Original Article

Dialysis Adequacy and Quality of Life in Diabetic and Non-diabetic Bangladeshi Patients on Maintenance Hemodialysis

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Abstract

Background: *Quality of life (QOL) is one of the chief areas to be addressed when caring for people with end stage renal disease (ESRD). The continual excretory function of native kidneys are replaced in such patients by few hours of rapid urea clearance in a week. This study aimed to explore whether more weekly hemodialysis sessions and dialysis adequacy do actually improve parameters of QOL and if this is beneficial enough at the cost of taking additional dialysis sessions in a low income country like Bangladesh. Whether being diabetic influences QOL was also investigated.*

Methods: *This cross-sectional study recruited 135 adults, who were on maintenance haemodialysis(MHD) for >3 months, from three dialysis centers in Dhaka from January to December, 2013. Patients with malignancy, dementia, and psychosis were excluded. Patients were interviewed once by the investigators to fill a validated Bangla version of the kidney disease quality of life short form questionnaire (KDQOL-SF-36 version 1.3) and calculate a QOL score.*

Results: *Mean age, mean duration of chronic kidney disease (CKD) and MHD were 50±12 years, 4.9±5.1 years and 12±11.8 months respectively. Overall QOL score for the study sample was 50±17. Only 43(31.9%) patients received adequate hemodialysis (mean Kt/V=1.3) while the rest (with Kt/V<1.2) had achieved an average Kt/V of 0.8 (p<0.001). Duration of MHD, hemoglobin, serum albumin, and ferritin were not significantly different for those adequately dialysed, compared to the rest. Also no improvement in any QOL parameter was found in those with Kt/V>1.2 (adequate HD). However, when a comparison was made between those with 3 HD sessions/week (n=63, mean MHD duration 24±14 months) with patients receiving 2 HD sessions/week (n=72, mean MHD duration 8.4±11 months), the former group had lower "effect of kidney disease" scores (p=0.021), higher "quality of social interaction" scores (p=0.031) and lower "role emotion" scores (p=0.002). When diabetic patients (n=82, mean age 54±8 years, MHD duration 18.5±9.5 months) and non-diabetic subjects (n=53, aged 42±13 years, MHD duration of 25±16 months) were compared, "effects of kidney disease", "cognitive function" and "quality of social interaction" scales were significantly higher in those having diabetes (with p<0.045, p<0.024 and p<0.022 respectively).*

Conclusion: *Since achieving hemodialysis adequacy was not found to improve QOL scores, an additional dialysis session at extra cost every week may not be advisable for people of a low income country.*

Key words: *Dialysis Adequacy, Quality of life, Maintenance haemodialysis*

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Introduction

Chronic kidney disease (CKD) refers to an irreversible deterioration in renal function which classically develops over a period of years. Loss of the excretory, metabolic and endocrine functions of the kidney leads to the development of the clinical symptoms and signs of renal failure.[1] The availability of various renal replacement therapies (RRT) such as hemodialysis has reduced the severity of symptoms and resulted in longer survival of end stage renal disease (ESRD) patients.[2] Hemodialysis, however, imposes a considerable economic burden on patients and their families.

It is now recognized that quality of life (QOL) is an important issue to consider when caring for people with chronic illnesses.[3] QOL refers to the measure of a patient's functioning, well-being and general health perception in each of three domains: physical, psychological and social.[4-6] Along with survival and other types of clinical outcomes, patients' QOL is an important indicator of the effectiveness of the medical care they receive.[5,7]

Uncontrolled observations suggest that increasing the intensity of dialysis to achieve a dialysis adequacy of at least 1.2 is associated with improved survival, which is the value recommended by the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines. Furthermore, numerous outcome studies have shown a correlation between the delivered dose of hemodialysis and patients' morbidity and mortality.[8-17] The evidence demonstrates that mortality among ESRD patients is lower when sufficient hemodialysis doses are provided.

This study was conducted to evaluate the QOL among the patients on maintenance hemodialysis (MHD) and also to evaluate whether increasing dialysis frequency and adequacy at greater weekly expenditure, improves QOL parameters among the Bangladeshi patients on MHD.

