INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078

(Volume 8, Issue 5 - V8I5-1196)
Available online at: https://www.ijariit.com

Effect of Intradialytic Aerobic Exercise on Fatigue in Patients Undergoing Hemodialysis

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ABSTRACT

Fatigue is a common debilitating symptom which remains unrecognized among people with chronic kidney disease with significant impacts on patients' everyday functioning. The aim of this study was to determine the effect of intradialytic aerobic exercise on fatigue in hemodialysis patients. A Quasi experimental study was carried out among 60 adult hemodialysis patients (30 each in the groups) selected by consecutive sampling technique. The baseline characteristics and pretest fatigue score were assessed for both the groups and the intradialytic aerobic exercise was administered for 8 weeks (three times/week) among the experimental group. Then post intervention I and II fatigue score were assessed in both the groups at end of 4th and 8th week. In Control group, there was no statistically significant difference in fatigue score between pre intervention, post intervention I and II (32.43 ± 7.78, 32.20 ± 7.00 and 31.13 ± 8.44, F=1.29, p = 0.28)). Whereas, in experimental group, there was significant reduction in fatigue score in post intervention I (26.97 ± 8.60) and II (23.57 ± 7.29) than pre intervention (32.20 ± 8.64) at p=0.001. There was significant difference in post intervention I (t=2.58, p= 0.001) and post intervention II (t=3.71, p = 0.001) between control and experimental group. This study shows that intradialytic aerobic exercises is beneficial in reducing fatigue, as a supplementary therapy in hemodialysis patients.

Keywords: *Fatigue, Chronic kidney Disease, Intradialytic aerobic exercise, Hemodialysis.*

1. INTRODUCTION

Chronic kidney Disease (CKD) is a public health problem[1], prevalence of which is increasing and affects over 75 million people worldwide[2]. Patients with end stage kidney diseases (ESKD) commonly receive sessions, three times with various age groups from different backgrounds [3-4]. Hemodialysis is provided on a strict thrice weekly treatment regimen, Mondays, Wednesdays and Fridays or Tuesdays, Thursdays, and Saturdays are dialysis days [3]. There are approximately 120,000 HD patients in India[5].

Fatigue is a common symptom for CKD patients, with a diminishing effect on quality of life4. Fatigue reduces ability for self-care, disrupts familial and social roles, and decreases the ability to perform routine activities, increases dependence and reduces self-confidence[6]. It was reported that 60 to 97% of hemodialysis patients experience some degree of fatigue compared to patients with normal kidney function7. Studies have reported on beneficial effect of exercises for hemodialysis patients in reducing fatigue, improving hemodialysis adequacy, exercise capacity, depression and quality of life in HD patients8. Aerobic exercise is a feasible and cost-effective intervention which can be carried out by the patients during HD. Since they are physically inactive for about 2 to 3 hours during each session, and long for some change or diversion, it encourages the patients to participate in an exercise program to be physically active and thus improve their psychological status. However, there is paucity of research on aerobic exercise upon fatigue among patients undergoing hemodialysis. Hence this study was conducted to determine the effect of intradialytic aerobic exercise on fatigue in patients undergoing hemodialysis.

2. METHODS

Study Design and Participants:

A quasi-experimental study was carried out among 60 adult subjects (30 each in the control and experimental groups) selected by consecutive sampling technique from 2 tertiary care centers in Chennai (one center for each group).

The inclusion criteria were as follows: patients on maintenance hemodialysis for more than 3 months, age ranging from 20 to 59 years, willing to participate in the study, receiving hemodialysis 3 times per week, for 3 or 4 hrs. (180 min or 240 min) per treatment, having no problems in arteriovenous (AV) fistulas (based on the physician's clinical diagnosis). The exclusion criteria were: tendency to have blood coagulation of dialysis filter (during hemodialysis), unwillingness to adhere to the exercise in hemodynamic of angina pectoris in the months and having any medical contraindication to exercise.

