

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/277408533>

Effect of vitamin C supplementation on marital satisfaction in patients undergoing hemodialysis: A randomized, double-blind and placebo-controlled trial

Article in Saudi journal of kidney diseases and transplantation: an official publication of the Saudi Center for Organ Transplantation, Saudi Arabia · May 2015

DOI: 10.4103/1319-2442.157312 · Source: PubMed

CITATIONS

0

READS

27

5 authors, including:



Vajihe Biniiaz

Mashhad University of Medical Sciences

12 PUBLICATIONS 57 CITATIONS

SEE PROFILE



A. Tayebi

Baqiyatallah University of Medical Sciences

34 PUBLICATIONS 233 CITATIONS

SEE PROFILE



Abbas Ebadi

Baqiyatallah University of Medical Sciences

528 PUBLICATIONS 2,601 CITATIONS

SEE PROFILE



Behzad Einollahi

Baqiyatallah University of Medical Sciences

325 PUBLICATIONS 3,078 CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:



Resilience of Patients With Chronic Physical Diseases: A Systematic Review and Meta-Analysis [View project](#)



social capital and fertility behaviors among female workers [View project](#)

Original Article

Effect of Vitamin C Supplementation on Marital Satisfaction in Patients Undergoing Hemodialysis: A Randomized, Double-Blind and Placebo-Controlled Trial

Vajihe Biniaz¹, Ali Tayebi², Abbas Ebadi², Shermeh Sadeghi², Behzad Einollahi¹

¹Nephrology and Urology Department and ²Department of Medical Surgical Nursing, Baqiyatallah University of Medical Sciences, Tehran, Iran

ABSTRACT. One of the common problems in patients on hemodialysis (HD) is marital dissatisfaction. Because anemia and fatigue are two important factors for marital dissatisfaction, and vitamin C can ameliorate both of them, we carried out this study to evaluate the effect of vitamin C on marital satisfaction among HD patients. This randomized, placebo-controlled, double-blind and parallel-group trial was conducted on 62 HD patients. The MFI-20 and ENRICH questionnaires were completed at the start and end of study. Required laboratory parameters including serum levels of hemoglobin (Hb), hematocrit (Hct) and ferritin were also measured at the start and at the end of the study. In the intervention group, 250 mg of vitamin C was injected intravenously immediately at the end of each HD session three times a week for eight consequent weeks. In the control group, placebo saline was injected. There was a significant change in the level of fatigue ($P = 0.01$) and the serum levels of Hb ($P = 0.006$) and Hct ($P = 0.02$). The mean of the marital satisfaction score increased significantly in the intervention group ($P = 0.001$): Baseline score of 35.7 ± 5.10 versus a final score of 38.0 ± 5.30 . However, the mean of marital satisfaction score decreased in the control group: Baseline 37.1 ± 7.10 versus a final score of 34.7 ± 7.40 . Our findings suggest that vitamin C supplementation can modify the marital satisfaction. Further studies are recommended.

Introduction

End-stage renal disease (ESRD) is one of the most common chronic diseases.¹⁻⁵ One of the fre-

Correspondence to:

Dr. Ali Tayebi
Nursing School of Baqiyatallah University of
Medical Sciences (Velayat complex),
Nobonyad Square, Babayi Highway,
Tehran, Iran
E-mail: Tayybi.ali@yahoo.com

quent problems in patients suffering from ESRD is marital dissatisfaction and sexual dysfunction.⁶ Marital satisfaction for married people is the most prominent contributor of life satisfaction and self-esteem.⁷ Although marital dissatisfaction is not synonymous with sexual dysfunction, it is significantly associated with sexual dissatisfaction.⁸⁻¹⁰

Marital dissatisfaction impairs family dynamics processes.^{11,12} It is one of the predictive factors of marital quality,¹³ physical health, psychological well-being¹⁴ and quality of life.¹⁵ It

also severely links with lower health outcome, depression and anxiety.^{11,16,17}

Marital satisfaction in patients undergoing hemodialysis (HD) is significantly lower than healthy individuals;^{18,19} 81.4% of HD patients suffer from a marital dissatisfaction,²⁰ due in 60–80% of them to some level of sexual dysfunctions after the inception of therapy.²¹

In addition to depression, anxiety, hormonal and psychological disturbances,¹⁵ drug consumption and sleeping disorders,¹⁹ anemia and fatigue are two main factors of marital dissatisfaction in HD patients.²²