Methods

This cross-sectional study was conducted among patients of ESRD on MHD attending Hemodialysis Units of National Institute of Kidney Diseases and Urology (NIKDU), Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorder (BIRDEM) and Square Hospital, Bangladesh between January 2013 and December 2013. Adult patients on MHD for at least 3 months and without

malignancy, dementia and psychosis were enrolled into the study.

Enrolled patients were interviewed by the investigator(s) when they were on dialysis or after dialysis in order to fill a pre-tested questionnaire to assess QOL as well as to record patient specific information like age, gender, educational level, monthly income and clinical data like hemodialysis duration, blood pressure, underlying disease (diabetes, hypertension, glomerulonephritis and others) and the use of blood transfusion (BT) or erythropoiesis stimulating agents (ESAs).

QOL score was calculated using the KDQOL-SF-36 version 1.3 consisting of 38 questions of which the first 24 questions included kidney disease specific items and general health related items and questions 25 to 38 included background information of patients. Pre-dialysis and post-dialysis blood samples were drawn at the same hemodialysis session. All the tests except post-dialysis blood urea were done from pre-dialysis blood sample. Investigations included complete blood count (CBC) by automated hematology analyzer, serum creatinine, total protein, albumin, iron profile as well as pre- and post-dialysis urea for calculating dialysis adequacy (in terms of Kt/V).

Two tailed Student's t-test was used to compare between 2 groups. One-way analysis of variance (one way ANOVA) was used to compare quantitative difference between multiple groups. The data were analyzed with the statistical software SPSS 11.5.0. Statistical significance was set at $p<0.05$.

The KDQOL-SF-36 version 1.3 questionnaire [18]

General health related scales were physical functioning (10 items), role physical (4 items), bodily pain (2 items), general health (5 items), emotional well-being (5 items), social functioning (2 items), role emotional (3 items) and energy/fatigue (4 items). these 8 scales were divided into two dimensions (physical and mental). The physical component aggregates items from the physical functioning, role physical, bodily pain, general health, vitality and social functioning. The mental component aggregates items from role-emotional, mental health, and also includes elements of general health, vitality and social functioning.

Kidney disease specific targeted scales were symptoms/problem (12 items), effect of kidney disease (8 items),

burden of kidney disease (4 items), work status (2 items), cognitive function (3 items), quality of social interaction (3 items), sexual function (2 items), sleep (4 items), social support (2 items), dialysis staff encouragement (2 items) and patient satisfaction (1 item). All the SF-36 subscales and 11 specific kidney related scales were scored independently.

The scoring procedure for the KDQOL-SF-36 first transforms the raw pre-coded numeric values of items to a 0-100 possible range; with higher transformed scores always indicating better quality of life, so that the lowest and highest possible scores are set at 0 and 100 respectively. In final step of scoring process, items in the same scales are averaged together to create the item score.

Results

Total 135 MHD patients were included in this study. Mean age of study subjects was 50 ± 12 years (Table I). Males were 80 (60%), females were 55 (40%). Mean duration of hemodialysis was 12 ± 11.8 months and blood pressure in majority was not controlled. Diabetes was the commonest etiology of ESRD (60%), (Figure 1).

Table I Clinical characteristics of study subjects (N=135)

Clinical parameters	Values
Age (years)	50 ± 12
Male : Female	3 : 2
Hypertension duration (years)	8 ± 6
Chronic kidney diseases duration (years)	4.9 ± 5.1
Hemodialysis duration (months)	12 ± 1.8
Systolic blood pressure (mm Hg)	160 ± 10
Diastolic blood pressure (mm Hg)	*89 ± 5*

Note:

HF - Heredofamilial
PKD - Polycystic kidney disease
OU - Obstructive uropathy
GN - Glomerulonephrities
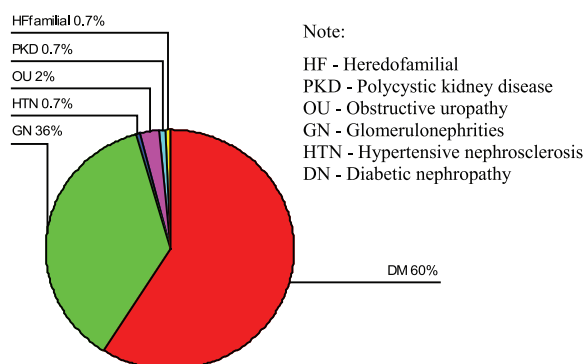HTN - Hypertensive nephrosclerosis
DN - Diabetic nephropathy