Based on the study findings of Maniam et al.[9] the calculated sample size was 32 (27 in each group) using open epi with power (95%) to detect a mean difference of fatigue score of 3.1 (fatigue score:µ1=7.6, µ2=10.7,S1=3.3and S2=2.9). Considering the attrition rate of 10% the sample size for the current study was rounded of to 60 (30 in each group). The researcher selected 67 HD patients from two centers, based on eligible criteria, out of which 62 subjects volunteered and 31 patients were enrolled in each group. Due to attrition, 30 subjects were in each group. Informed consent was obtained from all participants. The experimental group underwent intradialytic aerobic exercise. The ethical clearance was obtained from the Institutional Ethics Committee [ACON C/IEC/2018/014]. After obtaining consent, the data regarding background characteristics was collected, using demographic variables and clinical variables proforma and the fatigue by standardized fatigue tool developed by Michelsen et al[10] in 2003 (r=0.761), among both the groups. It consists of 10 items (Table 1) on physical (5 items) and mental fatigue (5 items) on 5-point rating scale, scored as 1 = Never, 2 = Sometimes; 3 = Regularly; 4 = Often and 5 = Always. The intradialytic exercise program was given for experimental group. The protocol for exercise was as follows: after connecting the patient to the hemodialysis machine, aerobic range of motion exercise (ROM) was performed for 15 minutes during the first 2 hours of the dialysis session and no exercise was prescribed during the second half of the session. The prescribed exercises included rotating the wrist as follows: 20 rounds per minute (RPM) clockwise and anticlockwise, 20 times full flexion and extension of the wrist, 20 times full flexion and extension of the elbow joint, 20 RPM of rotating the ankles clockwise and anticlockwise, 20 times full flexion and extension of the ankles[11]. The Post-intervention II was done at the end of 4th and 8th week for both the groups. The collected data was analyzed in SPSS-22 using appropriate descriptive (frequency, percentage, mean, standard deviation) and inferential (chi square test, independent t test, and repeated measures ANOVA) statistics.

3. RESULTS

The majority of the study subjects were between 41-60 years old (70%, 66.67%), males (60%, 53.33%), urban residents (60%, 53.33%), Hindus (63.33%, 56.67%), non-vegetarians (63.33% , 73.33%), married (70%, 60%), graduates (56.67%, 46.67%), unskilled workers (33.33%, 40%) with a monthly income of more than Rs.15000 (50%, 43.33%), not following any exercise regimen regularly (56.67%, 63.33%) and with spouse as their primary care giver (50%, 46.67%), (table 2) in control and experimental groups respectively.

The percentage distribution of clinical variables shows (table.3) the presence of co-morbidities such as diabetes mellitus and hypertension (50%, 46.66%) with the family history of ESRD (63.33%, 53.33%), unknown cause of chronic kidney disease (26.67% and 23.33%), were on HD for more than 3 years of duration (36.67%, 33.33%) regularly thrice in a week (83.33%, 83.33%) with > 60kg dry weight (36.67%, 30%) in control and experimental group respectively. Both were homogenous with respect to all selected demographic and clinical variables.

In experimental group, there was significant between pre-intervention and post intervention -II fatigue score (F = 33.99) at P = 0.001 (table 4). The independent t test reveals a significant reduction in fatigue scores among experimental group in post intervention I and post intervention II (p=0.001) in fig.1. Therefore, we can conclude that an Intradialytic Aerobic Exercise reduces significantly fatigue score among hemodialysis patients.

There current study reveals that there was a significant association between fatigue score of hemodialysis patients with their age, area of residence and duration of HD (P=0.05) by one-way ANOVA analysis (fig 2).

4. DISCUSSION

Chronic kidney disease is a major public health problem and epidemic in both developing and developed countries. Currently, about 50 million people have CKD worldwide, and the prevalence of this epidemic is reported to increase each year[12]. Physical exercise was reported to improve blood pressure, heart rate, rate of respiration, strength of the muscles, and improvement in overall quality of life.[13]