Although several studies have examined methods to reform marital and sexual dissatisfaction hitherto,²³ but we have not found any study that has reported of the influences of vitamin C on marital satisfaction in HD patients. Vitamin C is a water-soluble vitamin that can ameliorate both anemia^{24–26} and fatigue.^{27,28} Vitamin C deficiency is also a prevalent complication in patients undergoing HD,^{29,30} however, it is not clear whether vitamin C deficiency is the cause or the consequence of chronic kidney diseases.³¹ Vitamin C is required for the collagen, L-carnitine and certain neurotransmitters' bio-synthesis; it is also involved in protein metabolism.³² Vitamin C is also a significant physiological antioxidant and has been shown to stimulate other antioxidants within the body, including vitamin E.³³ Furthermore, vitamin C plays a key role in the immune function³⁴ and improves the absorption of non-heme iron.³⁵ Because humans are not able to synthesize vitamin C endogenously, it is considered a vital dietary supplement.³⁶

Toxicity of vitamin C is low and has no serious side-effects. Gastrointestinal disturbances such as nausea, vomiting and diarrhea are the most common grievances of high intakes of vitamin C. Although vitamin C contributes to urinary oxalate excretion, it is not clear whether large doses of vitamin C can actually increase the potential for the formation of kidney stones, especially in individuals with hyperoxaluria. A few studies also claimed that the enhancement of non-heme iron absorption by high doses of vitamin C could lead to excess iron absorption

and exacerbate iron overload in individuals with hereditary hemochromatosis.³⁷ Because of concerns about hyperkalemia³⁸ and oxalosis³⁹ in the HD patients, prescriptions of vitamin C are restricted to 10–70% of these patients.^{40,41}

Although some practitioners are currently using doses of 1000–3000 mg/week of vitamin C,⁴² we have not found a systematic study or any case report in the recent years that reported oxalosis in HD patients as a result of vitamin C supplementation.⁴³

We aimed from this study to evaluate the effect of vitamin C on the marital satisfaction among the HD patients.

Materials and Methods

This study was conducted as a randomized, placebo-controlled, double-blind and parallel-group trial on chronic HD patients from October 2012 to January 2013.

Sixty-two volunteer patients were enrolled from two HD units in two hospitals in an urban area of Iran. Available sampling was used to select the patients for the study. Then, the samples were randomly distributed by a lottery method into two equal groups (simple random sampling); the intervention group received vitamin C and the control group received placebo.

Both groups were not significantly different in the clinical parameters, including age, sex, weight, marital and employment status, length and session of dialysis and smoking. All participants had a spouse and a sexual partner before and after the inception of HD.

The length of HD sessions in all the study patients was approximately 4 h and the frequency of HD was three times a week with close KT/V (K: clearance of dialyzer, T: time of dialysis and V: volume of body fluid), which did not change during the study for all the patients.

We included in the study patients older than 18 years who attended regular HD three sessions per week, received HD 3 months, had the level of hemoglobin (Hb) >80 g/L and did not take vitamin C at least from three months before the study. We excluded from the study patients who had active infection or active

cancer. Only 57 patients completed the study (30 persons in the intervention and 27 persons in the control group), and Figure 1 shows the recruitment consort diagram. Sample size was determined by elements such as (1) estimation of outcomes in each group, (2) the (type I) error level, (3) the statistical power error level and (4) the standard deviation of the measurements for continuous outcomes. In this study, *P*-values <0.05 were considered as significant, and the statistical power was considered as 80%.

We obtained verbal and written consents from all the study patients after informing each participant about the study purposes, confidentiality of their information and the possibility to withdraw from the study at any stage. Ethical approval was obtained from the institutional ethical committee.

The research instruments used in our study consisted of demographic and MFI-20 and ENRICH questionnaires. These questionnaires were filled at the start and at the end of the study.

The questionnaire of demographic data consisted of age, gender, marital and educational status, number of children, employment status, income, weight, smoking history, causes of kidney disease and vintage of dialysis.

The MFI-20 questionnaire consisting of 20 items (including five sub-scales, and each sub-scale consisted of four items) is a self-report instrument measuring the level of fatigue. It included five dimensions such as general, physical and intellectual fatigue, reduced activity and motivation. Each item was rated over a scale from 1 to 5 and each sub-scale was rated from 4 to 20. The higher score demonstrated a