Figure 1 *Cause of ESRD in study participants (N=135)*

Regarding QOL, in the kidney disease specific domains, most of the scale scores were more than 50 except the burden of kidney disease item. In general health related domain most of the scale scores were below 50 except the emotional well-being item (Table II).

Table II Quality of life (QOL) scores of study subjects (N=135)

Quality of life score	Mean ± SD
Kidney diseases specific domain	
Symptom/problem list	67 ± 9
Effect of Kidney disease	59 ± 9
Burden of Kidney disease	12 ± 12
Work status	50 ± 0.0
Cognitive function	62 ± 14
Quality of social interaction	77 ± 13
Sexual function	36 ± 43
Sleep	52 ± 9
Social support	62 ± 18
Dialysis staff encouragement	91 ± 14
Patient satisfaction	60 ± 8
General health related domain	
Physical function	43 ± 33
Role Physical	18 ± 39
Pain	48 ± 21
General health	32 ± 19
Emotional well being	78 ± 23
Role emotion	8 ± 14
Social function	48 ± 19
Energy/fatigue	42 ± 13
Overall score	50 ± 17

Dialysis adequacy among the study subjects

The study subjects were assessed in groups according to Kt/V (indicator of adequate dialysis) cut off values:
Group-1: Kt/V >1.2, indicating optimum dialysis.
Group-2: Kt/V <1.2, indicating inadequate dialysis.

Comparison of different clinical and laboratory parameter between two Kt/V groups showed blood transfusion (BT) per month was lower in group 1 ($p<0.001$). Other parameters between two groups were not significantly different (Table III). Only 43 (31.9%) patients received adequate haemodialysis with a mean Kt/V of 1.3 while the rest (with Kt/V<1.2) had achieved an average Kt/V of 0.8 (p<0.001). Number of months since commencement of MHD and blood hemoglobin, serum total protein, albumin, ferritin as well as transferrin saturation were not significantly different for those who received adequate dialysis compared to the rest (Table III).

Table III Comparison of different parameters in relation to Kt/V cut off value (N=135)

Parameter	Kt/V >1.2 (n=43)	Kt/V <1.2 (n=92)	p value
Age (years)	51 ± 9	48 ± 13	**0.003**
Blood transfusion duration (months)	5.1 ± 11	7.8 ± 12	0.204
Blood transfusion (unit/month)	0.6 ± 0.8	0.9 ± 0.9	**0.004**
Dialysis duration (months)	20 ± 10	21 ± 13	0.095
Hemoglobin (gm/dl)	10.1 ±1.4	9.4 ± 1.2	0.236
Kt/V	1.3	0.8	<0.001
Total protein (gm/dl)	6.2± 1.2	6.5 ± .8	0.699
Albumin (gm/dl)	3.1 ± 0.3	3.3 ± 0.4	0.081
Ferritin (ug/l)	530 ± 282	570 ± 390	0.094
TSAT (Transferin saturation) %	41 ± 21	38 ± 19	0.465

When the QOL parameter were compared between two Kt/V groups no significant difference was seen (Table IV). No improvement in any of the QOL parameters assessed was found to be present in those with with Kt/V>1.2 (adequate dialysis).