Patients who have ESKD and are treated with (HD) face a stressful and disruptive chronic illness with a complex and demanding treatment regimen. ESKD patients on (MHD), following a session of HD, frequently complain of tiredness, weakness, exhaustion, weariness, a sensation of prostration or fatigue[14]. Attention to preventing fatigue is important because fatigue can affect patient quality of life both in the short and in the long term. The result of the study shows that the mean fatigue score was 32.4/50 and 32.2/50 in control and experimental group. Mohamed et al. reported that the majority of hemodialysis patients in Egypt experienced fatigue [15]. The results of this study showed that there was a significant difference in the levels of fatigue between the experimental and control groups in the post intervention I and II. It could be inferred from the results of this study that intradialytic exercise is a promising way to control the natural progression of fatigue that the hemodialysis patients experience through time as the fatigue will increase if not addressed timely and appropriately. The results of our study are in agreement with the findings of Soliman et al[16]. The results of Liu et al[17] also suggest that aerobic exercise plays an important role in physical function and decreases depression. Several studies have demonstrated that exercise during dialysis not only decreases fatigue, but also increases self-confidence and

self-efficacy[18,19]. The intradialytic aerobic exercise program resulted in a substantial decrease in fatigue. It seems that during dialysis exercise increases the muscle blood flow and opens the capillary surface area which subsequently increases the flux of urea from the tissue to the vascular compartment[20]. The intradialytic exercises widen muscular arteries, improves perfusion, and alleviates diseases affecting blood circulation in muscles. Therefore, due to the improvement in perfusion and enhanced blood circulation and better toxin elimination and higher muscular strength, and consequently, lower levels of fatigue and impotence, we can expect improvement in the quality of life of patients undergoing hemodialysis. This study provides a more time-efficient option for exercise among hemodialysis patients as the method used did not necessitate extra time, costs, and transportation [21].

This study found a significant association between fatigue and age of the HD patients. The fatigue score was found to increase with the age of hemodialysis patients. This was in keeping with the findings of Debnath et al. Age and education were associated with fatigue, but hemodialysis-related variables were not. They reported a significant inverse association of physical activity with fatigue severity observed on non-dialysis day. There was also a negative association between the normalized protein catabolic rate and fatigue severity on both dialysis and non-dialysis days.[22]. There was also a significant association between fatigue and dialysis vintage (p-0.05) in this study. This is similar to the results of Bossollo et al[23] HD treatment related fatigue is not well understood however many socio demographic variables such as age, dialysis vintage, gender, and race have been implicated in the severity and the prevalence of the symptoms. A cause of the observed minimal levels of physical activity is probably that the HD procedure per se [e.g., duration of dialysis sessions (Caplin et al., 2011) etc.,] contributes to fatigue.[24]

In our study we found that HD patients residing in urban areas, showed higher values of total FAS score (mean: 10.97) compared to residents of suburban areas (mean:7.33) rural areas (mean :5.05). Similar result was reported by Zyga et al that the place of residence influences the level of fatigue since patients living in suburban areas noted lower indicator of overall fatigue and physical fatigue than those who live in the city center. This may be due to extra time needed to travel in heavy traffic of cities to reach the hemodialysis unit in time[25].

This study had limitations. Although two main centers were selected, and all eligible patients were included, the sample size decreased due to the dropout. It is recommended that this study be conducted with a larger sample size.

5. CONCLUSION

This study showed the effects of intradialytic aerobic exercise interventions that could be safely practiced in the HD units to a wide range of the dialysis population. Despite the beneficial effects of aerobic exercise training in the HD population, there is a lack of the widespread adoption of such program. We recommend that the orientation and awareness program can be organized for health care professionals in the dialysis unit to consider and implement such simple training programs as standard clinical practice in dialysis unit. Furthermore, additional studies are required with longer duration, larger sample sizes, and different exercises in HD patients.

6. ACKNOWLEDGEMENT

The authors wish to thank all participated and clinical staffs.

Financial support and sponsorship: Nil

Conflict of interest: Nil

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APPENDIX

Table 1: Standardized Fatigue Assessment Scale (FAS) (Michielsen,et.al, 2003)

S.NO	Statements	1 Never	2 Sometimes	3 Regularly	4 Often	5 Always
1	I am bothered by fatigue					
2	I get tired very quickly					
3	I don't do much during the day					
4	I have enough energy for everyday life					
5	Physically, I feel exhausted					
6	I have problems to start things					
7	I have problems to think clearly					
8	I feel no desire to do anything					
9	Mentally, I feel exhausted					
10	When I am doing something, I can concentrate quite well					

Table 2: Frequency and Percentage Distribution of Demographic Variables of Patients Undergoing Hemodialysis