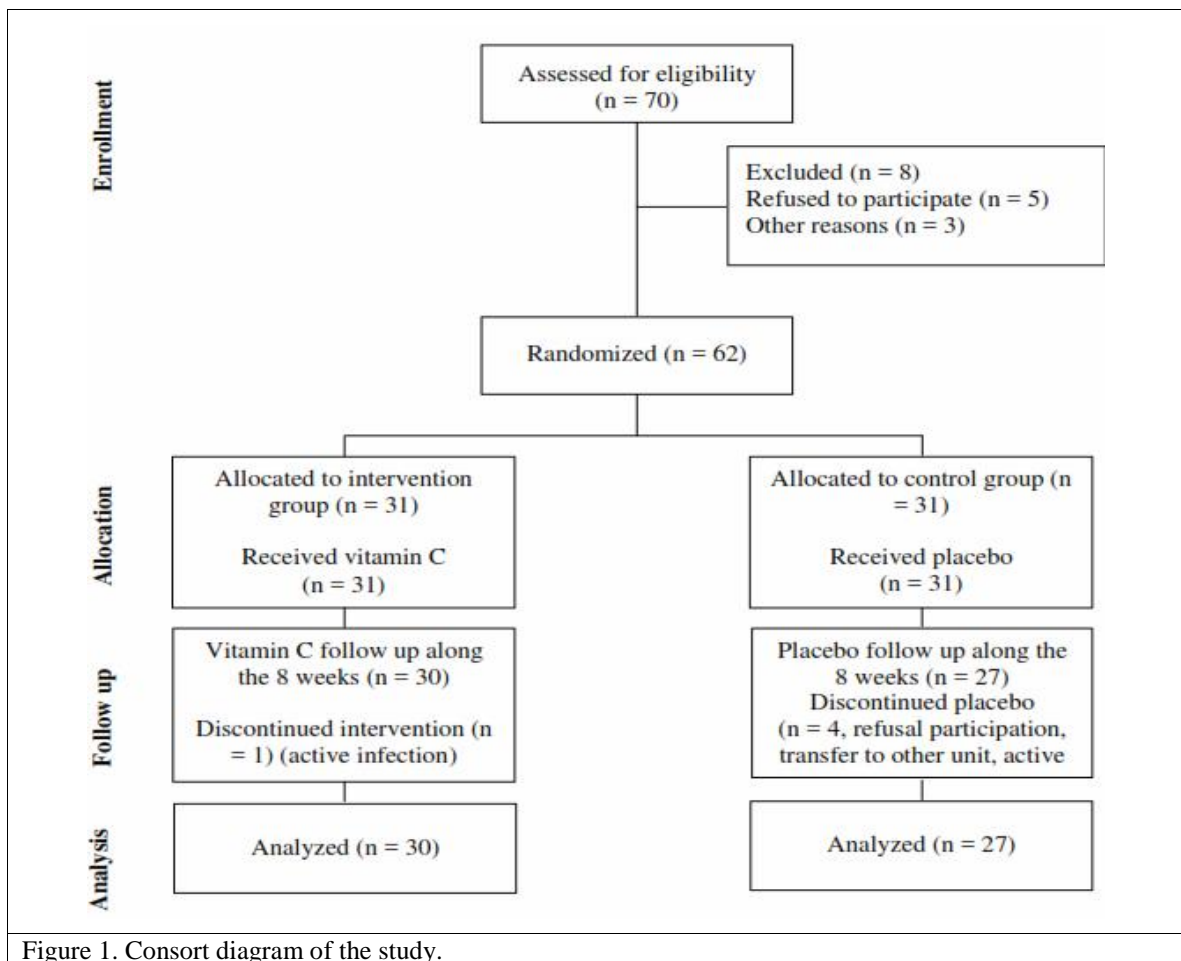


Figure 1. Consort diagram of the study.

greater level of fatigue. The respondents had to compare each of 20 declarations on how they had been feeling lately. The MFI-20 was extensively used; it discovered a fine internal consistency with an average α -coefficient between 0.65 and 0.89.

We used a sub-scale of the ENRICH questionnaire to evaluate the marital satisfaction in the study patients. We used the PREPARE/ENRICH Inventory (the ENRICH Couple Scales) that included ten items that assessed the marital satisfaction. One of these ten items assessed sexual satisfaction. The total score was the sum of positive and negative items and ranged from 10 to 50. The mean and the scoring levels were based on a national sample of 50,000 married couples with data on ENRICH described in a book by David Olson, Amy Olson-Sigg and Peter Larson.⁴⁴ An average Cronbach's α -coefficient of 0.80–0.85 and 80–85% discriminant validity in discriminating happy from displeased couples demonstrated that internal consistency and construct validity of the ENRICH questionnaire were acceptable.⁴⁵

Laboratory investigations included serum levels of Hb, hematocrit (Hct) and ferritin, which were measured at the start and at the end of the study. The blood samples were obtained from the venous line at the beginning of the HD sessions.

In the intervention group, 250 mg of vitamin C was injected immediately at the end of each HD session via the intravenous route three times a week for eight consequent weeks; in the control group, placebo saline was injected instead. Although the recommended amount for vitamin C intake in patients on HD is 100–200 mg/ per day,⁴⁶ only 250 mg of vitamin C three times a week – lower than the safe dosage recommended by the National Institute of Health (NIH) – was prescribed in order to avoid oxalosis in the study patients.