Table IV Comparison of QOL parameters in relation to adequacy of dialysis (N=135)

Items	Kt/V>1.2 (n=43)	Kt/V<1.2 (n=92)	p value
Kidney disease specific (QOL) Domain			
Symptom/problem	68 ± 9	67 ± 9	0.654
Effect of kidney disease	61 ± 8	58 ± 9	0.950
Burden of kidney disease	13 ± 12	11' ± 11	0.526
Cognitive function	64 ± 14	61 ± 15	0.639
Quality of social interaction	76 ± 13	76 ± 13	0.481
Sexual function	50 ± 45	30 ± 40	0.065
Sleep	53 ± 10	52 ± 9	0.351
Social support	62 ± 17	62 ± 18	0.511
General health related QOL Domain			
Physical functioning	45 ± 32	43 ± 33	0.694
Role physical	19 ± 39	18 ± 39	0.951
Pain	51 ± 20	46 ± 21	0.748
General health	32 ± 17	33 ± 20	0.146
Emotional well being	78 ± 19	78 ± 24	0.136
Role emotion	6 ± 12	8 ± 15	0.170
Social function	50 ± 22	46 ± 17	0.150
Energy/fatigue	42 ± 13	42 ± 13	0.770

Comparison of study subjects according to the frequency of hemodialysis

Study subjects clinical, laboratory and QOL parameters were assessed according to hemodialysis frequency i.e. number of session per week in 2 groups:

Group 1: 2 sessions/week

Group 2: 3 sessions/week

Dialysis duration was higher in 3 sessions/week patients than 2 sessions/week ($p< 0.004$). Serum Albumin level was higher in patients of 3 sessions/week than 2 sessions/week ($p< 0.022$) (Table V).

When a comparison was made between those with 3 dialysis sessions/week (n=63 with mean MHD duration of 24±14 months) with patients receiving 2 dialysis sessions/week (n=72 with mean MHD duration of 8.4±11 months), the former group had lower "effect of kidney disease" scores (p=0.021), higher "quality of social interaction" scores (p=0.031) and lower "role emotion" scores (p=0.002) as shown in Table VI.

Table V Clinical, laboratory parameter in relation to frequency of dialysis (N=135)

Parameter	Frequency of hemodialysis		p value
	2 sessions/week(n=72)	3 sessions/ week (n=63)	
Age (years)	47 ± 12	52 ± 12	0.983
Blood transfusion duration (months)	7.2 ± 12.6	6.6 ± 8.4	0.524
Blood transfusion (Unit / month)	0.9 ± 0.9	0.6 ± 0.9	0.073
Dialysis duration (months)	8.4 ± 11	24 ± 14	**0.004**
Hemoglobin (gm/dl)	9.3 ±1.3	10 ± 1.3	0.479
Total protein (gm/dl)	6.4 ± 0.6	6.4 ± 1	0.082
Serum Albumin (gm/dl)	3.2 ± 0.3	3.2 ± 0.4	**0.022**
Ferritin (ug/l)	566 ± 362	547 ± 355	0.833
Transferin Saturation %	41± 20	37 ± 19	0.293

Table VI Quality of life parameter in relation to frequency of hemodialysis (N=135)

Items	Hemodialysis 2 sessions /week	Hemodialysis 3 sessions /week	p value
Kidney disease specific (QOL) Domain			
Symptom/problem	68 ± 9	67 ± 9	0.665
Effect of Kidney disease	59 ± 10	58 ± 7	**0.021**
Burden of Kidney disease	12 ± 13	11 ± 11	0.108
Cognitive function	62 ± 16	62 ± 12	0.122
Quality of social interaction	75 ± 15	77 ± 11	**0.031**
Sexual function	31 ± 43	42 ± 41	0.526
Sleep	53 ± 10	51 ± 9	0.820
Social support	61 ± 18	64 ± 17	0.624
General health related (QOL)Domain			
Physical functioning	45 ± 32	42 ± 33	0.519
Role Physical	18 ± 38	19 ± 39	0.778
Pain	49 ± 19	46 ± 23	0.081
General health	34 ± 20	31 ± 18	0.526
Emotional well being	81 ± 23	75 ± 21	0.646
Role emotion	9 ± 16	5 ± 12	0.002
Social function	47 ± 17	47 ± 21	0.069
Energy/ fatigue	42 ± 13	42 ± 13	0.430

Table VII Comparison of different clinical and biochemical parameters between diabetic and non diabetic subjects (N=135)