Variables		Group				$\chi 2$ & p value
		Experimental(n=30)		Control(n=30)		
		f	%	f	%	
Age in years	21-30	3	10.00	4	13.33	$\chi 2$=0.37 p=0.95
	31-40	6	20.00	6	20.00	
	41-50	8	26.67	9	30.00	
	51-60	13	43.33	11	36.67	
Gender	Male	18	60.00	16	53.33	$\chi 2$=0.27 p=0.60
	Female	12	40.00	14	46.67	
Residence	Rural	4	13.33	5	16.67	$\chi 2$=0.28 p=0.87
	Semi urban	8	26.67	9	30.00	
	Urban	18	60.00	16	53.33	
Religion	Hindu	19	63.33	17	56.67	$\chi 2$=0.36 p=0.84
	Christian	7	23.33	9	30.00	
	Muslim	4	13.33	4	13.33	

Dietary habits	Vegetarian	11	36.67	8	26.67	$\chi2$=0.69 p=0.41
	Non-Vegetarian	19	63.33	22	73.33	
Education	. Illiterate	0	0.00	0	0.00	$\chi2$=0.60 p=0.74
	Primary/middle	5	16.67	6	20.00	
	High school/HSC	8	26.67	10	33.33	
	Graduate and above	17	56.67	14	46.67	
Occupation	Home maker	6	20.00	7	23.33	$\chi2$=1.29 p=0.94
	Unskilled	4	13.33	5	16.67	
	Semi-professional	10	33.33	7	23.33	
	Professional	3	10.00	4	13.33	
	Unemployed	1	3.33	2	6.67	
	Retired	6	20.00	5	16.67	
Income in rupees	<Rs. 5000	0	0.00	0	0.00	$\chi2$=0.27 p=0.87
	Rs.5001-10,000	6	20.00	7	23.33	
	Rs.10,001-15,000	9	30.00	10	33.33	
	>Rs.15,000	15	50.00	13	43.33	
Marital status	Married	21	70.00	18	60.00	$\chi2$=0.98 p=0.80
	Unmarried	2	6.67	4	13.33	
	Widowed	5	16.67	6	20.00	
	Divorced	2	6.67	2	6.67	
Habit of regular exercise	Yes	13	43.33	11	36.67	$\chi2$=0.27 p=0.60
	No	17	56.67	19	63.33	
Primary Caregiver	Self	10	33.33	8	26.67	$\chi2$=1.26 p=0.75
	Spouse	15	50.00	14	46.67	
	Son	3	10.00	6	20.00	
	Daughter in law	2	6.67	2	6.67	

Table 3: Frequency and Percentage Distribution of Clinical Variables of Patients Undergoing Hemodialysis

Variables		Group				$\chi2$ & p value
		Experimental(n=30)		Control(n=30)		
		n	%	N	%	
Comorbidities	Diabetes mellitus	6	20.00	5	16.67	$\chi2$=0.52 p=0.91
	Hypertension	4	13.33	6	20.00	
	Both	15	50.00	14	46.66	
	Other renal disease	5	16.67	5	16.67	
Family history of ESRD	Present	19	63.33	16	53.33	$\chi2$=0.61 p=0.43
	Absent	11	36.67	14	46.67	
Cause For Kidney Disease	Diabetes mellitus	4	13.33	5	16.67	$\chi2$=0.31 p=0.99
	Hypertension	7	23.33	8	26.67	
	polycystic kidney disease	3	10.00	3	10.00	
	Unknown etiology	8	26.67	7	23.33	
	Any other cause	8	26.67	7	23.33	
Duration of ESRD in yrs	< 1	6	20.00	6	20.00	$\chi2$=0.12 p=0.99
	1-3	7	23.33	7	23.33	
	3-5	6	20.00	7	23.33	
	.> 5	11	36.67	10	33.33	
Duration of HD	.<6 months	0	0.00	0	0.00	$\chi2$=0.42 p=0.93
	6 months-1 year	6	20.00	8	26.67	
	1-2 years	6	20.00	5	16.67	
	2-3 years	7	23.33	7	23.33	
	.>3 years	11	36.67	10	33.33	
Dry weight(kg)	31-40	3	10.00	5	16.67	$\chi2$=0.83 p=0.84
	41-50	6	20.00	7	23.33	
	51-60	10	33.33	9	30.00	
	>60	11	36.67	9	30.00	