Statistical Analysis

All data were displayed as mean (SD). The χ^2 -test, T-test, Paired T-test and ANOVA were used in this study. The data were analyzed via the SPSS software (version 18).

Results

Of the 57 study patients, 35 (61.4%) were males and 22 (38.6%) were females and their mean age was 57.7 ± 11.1 years (range 27–80 years). The mean age of the males (58.05 years) was similar to that of females (57.1 years). Thirty (52.6%) of the patients were retired. The mean age for the retired, unemployed and employed individuals was 59.3, 64 and 47.1 years, respectively. The mean of HD duration was 48.7 ± 60.4 months (range 3–300 months). The prevalent causes of nephropathy included hypertension (HTN) and diabetes (DM); there were 26.3% HTN, 14% DM, 24.6% HTN and DM simultaneously. The educational level of 52.6% of the patients was primary–secondary. The mean of the duration of marriage was 32.4 years and the mean number of children was 3.2. The mean of the marital satisfaction level score before the administration of vitamin C was 36.37. Demographic characteristics of patients are shown in Tables 1 and 2.

Approximately 30% of the patients complained of marital dissatisfaction, and more than 49% of them had sexual dissatisfaction. Duration of marriage was more than 30 years in 64.9% of the patients. Of the study patients, 15.8% of men and 10.6% of women declared marital dissatisfaction, and 54.4% of men and 33.3% of women stated sexual dissatisfaction.

The mean of fatigue scale was 62.66 ± 15.7 . The means of serum Hb, Hct and ferritin were 10.9 ± 1.43 g/dL, $33.9 \pm 4.30\%$ and 737 ± 736 ng/mL, respectively.

There was a significant and direct relationship between marital and sexual satisfaction ($P = 0.001$), which indicated that the increase of sexual satisfaction resulted in an increase of marital satisfaction. Although a one-way ANOVA showed the existence of a positive statistical relationship between age and fatigue score ($P = 0.005$); there was no meaningful relationship between age and marital ($P = 0.31$) and sexual satisfaction ($P = 0.5$). A statistically significant relationship was found between dialysis vintage and fatigue ($P = 0.02$), but no significant relationship was observed between dialysis vintage

Table 1. Baseline qualitative characteristics of the respondents.

Variables		Group		P-value*
		Intervention N (%)	Control N (%)	
Gender	Male	19 (33.3)	16 (28.1)	0.48
	Female	11 (19.3)	11 (19.3)	
Education	Primary–secondary	14 (24.6)	16 (28.1)	0.74
	College/university level	16 (28.1)	11 (19.2)	
Employment	Employed	3 (5.3)	3 (5.3)	0.99
	Retired	17 (29.9)	15 (26.3)	
	Housekeeper	10 (17.5)	9 (15.7)	
Smoking	Yes	1 (1.8)	0	0.52
	No	29 (50.8)	27 (47.4)	
Nephropathy cause	HTN	7 (12.3)	8 (14)	0.49
	DM	3 (5.3)	5 (8.8)	
	HTN and DM	7 (12.3)	7 (12.3)	
	Others	13 (22.7)	7 (12.3)	

*The type of the test : ²-test.

and marital ($P = 0.43$) and sexual satisfaction ($P = 0.48$). A one-way ANOVA between groups established the existence of a statistical correlation between marital satisfaction with fatigue ($P = 0.01$). This indicated that marital satisfaction increased whenever the fatigue levels decreased. There was a statistical relationship between serum levels of Hb ($P = 0.009$) and Hct ($P = 0.02$) with fatigue, but no significant correlation between these parameters and marital ($P = 0.42, 0.45$) and sexual satisfaction ($P = 0.38, 0.65$) was demonstrated. An independent samples t -test yielded no significant relationship between gender with marital satisfaction, sexual satisfaction and fatigue ($P = 0.48, 0.64$ and 0.51 , respectively). There was no significant relationship between marital and sexual

satisfaction with the duration of marriage ($P = 0.97$) and the number of children ($P = 0.95$). Moreover, we observed no significant relationship between occupation and marital ($P = 0.52$) and sexual satisfaction ($P = 0.85$). The highest mean of fatigue was seen in individuals with diabetes. There was no significant correlation between causes of nephropathy and marital satisfaction, sexual satisfaction and fatigue ($0.7, 0.6$ and 0.59 , respectively).