Parameter	Diabetic subjects (n=82)	Non diabetic subjects (n=53)	*p* value
Hemoglobin (gm/dl)	9.7± 1.3	9.5 ± 1.3	0.209
Kt/V	1.05 ± 0.3	1 ±0.3	0.458
Total protein (gm/dl)	6.3 ± .9	6.6 ± .7	**0.038**
Albumin (gm/dl)	3.2 ± .4	3.3 ± .4	0.708
Ferritin (ug/l)	538 ± 351	584 ±	0.610
TSAT (Transferin saturation) %	39 ± 21	42 ± 19	0.634

Comparisons of different clinical, biochemical and QOL parameters between diabetic and non-diabetic subjects

Different clinical and biochemical parameters were compared between diabetic subjects with non-diabetic ones. Diabetics had lower serum total protein than non diabetic subjects $(p < 0.038)$. Other parameters were not different (Table VII).

QOL parameters were compared between diabetic and non-diabetic subjects. This showed in kidney disease specific domain effects of kidney disease, cognitive function and quality of social interaction scales were significantly higher in diabetes $(p < 0.045, p < 0.024$ and $p < 0.022$ respectively). Other parameters were not different between two groups (Table VIII).

Table VIII Comparison QOL between diabetic and non diabetic subjects

Items	Diabetic (n=82)	Non diabetic (n=53)	*p* value
Kidney disease specific (QOL) Domain			
Symptom/problem	68 ± 9	66 ± 9	0.312
Effect of Kidney disease	60 ±8	57 ± 10	**0.045**
Burden of Kidney disease	14 ±11	9 ±13	0.167
Cognitive function	63 ± 13	62 ± 15	**0.024**
Quality of social interaction	77 ± 12	75 ± 13	**0.022**
Sexual function	41 ± 43	30 ± 43	0.148
Sleep	52 ± 10	52 ± 8	0.627
Social support	63 ± 18	60 ± 18	0.415
General health related (QOL) Domain			
Physical functioning	43 ± 32	45 ±34	0.997
Role Physical	17 ± 37	26 ± 44	0.613
Pain	50 ± 22	44 ±18	0.268
General health	35 ± 19	29 ± 19	0.139
Emotional well being	79 ± 22	74 ± 23	0.588
Role emotion	7 ± 14	7 ± 14	0.867
Social function	48 ± 19	40 ± 19	0.464
Energy/fatigue	43 ± 12	39 ± 14	0.194

Discussion

Advances in dialysis treatment have contributed to improved survival of patients with ESRD, but the QOL is much lower for those patients than for the general population.[19] In the presenting study over fifty percent patients were on 2 sessions of hemodialysis per week. This is a common scenario for developing countries due to economic and logistic constraints. A Pakistani study showed that 1, 2 and 3 sessions per week dialysis were taken by 7.2%, 77.6% and 15.2% patients.[20] Some factors such as stenosis of the end of veins of arteriovenous fistula, poor and weak fistula, lack of following the schedule of dialysis by the patient, cardiovascular diseases, hemodynamic instability, infections, malignancies, re-circulation and reuse of dialysis filter can be the important causes of low dialysis adequacy.[21]

The mean Kt/V was around 1.0 in this present study. The KDQOI recommendation is Kt/V $\geq$1.2 per dialysis session.[22] Only 50% patients had single pool Kt/V $\geq$1 in a study in Indian hemodialysis patients.[23] This finding was similar to our study. The low Kt/V is due to underdialysis and related to poor health care support. Another study revealed that about 60% of the study population had Kt/V <1.2, indicating that patients were receiving inadequate dialysis dose.[24] These results were in agreement with similar findings to those carried out in other developing countries such as Brazil, Nigeria, Nepal, Pakistan, and Iran (about 55–65% of patients had a Kt/V <1.2). [25] On the other hand, the results of the study were in disagreement with those reported from developed countries as the United States according to the 2007 annual report, over 90% of the patients had a Kt/V >1.2. [26] QOL score parameters were compared according to Kt/V cut off, with group 1 having Kt/V $\geq$1.2 (optimum dialysis) and group 2 Kt/V $\leq$1.2 (indicate inadequate dialysis) within our participants.