Table 4: Comparison of Fatigue score between pretest, post intervention-I, and II among Experimental and Control Group (RM ANOVA with Post Hoc Analysis (N=60)

Group	Assessment	Mean	SD	F value	'p' value	Post Hoc Analysis (Bonferroni t- test)		
						Comparison	Mean Difference	'p' value

Control (n=30)	Pre intervention	32.43	7.78	F=1.29	p=0.28	Pre intervention Vs post intervention -I	0.23	0.01
	Post intervention - I	32.20	7.00			Pre intervention t Vs Post intervention -III	1.30	0.01
	Post intervention - II	31.13	8.44			Post intervention -1 Vs post intervention - II	1.07	0.05
Experimental (n=30)	Pre intervention	32.20	8.64	F=33.99	p=0.001	Pre intervention Vs post intervention -I	5.23	0.001
	Post intervention - I	26.97	8.60			Pre intervention Vs Post intervention -III	8.63	0.001
	Post intervention - II	23.57	7.29			Post intervention -1 Vs post intervention - II	3.40	0.001

FIGURES

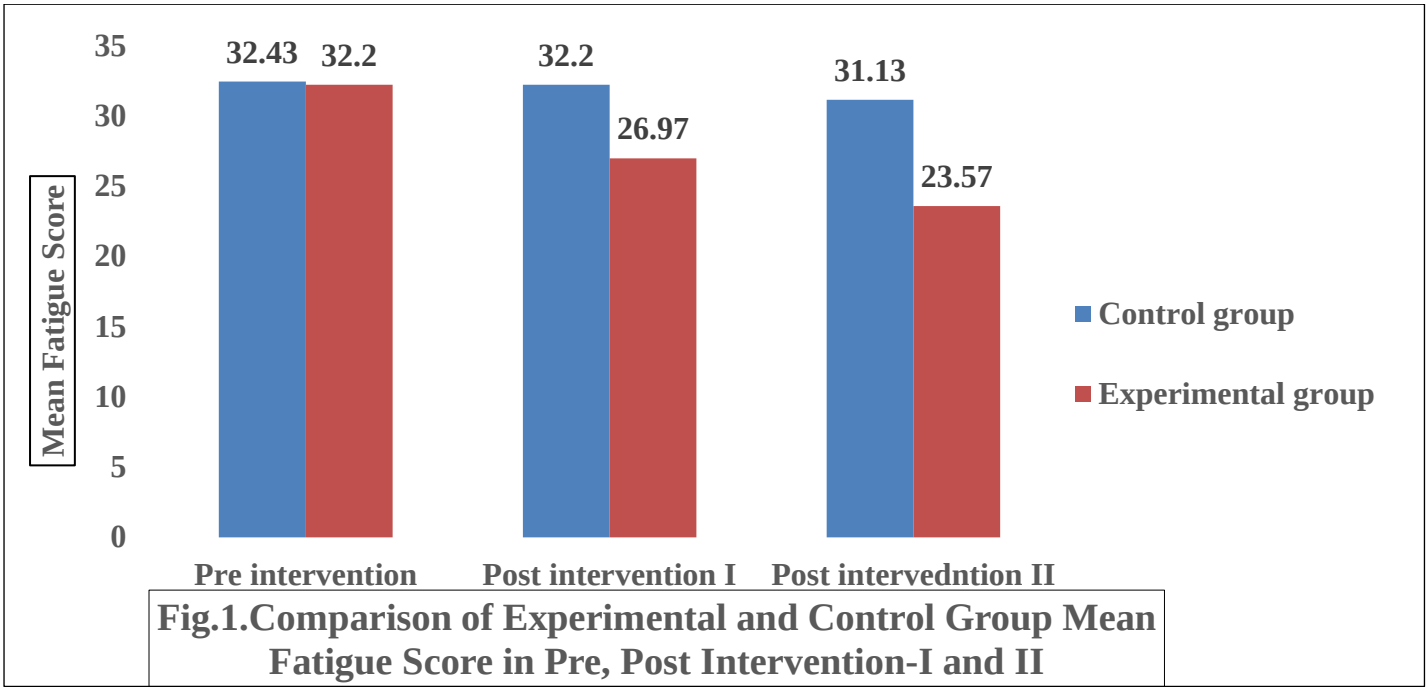

Fig.1.Comparison of Experimental and Control Group Mean Fatigue Score in Pre, Post Intervention-I and II