As shown in Table 3, the intervention group of patients who received supplemental vitamin C attained greater ameliorations in marital satisfaction than the control group. The independent t -test of the difference of the means between the intervention and the control groups indicated that marital satisfaction increased significantly

Table 2. Baseline quantitative characteristics of the respondents

Variables	Group		P-value*
	Intervention Mean \pm SD	Control Mean \pm SD	
Age (years)	58.3 \pm 11.5	57.1 \pm 10.7	0.68
Dialysis vintage (months)	56.4 \pm 54.3	33.8 \pm 30.8	0.64
Body weight (kg)	68.4 \pm 11.9	69.3 \pm 12.7	0.8
Years married	32.0 \pm 11.9	33.0 \pm 11.1	0.78
Children (number)	3.00 \pm 1.38	3.4 \pm 1.47	0.28
Serum parameters			
Creatinine (pg/mL)	699 \pm 319	596 \pm 410	0.22
RBC (mil/mm ³)	3.82 \pm 0.40	3.67 \pm 0.80	0.4
RDW (%)	14.1 \pm 1.70	14.9 \pm 2.70	0.19

*The type of the test: Independent t -test.

Table 3. Variable alterations in different stages of the study.

Variables	Time*	Group		P-value
		Intervention Mean \pm SD	Control Mean \pm SD	
Fatigue	1	62.7 \pm 14.7	62.6 \pm 16.9	0.97
	2	49.8 \pm 13.5	61.6 \pm 16.2	0.004
Marital satisfaction	1	35.7 \pm 5.10	37.1 \pm 7.1	0.37
	2	38.0 \pm 5.30	34.74 \pm 7.4	0.06
Mean difference of marital satisfaction		2.30 \pm 1.70	-2.40 \pm 3.05	0.001
Sexual satisfaction	1	3.56 \pm 1.10	3.14 \pm 1.06	0.15
	2	3.46 \pm 1.04	3.00 \pm 0.87	0.07
Hemoglobin (g/dL)	1	10.94 \pm 1.20	11.03 \pm 1.5	0.79
	2	12.01 \pm 1.60	10.81 \pm 1.5	0.006
Hematocrit (%)	1	33.55 \pm 3.50	34.24 \pm 4.8	0.53
	2	36.81 \pm 5.30	33.61 \pm 5.06	0.02
Ferritin (ng/mL)	1	656 \pm 366	686 \pm 705	0.83
	2	671 \pm 390	733 \pm 900	0.73

*Time 1 = pre-test, Time 2 = post-test.

in the intervention group ($P = 0.001$): Baseline 35.7 \pm 5.10 versus a final score of 38.0 \pm 5.30 (effect size of marital satisfaction was 0.24 and confidence interval: 34.6–37.8); in contrast, this mean decreased in the control group: Baseline 37.1 \pm 7.10 versus a final score of 34.8 \pm 7.40.

Discussion

We hypothesized that supplemental vitamin C would have an effect on self-reported marital satisfaction and designed this study to test that hypothesis. The intervention group in our study that received supplemental vitamin C attained greater ameliorations in marital satisfaction than those in the control group; this improvement was not significant. Thus, our study supports the association between vitamin supplementation and an increase in the mean of marital satisfaction.

The comparison between the intervention group and the controls showed the existence of significant changes of the serum levels of Hb and Hct in the intervention group and no significant difference in the serum level of ferritin in both groups. Vitamin C can decrease recombinant human erythropoietin (rHuEpo) resistance in HD patients. It increases the available iron by releasing iron from ferritin and its mobilization from

the reticuloendothelial system to transferrin.⁴⁷

Furthermore, our study found a statistically significant negative relationship between marital satisfaction and level of fatigue ($P = 0.01$). Fatigue is one of the most common side-effects of HD and can predict cardiovascular events. It impairs the quality of life in HD patients and causes patients' reluctance to comply with their prescriptions. As others,²⁸ our study also showed that vitamin C supplementation significantly decreased fatigue complaints in the HD patients.

Our study demonstrated that more than 49% of the study patients had sexual dissatisfaction. Asadifard et al²⁸ studied 100 women on chronic HD. Results indicated that more than 60% of the patients suffered from a range of sexual dysfunction. Seethala et al²¹ also found 80% of women on chronic HD with impaired sexual function.

Bay et al⁴⁴ proposed that stretching and breathing exercises resulted in improved sexual satisfaction. Although his study showed that sexual satisfaction improved, it did not sustain significance.