When QOL parameters were compared between these two groups it showed no difference in QOL score between our two groups. Nevertheless, others found a positive correlation between dialysis dose (Kt/V) and scoring of physical domain of QOL while there was no correlation between dialysis dose (Kt/V) and psychological, social or environmental domain scores.[24] These results were in agreement with those who found out that increase dialysis dose had been associated with a better QOL and another set of authors who found out

that increase dialysis dose was associated with a decrease number of awakenings at night. [27, 28]

Then QOL parameters were compared according to hemodialysis session frequency. Group 1 took $\leq$2 session/week and group 2 took $\geq$3 sessions/week. Naturally, several items of the QOL score was expected to be higher in patients who received dialysis treatment atleast 3 days (each 4 hours) per week as evidenced by a few studies.[29] However, when QOL parameters were compared between these two of our groups, these showed that only social interaction scale score was higher in group 2 than 1 (77 vs. 75, $p < 0.05$). A Brazilian study showed it was rather younger age and fewer months since the initiation dialysis that were predictors of higher (better) physical QOL.[30] For general health related items, only role emotion scored (5 vs. 9, $p < 0.005$) significantly higher in our group 1 than group 2. Thus there was no meaningful difference in reported QOL for patients dialyzing two times versus three times weekly, similar to the Chinese.[31]

The most common primary disease leading to ESRD in this study was diabetic nephropathy. The USRDS data base showed that in majority countries diabetic nephropathy is the leading cause.[32] In Europe the most common primary disease was diabetic nephropathy.[33] In the presenting study diabetic subjects were around 60%. And it was found in a study that diabetes had an adverse effect on the QOL study subjects.[34] Most affected scales were general health and vitality. In another study it was also found that diabetic dialysis patients had lower QOL parameters.[35] In the presenting study comparison between diabetic and non diabetic showed that in effect of kidney disease, cognitive function and quality of social interaction score was higher in diabetics.

Diabetics were older than non-diabetics (52±8 vs 42±13 years) in our study population (p<0.001). Physical function, role limitations caused by physical problems, bodily pain and general health dimensions are usually summarized into a physical composite summary (PCS) by certain authors. Comparison of QOL parameters showed for kidney disease specific domain, effect of kidney disease (60 vs. 57, p<0.05), cognitive function (63 vs. 62, p<0.05) and quality of social interaction score (77 vs. 75, p<0.05) were significantly higher in our diabetic subjects. In a similar study, non-diabetic patients

on hemodialysis had better QOL in physical health as compared to diabetics ($p < 0.05$) in Lahore.[20] In those with diabetes, PCS scores were significantly lower compared to those without diabetes in Stockholm.[36]

Previous studies reported that non-diabetic patients had better mental composite summary scores compared to diabetic patients.[37] It was found that a combination of diabetes and chronic medical condition (renal failure) might adversely affect the mental dimension as measured by the SF-36 questionaire.[38] This association could be explained by the better overall health status of MHD patients without diabetes compared to those with it. Diabetic patients on MHD have a higher burden of morbidity and mortality due to risk of microvascular and macrovascular such as cardiovascular diseases, cerebrovascular events and peripheral vascular disease than non-diabetic patients on dialysis.[39] Several studies found that a combination of DM and chronic medical conditions such as renal failure might adversely affect mental health status such as vitality, social functioning and role-emotional as measured by SF-36.[40, 41]

Limitations of the study

This was a cross sectional study conducted in 3 dialysis centers in Dhaka city which may not be representative for the whole country. The study conducted with a small sample size also a limitation of the study.

Conclusion

Achieving a hemodialysis adequacy (Kt/V>1.2) was not found to improve QOL scores in the study subjects and therefore bearing the extra cost of an additional dialysis session per week may not be advisable for those not so well off.

Conflict of Interest: Nothing to declare.

References

1. Goddard J, Turner NA, Stewart LH. Kidney and urinary tract disease. In: Colledge NR, Walker BR, Ralston SH, editors. Davidson's Principal and Practice of Medicine 21st Edition. Edinburgh, Churchill Livingstone 2010: p 459-519.

2. Sathvik BS, Parthasarathi G, Narahari MG, Gurudev KC. An assessment of the quality of life in hemodialysis patients using the WHOQOL-BREF questionnaire. Indian J Nephrol 2008; 18: 141-49.