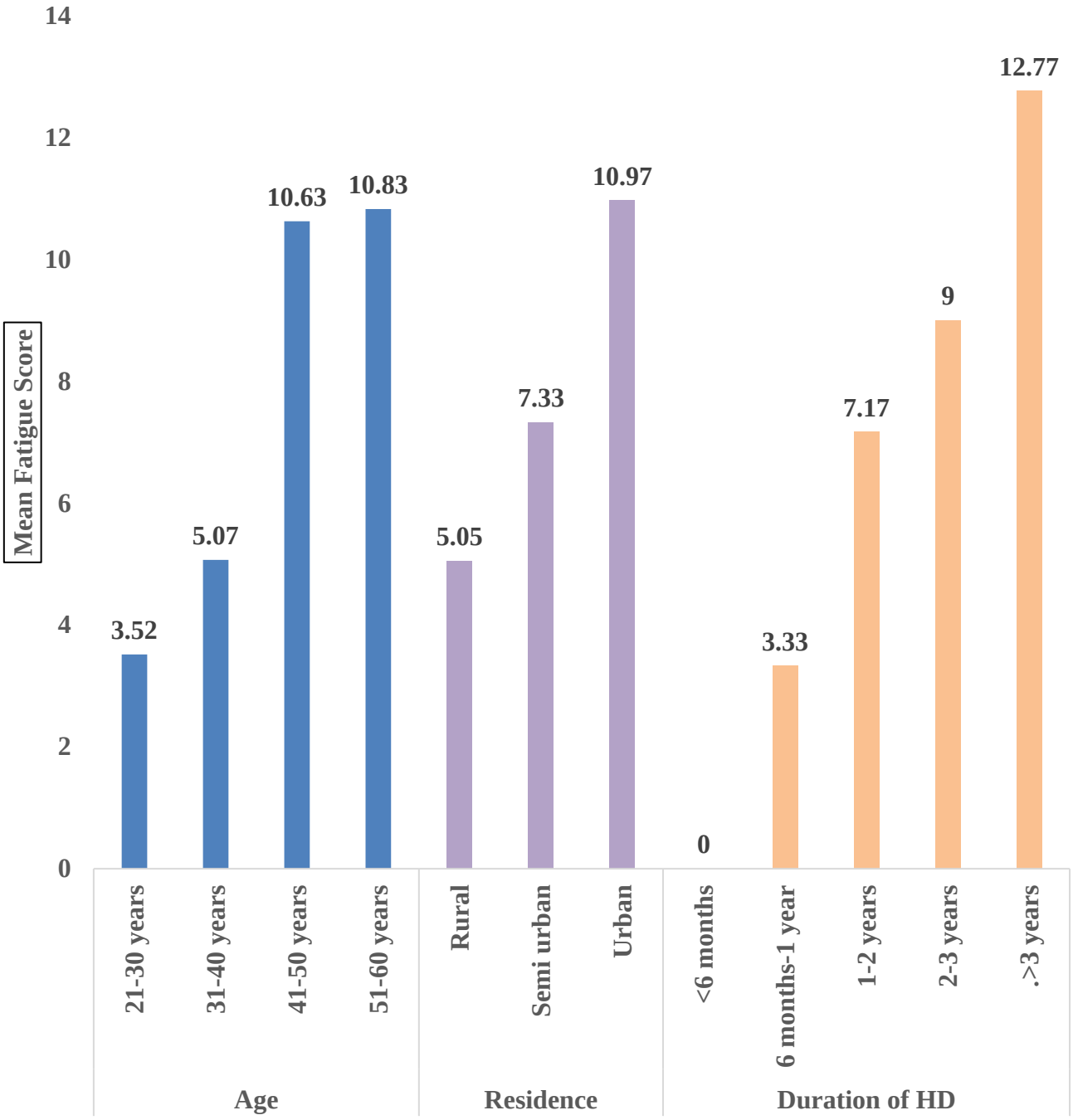

Fig.2. Association Between Fatigue Score and Demographic Variables of HD Patients (Experimental Group)