Most of the studies about marital satisfaction in HD patients focused on the relationship between the marital dissatisfaction and the psychological symptoms, such as depression and

anxiety; there are a few studies that evaluated the effect of vitamin supplementation on marital satisfaction. HD patients are at risk of low levels of serum vitamin C.⁴⁸ According to Dashti, approximately 54% of the patients on HD suffer from vitamin C deficiency.⁴⁹

Vitamin C is a water-soluble vitamin; regular HD can reduce it^{50,51} and dietary restrictions as a result of fear related to hyperkalemia³⁷ and concerns about inducing oxalosis can result in a significant deficiency of this vitamin. Although the normal range of serum vitamin C is 30–60 μM , the majority of HD patients have serum levels of vitamin C less than 10 μM and even some of them have less than 2 μM .⁴³ Moreover, chronic inflammation due to the release of inflammatory mediators in the HD patients can reduce the production of essential antioxidants and increase oxidative stress⁵² and free radicals.⁵³ Vitamin C plays a role as an important antioxidant that can decrease the oxidative stress and ameliorate the chronic inflammation.

Even if the intake of 60–100 mg of vitamin C for health maintenance in an individual with normal kidney function is sufficient, it may not be adequate in a HD patient due to the aforementioned reasons. Accordingly, the recommended allowed amounts for the daily intake of vitamin C in HD patients are 100–200 mg that almost none of the HD patients use.⁵⁴

No relationship was observed between weight, age, dialysis vintage, educational level, duration of marriage, age difference of the couples and the number of children and marital satisfaction. Thus, vitamin C supplementation had a tendency of improving the marital satisfaction independent of the education level and age.

The limitations in our study included the inability to measure the plasma levels of vitamin C before and after the study in order to know the patients who had vitamin C deficiency. Another limitation of this study was the small sample size. Performing studies with larger sample sizes and longer-term usage of vitamin C are recommended.

We conclude that marital dissatisfaction is a common disorder in patients on HD that is still significantly understudied. Assessment of mari-

tal dissatisfaction in the clinical setting is recommended to identify and monitor couple dissatisfaction and family problems experienced by patients undergoing HB. Standardized assessment of fatigue and anemia are especially recommended to identify those at risk of marital disagreement. Our findings highlighted the importance of focusing on marital satisfaction and indicated that vitamin C supplementation may be a simple and useful intervention in modifying marital dissatisfaction. The results from the study also established a path for further investigation with a larger sample size and longer-term usage of vitamin C.

Acknowledgment

This manuscript was one part of a master degree thesis supported by the Baqiyatallah University of Medical Sciences. This project was supported by a grant from the Nephrology and Urology Research Center of Baqiyatallah University of Medical Sciences. The authors gratefully acknowledge the assistance of all participants and nurses of the Baqiyatallah and Shahid Chamran hospitals.

References

1. Castner D. Understanding the stages of chronic kidney disease. *Nursing* 2010;40:24-31.
2. Hosseinpanah F, Kasraei F, Nassiri AA, Azizi F. High prevalence of chronic kidney disease in Iran: A large population-based study. *BMC Public Health* 2009;9:44.
3. Horigan AE. Fatigue in hemodialysis patients: A review of current knowledge. *J Pain Symptom Manage* 2012;44:715-24.
4. Letchmi S, Das S, Halim H, et al. Fatigue experienced by patients receiving maintenance dialysis in hemodialysis units. *Nurs Health Sci* 2011;13:60-4.
5. Cleary J, Drennan J. Quality of life of patients on haemodialysis for end-stage renal disease. *J Adv Nurs* 2005;51:577-86.
6. Oyekçin DG, Gülpek D, Sahin EM, Mete L. Depression, anxiety, body image, sexual functioning, and dyadic adjustment associated with dialysis type in chronic renal failure. *Int J Psychiatry Med* 2012;43:227-41.