3. Tallis K. How to improve the quality of life in patients living with end stage renal failure. Ren Soc Aust J 2005; 1: 18-24.

4. Germin-Petrovi D, Devcic IM, Lesac A, Mandic M, Soldatic M, Vezmar D, et al. Health-related Quality of Life in the Patients on Maintenance Hemodialysis: The Analysis of Demographic and Clinical Factors. Coll Antropol 2011; 35: 687–93.

5. El Hamed, Ali HMA, Elsebai NAM, Ramadan FAF, Salam WIS, Abdelhady TMA. Impact of Teaching Guidelines on Quality of Life for Hemodialysis Patients. Nature and Science2011; 9:214-22.

6. Theofilou P. Quality of life and mental health in hemodialysis and peritoneal dialysis patients: the role of health beliefs. Int J Urol Nephrol 2011; 44(1):245-53.

7. Valderrábano F, Jofre R, López-Gómez J. Quality of life in end-stage renal disease patients. Am J Kid Dis 2001; 38(3):443-64.

8. Collins AJ. Influence of target hemoglobin in dialysis patients on morbidity and mortality. Kidney Int 2002; 80 (suppl.):S44-S48.

9. Fernández J, Carbonell M, Mazzuchi N, Petruccelli D. Simultaneous analysis of morbidity and mortality factors in chronic hemodialysis patients. Kidney Int 1992;41(4):1029-34.

10. Gotch FA, Daugirdas JT, Depner TA. Comparison of methods to predict equilibrated Kt/V in the HEMO Pilot Study. Kidney Int 1997; 52: 1395-405.

11. Hakim RM, Stannard D, Port FK, Held PJ. The effect of the dialysis membrane on mortality of chronic hemodialysis patients in the U.S. J Am Soc Nephrol 1994; 3: 351.

12. Held PJ, Port FK, Wolfe RA. The dose of hemodialysis and patient mortality. Kidney Int 1996; 50:550-56.

13. Lowrie EG, Laird NM, Parker TF, Sargent JA. Effect of the hemodialysis prescription on patient morbidity: report from the National Cooperative Dialysis Study. N Engl J Med 1981;305:1176-81.

14. Lowrie EG. Chronic dialysis treatment: Clinical outcome and related processes of care. Am J Kidney Dis 1994; 24:255-66.

15. Owen WF, Lew NL, Liu Y, Lowrie EG, Lazarus JM. The urea reduction ratio and serum albumin concentration as predictors of mortality in patients undergoing hemodialysis. N EngI J Med 1993; 329: 1001-6.

16. Owen WF Jr, Chertow GM, Lazarus JM, Lowrie EG. The dose of hemodialysis: Survival differences by race and gender. JAMA 1998; 280: 1764-68.

17. Parker TF, Husni L, Huang W, Lew N, Lowrie E. Survival of hemodialysis in the U.S. is improved with a greater quantity of dialysis. Am J Kidney Dis 1994; 23:670-80.

18. Joshi VD, Mooppil N, Lim JF. Validation of the kidney disease quality of life-short form: a cross-sectional study of a dialysis targeted health measure in Singapore. BMC Nephrol 2010;11:36.

19. Fukuhara S, Lopes AA, Bragg-Gresham JL, Kurokawa K, Mapes DL, Akizawa T, et al. Health-related quality of life among dialysis patients on three continents: the Dialysis

Outcomes and Practice Patterns Study. Kidney Int 2003; 64:1903-10.

20. Anees M, Hameed F, Mumtaz A, Ibrahim M, Khan MNS. Dialysis-Related Factors Affecting Quality of Life in Patients on Hemodialysis. IJKD 2011; 9:14.

21. Ebrahimi H, Sadeghi M, Khatibi MR. The relationship between quality of life with dialysis efficacy and laboratory parameters in Shahroud' hemodialysis patients. Iran J Crit Care Nurs 2015; 8(2): 109-16.

22. National Kidney Foundation. KDOQI Clinical Practice Guideline for Hemodialysis Adequacy: 2015 update. Am J Kidney Dis. 2015;66(5):884-930.

