2017) in their study reported that water with alkalizing properties significantly enhances hydration, mitigates fluid and electrolyte imbalances, and accelerates lactate consumption following intense anaerobic exercise. Furthermore, the group receiving alkaline water demonstrated a notable reduction in both serum creatinine and urea levels. Similarly, in alkaline water group resulted in a significant net decrease in serum creatinine and urea. In contrast with this finding **Susiwati & Lusitano (2021),** in their study on differences of serum urea measurements in patients with hemodialyzed drinking Ro Water and alkaline water. They reported that the difference in urea and creatinine measurements before and after alkaline water consumption was not statistically significant.

The current analysis indicated an advancement in glomerular filtration, suggesting that consistent alkaline water consumption in long-term trials could potentially reduce the risk of requiring dialysis. These findings have significant hypothetical consequences for both the clinical managing of CKD patients and the economic considerations of kidney failure disease programs. This finding is consistent with **Susantitaphong et al (2012),** which reported alkali water drinking was related with a decrease in serum creatinine, decline in glomerular filtration and a lower frequency of dialysis initiation.

However, there is notable improvement of PH in intervention groups, but it has no statistical significance in both groups. Alkalinity is a determination of buffering function of water, and it is a significant parameter demonstrating the ability of water to neutralize acid. In agreement with **Harikumar et al, (2017),** in their study which mentioned that alkalinity depicted as a degree of water's buffering ability, is a crucial indicator of its ability to buffer acid. It is typically linked to high pH, and elevated levels of dissolved solids. While alkalinity itself is not considered harmful to humans and appears to have no adverse health effects, alkaline diets, conversely, may offer various health advantages. In the present study, results presented that there is high statistical difference regarding the study participants blood pressure measurements at different times especially after the intervention. These results may be related to alkaline water controlling oxidative pressure and reducing inflammation, indicating to lower blood pressure. Inconsistency in findings were giving proof in earlier studies; **Yang et al (2007);** in their study which concerned with oral consumption alkaline water, researchers hypothesized that using alkaline water as a hemodialysis have potent vasoconstrictors effects. In addition to **Nakayama et al (2010),** reported in a clinical trial on a patient with hemodialysis using dissolved dihydrogen the vasoconstriction effects of blood vessels. **Weidman et al (2016),** in their study which related to the effect of electrolyzed high-pH alkaline water on blood viscosity in adults. This study indicated that filtered alkaline water typically contains higher levels of essential elements like calcium and magnesium, which is hypothesized to have a decline in blood pressure measurements.

The present study reported that there are high statistical differences (p = .000* and .005*) between the results of control and study group in relation to quality of life parameters including medical outcome, burden of disease, symptoms and problems and effect of disease. This finding could establish a basis for a clinically relevant, effective, and reliable method of delivering hydrogen gas as a component of alkaline water to reduce cellular injury associated with kidney failure. In the same context, the study by **Kang et al (2011)** reported that cancer patients receiving radiotherapy often experience fatigue and impaired quality of life. Radiotherapy often leads to various side effects, primarily due to increased oxidative stress and inflammation caused by the production of reactive oxygen. Hydrogen, as a therapeutic medical gas, offers potential benefits by exhibiting antioxidant properties and reducing tissue inflammation. Also, **Rias et a; (2020)**, in their study which attributed the protective effects of alkaline water to its active atomic hydrogen, which possesses strong reducing capabilities. This enables it to contribute to reactive oxygen activity and participate in oxidation-reduction reactions, thereby boosting antioxidant concentrations. Hydrogen's ability to rapidly diffuse across cell membranes offers substantial protection against oxidative stress.

Furthermore, given the close link between inflammation and oxidative stress, numerous studies have explored hydrogen's potential anti-inflammatory properties. Additionally, **LeBaron et al (2022),** mentioned that consuming alkaline water for an eight-week period led to an increase in both physical constituent scores and overall Quality of Life (QoL) compared to a control group. This improvement is likely attributed to the hydrogen content in alkaline water, which acts as an antioxidant, potentially reducing oxidative stress and thereby enhancing sleep quality. Consequently, improved sleep can foster greater physical activity by mitigating fatigue, aiding endurance recovery, and boosting overall physical performance, ultimately contributing to better total quality of life and physical constituent scores. Present findings also support our secondary outcome that alkaline water was significantly allied with a higher quality of life scores, including medical outcomes, burden of disease, symptoms and problems, effect of disease and total quality of life scores, which implies an appropriate performance in the dimension of physical and mental state. This highlights that alkaline water may have positive effects on reducing clinical harm due to decreased inflammation and declining the occurrence of complications induced by hemodialysis.

Conclusion

Alkaline water consumption may be considered as a source of easy to apply way to reduce metabolic problems in patients with hemodialysis. The finding of the current study revealed a significantly improved primary outcome in relation to clinical parameters such as sodium, potassium calcium, urea, creatinine, albumin glomerular filtration rate, urine output as well blood pressure measurement. In addition to a significantly improved secondary outcome as regards to medical outcome, burden of disease, symptoms and problems, effect of disease quality of life scores.

Further Research & Clinical Implications:

Further studies are warranted to precisely examine the mechanism by which alkaline water consumption might improve and prevent complications of renal diseases, thus highlighting the need for research exploring its broader impact on health status.

- Conduct larger-scale, long-term randomized controlled trials to further examine the prospective benefits of alkaline ionized water consumption on hemodialysis patients.
- Assess the long-term effects of extended consumption of alkaline ionized water on patients with hemodialysis.
- Educate healthcare professionals and hemodialysis patients about the possible advantages and risks of alkaline ionized water consumption, including proper water selection and preparation.
- Develop and adhere to clear, standardized protocols for the administration of alkaline ionized water as dosage, timing, and quality standards of the water. These protocols should be developed in collaboration with the nephrologist, nurses and potentially a dietitian.
- Develop evidence-based clinical guidelines for the use of alkaline ionized water in hemodialysis patients, considering individual patient needs and potential contraindications.
- Conduct studies examining patient-reported outcomes and the influence of alkaline ionized water on their quality of life.
- Explore the cost-effectiveness of incorporating alkaline ionized water into the routine care of hemodialysis patients.

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