7. Whisman MA, Uebelacker LA, Tolejko N, Chataav Y, McKelvie M. Marital discord and well-being in older adults: Is the association confounded by personality? *Psychol Aging* 2006;21:626-31.
8. Berry R, Williams F. Assessing the relationship between quality of life and marital and income satisfaction: A path analytic approach. *J Marriage Fam* 1987;49:107-16.
9. Rostami A, Ghazinour M, Nygren L, Nojumi M, Richter J. Health-related Quality of Life, Marital Satisfaction, and Social Support in Medical Staff in Iran. *Appl Res Qual Life* 2013;8:385-402.
10. Yeh H, Lorenz F, Wickrama K, Conger R, Elder G. Relationships Among Sexual Satisfactin, Marital Quality, and Marital Instability at Midlife. *J Fam Psychol* 2006;20:339-43.
11. Cukor D, Cohen SD, Peterson RA, Kimmel PL. Psychosocial aspects of chronic disease: ESRD as a paradigmatic illness. *J Am Soc Nephrol* 2007;18:3042-55.
12. Amiri S, Khoushah M, Ranjbar F, et al. Factors related to marital satisfaction in women with major depressive disorder. *Iran J Psychiatry* 2012;7:164-9.
13. Proulx CM, Helms HM, Buehler C. Marital quality and personal well-being: A meta-analysis. *J Marriage Fam* 2007;69:576-93.
14. Chen J, Zhang Y, Hong Z, Sander JW, Zhou D. Marital adjustment for patients with epilepsy in China. *Epilepsy Behav* 2013;28:99-103.
15. Trief P, Wade M, Dee Britton K, Weinstock R. A Prospective Analysis of Marital Relationship Factors and Quality of Life in Diabetes. *Diabetes Care* 2002;25:1154-8.
16. Davila J, Karney BR, Hall TW, Bradbury TN. Depressive symptoms and marital satisfaction: Within subject associations and the moderating effects of gender and neuroticism. *J Fam Psychol* 2003;17:557-70.
17. Walker R1, Isherwood L, Burton C, Kitwe-Magambo K, Luszcz M. Marital satisfaction among older couples: The role of satisfaction with social networks and psychological well-being. *Int J Aging Hum Dev* 2013;76:123-39.
18. Ghazizadeh S, Lessan-Pezeshki M. Reproduction in women with end-stage renal disease and effect of kidney transplantation. *Iran J Kidney Dis* 2007;1:5-12.
19. Tavallaii SA, Nemati E, Khoddami Vishteh HR, Azizabadi Farahani M, Moghani Lankarani M, Assari S. Marital adjustment in patients on long-term hemodialysis: A case-control study. *Iran J Kidney Dis* 2009;3:156-61.
20. Zamd M, Gharbi MB, Ramdani B, Zaid D. Sexual dysfunction in male patients undergoing hemodialysis in Morocco. *Saudi J Kidney Dis Transpl* 2005;16:33-9.
21. Seethala S, Hess R, Bossola M, Unruh ML, Weisbord SD. Sexual function in women receiving maintenance dialysis. *Hemodial Int* 2010;14:55-60.
22. Lawrence I, Price D, Howlett T, Harris K, Feehally J, Walls J. Erythropoietin and sexual dysfunction. *Nephrol Dial Transplant* 1997;12:741-7.
23. Vecchio M, Navaneethan SD, Johnson DW, et al. Interventions for treating sexual dysfunction in patients with chronic kidney disease. *Cochrane Database Syst Rev* 2010;12:CD007747.
24. Deved V, Poyah P, James MT, et al; Alberta Kidney Disease Network. Ascorbic acid for anemia management in hemodialysis patients: A systematic review and meta-analysis. *Am J Kidney Dis* 2009;54:1089-97.
25. Einerson B, Nathorn C, Kitiyakara C, Sirada M, Thamlikitkul V. The efficacy of ascorbic acid in suboptimal responsive anemic hemodialysis patients receiving erythropoietin: A meta-analysis. *J Med Assoc Thai* 2011;94 Suppl 1:S134-46.
26. Coombes JS, Fassett RG. Antioxidant therapy in hemodialysis patients: A systematic review. *Kidney Int* 2012;81:233-46.
27. Johansen KL, Finkelstein FO, Revicki DA, et al. Systematic review of the impact of erythropoiesis-stimulating agents on fatigue in dialysis patients. *Nephrol Dial Transplant* 2012;27:2418-25.
28. Jung G, Yeom C, Cho B, Choijs L. The effect of intravenous vitamin C in people with Fatigue. *J Korean Acad Fam Med* 2006;27:391-5.
29. Coveney N, Polkinghorne KR, Linehan L, Corradini A, Kerr PG. Water-soluble vitamin levels in extended hours hemodialysis. *Hemodial Int* 2010;doi:10.1111/j.1542-4758.2010.00505.x.
30. Zhang K, Dong J, Cheng X, et al. Association between vitamin C deficiency and dialysis modalities. *Nephrology* 2012;17:452-7.
31. Raimann JG, Levin NW, Craig RG, Sirover W, Kotanko P, Handelman G. Is vitamin C intake too low in dialysis patients?. *Semin Dial* 2013;26:1-5.
32. Carr AC, Frei B. Toward a new recommended