23. Madhumathi R, Rajiv J, Shirly M. Hemodialysis for end stage renal disease in southern India- A perspective from a tertiary referral care centre. Nephrol Dial Transplant 1998;13: 2494-2500.

24. El-Sheikh M, El-Ghazaly G. Assessment of hemodialysis adequacy in patients with chronic kidney disease in the hemodialysis unit at Tanta University Hospital in Egypt. Indian J Nephrol. 2016;26(6):398-404.

25. Amini M, Aghighi M, Masoudkabir F, Zamyadi M, Norouzi S, Rajolani H, et al. Hemodialysis adequacy and treatment in Iranian patients: A national multicenter study. Iran J Kidney Dis 2011; 5:103–9.

26. ESRD Annual Report. Clinical performance measures project. Am J Kidney Dis 2008;51(Suppl 1):S1.

27. Manns BJ, Johnson JA, Taub K, Mortis G, Ghali WA, Donaldson C. Dialysis adequacy and health related quality of life in hemodialysis patients. ASAIO J 2002;48:565–59.

28. Benz RL, Pressman MR, Hovick ET, Peterson DD. Potential novel predictors of mortality in end-stage renal disease patients with sleep disorders. Am J Kidney Dis 2000;35:1052–60.

29. Mollaoðlu M, Deveci G. Quality of Life in Patients with Chronic Renal Failure and Some Affecting Factors. Arch Renal Dis Manag 2017; 3(1):12-19.

30. Bohlke M, Nunes DL, Marini SS, Kitamura C, Andrade M, Von-Gysel MPO. Predictors of quality of life among patients on dialysis in southern Brazil. Sao Paulo Med J 2008;126(5):252–56.

31. Bieber B, Qian J, Anand S. Two-times weekly hemodialysis in China: frequency, associated patient and treatment characteristics and Quality of Life in the China- Dialysis Outcomes and Practice Patterns study. Nephrol Dial Transplant 2014; 29:1770-77.

32. Renal Data System. USRDS 2009 annual data report: atlas of chronic kidney disease and end-stage renal disease in the United States. National Institute of Diabetes and Digestive and Kidney Diseases, 2009. (http://www.usrds.org.)

33. Grundy SM, Benjamin IJ, Burke GL, Chait A, Eckel RH, Howard BV, et al. Diabetes and cardiovascular disease: a statement for healthcare professionals from the American Heart Association; Circulation 1999;100(10):1134-46.

34. Gautam Y, Sharma A, Agarwal A, Bhatnagar M, Trehan RR. A Cross-sectional Study of QOL of Diabetic Patients at Tertiary Care Hospitals in Delhi. Indian J Community Med 2009; 34 :346-50.

35. Osthus TB, von der Lippe N, Ribu L, Rustøen T, Leivestad T, Dammen T et al. Health-related quality of life and allcause mortality in patients with diabetes on dialysis. BMC Nephrol; 2012; 3:13-78.

36. Pagels AA, Söderkvist BK, Medin C. Health-related quality of life in different stages of chronic kidney disease and at initiation of dialysis treatment. Health Qual Life Outcomes 2012; 10: 71.

37. Wee HL, Cheung YB, Li SC, Fong KY, Thumboo J. The impact of diabetes mellitus and other chronic medical conditions on health-related quality of life: is the whole greater than the sum of its parts? Health Qual Life Out 2005; 3: 2.

38. Chiang CK, Peng YS, Chiang SS, Yang CS, He YH. Health-related quality of life of hemodialysis patients in Taiwan: a multicenter study. Blood Purif 2004; 22: 490-98.

39. Sørensen VR, Mathiesen ER, Watt T, Bjorner JB, Andersen MV. Diabetic patients treated with dialysis: complications and quality of life. Diabetologia 2007; 50: 2254-62.

40. Zyga SB, Virvidakis K, Bahopoulos G. The influence of varying blood and dialysate flow on hemodialysis adequacy. EDTNA ERCA J 2005;31: 24-26.

41. Borzou SR, Gholyaf M, Zandiha M, Amini R, Goodarzi MT. The effect of increasing blood flow rate on dialysis adequacy in hemodialysis patients. Saudi J Kidney Dis Transpl 2009;20: 639-42.