- dietary allowance for vitamin C based on anti-oxidant and health effects in humans. *Am J Clin Nutr* 1999;69:1086-107.
33. Frei B, England L, Ames BN. Ascorbate is an outstanding antioxidant in human blood plasma. *Proc Natl Acad Sci U S A* 1989;86:6377-81.
 34. Jacob RA, Sotoudeh G. Vitamin C function and status in chronic disease. *Nutr Clin Care* 2002; 5:66-74.
 35. Gershoff SN. Vitamin C (ascorbic acid): New roles, new requirements? *Nutr Rev* 1993;51: 313-26.
 36. Li Y, Schellhorn HE. New developments and novel therapeutic perspectives for vitamin C. *J Nutr* 2007;137:2171-84.
 37. Lamarche J, Nair R, Peguero A, Courville C. Vitamin C-induced oxalate nephropathy. *Int J Nephrol* 2011;2011:146927.
 38. Durose CL, Holdsworth M, Watson V, Przygodzka F. Knowledge of dietary restrictions and the medical consequences of noncompliance by patients on hemodialysis are not predictive of dietary compliance. *J Am Diet Assoc* 2004;104: 35-41.
 39. Wells CG, Johnson RJ, Qingli L, Bunt-Milam AH, Kalina RE. Retinal oxalosis. A clinicopathologic report. *Arch Ophthalmol* 1989;107: 1638-43.
 40. Andreucci VE, Fissell RB, Bragg-Gresham JL, et al. Dialysis Outcomes and Practice Patterns Study (DOPPS) data on medications in hemodialysis patients. *Am J Kidney Dis* 2004;44(5 Suppl 2):61-7.
 41. Ching SY, Prins AW, Beilby JP. Stability of ascorbic acid in serum and plasma prior to analysis. *Ann Clin Biochem* 2002;39:518-20.
 42. Attallah N, Osman-Malik Y, Frinak S, Besarab A. Effect of intravenous ascorbic acid in hemodialysis patients with EPO-hyporesponsive anemia and hyperferritinemia. *Am J Kidney Dis* 2006;47:644-54.
 43. Handelman GJ. Vitamin C deficiency in dialysis patients—are we perceiving the tip of an iceberg? *Nephrol Dial Transplant* 2007;22:328-31.
 44. Bay R, Bahari Ismail SH, Zahiruddin WM, Arifin WN. Effect of combined psycho-physiological stretching and breathing therapy on sexual satisfaction. *BMC Urol* 2013;13:16.
 45. Olson DH, Larson PJ, Olson AK. PREPARE/ENRICH Program: Customized Version. Minneapolis, Minnesota, Life Innovations, Inc.; 2009.
 46. Sanadgol H, Bayani M, Mohammadi M, Bayani B, Mashhadi MA. Effect of vitamin C on parathyroid hormone in hemodialysis patients with mild to moderate secondary hyperparathyroidism. *Iran J Kidney Dis* 2011;5:410-5.
 47. Sezer S, Özdemir FN, Yakupoglu U, Arat Z, Turan M, Haberal M. Intravenous Ascorbic Acid Administration for Erythropoietin-Hyporesponsive Anemia in Iron Loaded Hemodialysis Patients. *Artif Organs* 2002;26:366-70.
 48. Locatelli F, Canaud B, Eckardt KU, Stenvinkel P, Wanner C, Zoccali C. Oxidative stress in end-stage renal disease: An emerging threat to patient outcome. *Nephrol Dial Transplant* 2003; 18:1272-80.
 49. Dashti-Khavidaki S, Talasaz AH, Tabefar H, et al. Plasma vitamin C concentrations in patients on routine hemodialysis and its relationship to patients' morbidity and mortality. *Int J Vitam Nutr Res* 2011;81:197-203.
 50. Vitamin C. Dietary Supplement Fact Sheet: NIH Office of Dietary Supplements. Available from: <http://www.google.com/url?sa=t&rct=j&q=Vitamin%20C.%20Dietary%20Supplement%20Fact%20Sheet%3A%20NIH%20Office%20of%20Dietary%20Supplements.&source=web&cd=2&cad=rja&ved=0CDMQFjAB&url=http%3A%2F%2Fods.od.nih.gov%2Ffactsheets%2F&ei=XysuUuTFI5ON7AbRwoHIDA&usq=AFQjCNHi8wMRoHLHmWtrxGvbKrE0vNQgSA&bvm=bv.51773540,d.bGE>. [Last cited in 2011 June 24]
 51. Morena M, Cristol JP, Bosc JY. Convective and diffusive losses of vitamin C during haemodiafiltration session: A contributive factor to oxidative stress in haemodialysis patients. *Nephrol Dial Transplant* 2002;17:422-7.
 52. Baradari AG, Emami Zeydi A, Espahbodi F, Shahmohammadi S. Evaluation of serum C-reactive protein level and its related factors in hemodialysis patients in Sari, Iran. *Pak J Biol Sci* 2011;14:595-9.
 53. Weissinger E, Nguyen-khoa T, Fumeron C, Saltile C, Walden M, Kaisert T. Effects of oral vitamin C supplementation in hemodialysis patients. *Proteomics* 2006;6:993-1000.
 54. Richter A, Kuhlmann M, Seibert E, Kotanko P, Levin N, Handelman G. Vitamin C deficiency and secondary hyperparathyroidism in chronic haemodialysis patients. *Nephrol Dial Transplant* 2008;19:2058-63.