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Cross-Sectional Study Of Somatic And Anxiety Symptoms In Relation To Physical Activity Among Chronic Kidney Disease Patients On Maintenance Haemodialysis

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Abstract:
Introduction: *Patients with chronic kidney disease (CKD) undergoing maintenance haemodialysis (MHD) frequently experience anxiety and somatic symptoms, which may be influenced by patterns of physical activity.* ***Aim:*** *To evaluate the associations between physical activity intensity and psychological symptom burden (somatic and anxiety) in MHD patients.*
Methodology: *This cross-sectional study was conducted at a tertiary care hospital in Pondicherry, India. Sixty adults receiving thrice-weekly MHD completed the Hamilton Anxiety Rating scale (HAM-A), the Somatic Symptom Scale-8 (SSS-8) and the International Physical Activity Questionnaire (IPAQ). Data were analysed using SPSS, group differences were assessed by one-way ANOVA with statistically significant set at $p<0.005$.*
Results: *Participants had a mean age of 44.15±10.41 years, and 53.3% were males. Vigorous activity was reported by 81.2% of patients with mild anxiety and by none of those with severe anxiety (p 0.007). Patients with high and very high somatic symptom burdens reported no days of vigorous activity compared with those with low burdens (p <0.001). Moderate activity was inversely related to somatic symptoms (p 0.028) but was not significantly associated with anxiety. Walking frequency differed by anxiety severity (p 0.032) but did not vary across somatic symptom levels (p 0.374).*
Conclusion: *Vigorous physical activity was inversely associated with anxiety and somatic symptoms in MHD patients, supporting Kidney Disease Outcomes Quality Initiative (KDOQI) recommendations and advocating tailored, comprehensive intradialytic exercise programmes to enhance future health outcomes.*
Keywords: *Anxiety disorders, Physical Activity, Renal dialysis, Somatic symptoms.*

INTRODUCTION

Chronic kidney disease (CKD) has emerged as a global public-health challenge, with its most severe form, End-Stage Renal Disease (ESRD) requiring renal replacement therapy (RRT) such as maintenance haemodialysis (MHD).[1–3] According to the Global Burden of Disease Study (GBD Collaboration), the prevalence of CKD increased by more than 30% between 1990 to 2017, and nearly 10% of adults worldwide now live with evidence of impaired kidney function.[4,5] Although haemodialysis (HD) access has expanded in 160 countries, disparities in availability, quality of care and patient outcomes persist, placing substantial strain on healthcare systems and patients.[5–7]
Patients undergoing thrice-weekly MHD often exhibit critically reduced levels of daily physical activity (DPA) and markedly impaired physical performance.[3,8,9] Contributing factors include arterial

hypertension, diabetes, advanced age, uremic myopathy, chronic inflammation, and a family history of CKD as well as the time demands of dialysis leading to a 40-60% of lower activity profile compared with age-matched healthy controls.[10,11] Such deficits have been independently linked to higher rates of hospitalization, poorer quality of life (QOL) and increased mortality, underscoring the need for targeted interventions to preserve and enhance physical function. Physical activity has been shown to improve cardiovascular and aerobic capacity as well as QOL in these population.[9,12] The findings of these investigations show the necessity of including physical activity as a part of the all-encompassing care for these individuals.[13]

Beyond physical impairments, MHD patients frequently report a constellation of somatic complaints including sleep disturbances, musculoskeletal pain, and gastrointestinal discomfort alongside high rates of anxiety.[11,14,15] In multicentre surveys, up to 50% of HD patients endorse significant somatic symptom burden on the Symptom Checklist-90 (SCL-90),[3] and nearly 43% meet the criteria for clinically relevant anxiety on the Beck Anxiety Inventory (BAI).[11] However, the relationship between these symptoms and free-living DPA levels remains poorly characterised.

Exercise interventions have demonstrated robust benefits for mental health across the CKD spectrum. A meta-analysis of randomized controlled trials (RCT) found that structured exercise yields moderate reductions in depressive symptoms (standard mean difference (SMD) -0.66) and anxiety (SMD -0.78) compared with controls in CKD patients.[14] Intra-dialytic exercise programmes decrease inflammatory markers, improve six-minute walk distances (SMWD) and alleviate depressive symptoms in MHD cohorts.[16] Virtual-reality-augmented cycling sessions have also been shown to reduce anxiety and depression scores over three months of interventions.[17]

Despite these findings, few studies have directly examined how somatic and anxiety symptoms correlate with free-living physical activity levels in MHD patients.[3,11,14] To address this critical gap, this cross-sectional study employs validated psychometric scales (somatic symptom scale-8 (SSS-8) and Hamilton anxiety scale (HAM-A)) alongside the international physical activity questionnaire (IPAQ) in relatively healthy adults receiving thrice-weekly MHD to elucidate these relationships, and inform the design of tailored exercise interventions targeting both physical and psychological well-being in the HD population.

Objectives

To assess physical activity using the IPAQ, somatic symptoms using the SSS-8, and anxiety using the HAM-A in CKD patients on MHD, and to correlate somatic and anxiety symptoms with physical activity levels.

METHODOLOGY

This hospital-based, cross-sectional observational study was conducted at a tertiary care hospital in Pondicherry, India, between January 2021 and June 2022. The protocol was approved by the Institutional Human Ethics Committee (IHEC) in accordance with the Declaration of Helsinki. All participants provided informed consent before enrolment.

Study population incudes adult aged 18 to 65 years receiving thrice-weekly MHD for at least three months in our nephrology clinic were included, ability to ambulate independently, and had no active infection requiring hospitalization in the preceding months. Exclusion criteria were age above 65 years old, limb amputation, significant intellectual disability or cognitive impairment, physical disability and unstable CVD.

Considering the psychiatric comorbidity in patients undergoing haemodialysis about 4.1% of patients had sever depressive disorder by the study conducted by Goyal et al,[18] the sample size was calculated with absolute precision of 5% at 95% confidence interval (CI) (α = 0.05), using the formula $n = \frac{Z_{1-\frac{\alpha}{2}} \times pq}{d^2}$, the sample size was 60. (prevalence (p) 0.04; q = 1-p = 1-0.04 = 0.96; $Z_{1-\alpha/2}$ – 1.96 at 95% CI; absolute precision (d) – 0.05). Convenience sampling was used until the sample size was achieved.

After dialysis, participants were interviewed privately, with female patients accompanied by a female staff nurse and bystander. Demographic data were collected using a standard clinical proforma. Current physical activity was measured by the IPAQ and categorized as inactive, moderately active and health-enhancing physically active based on activity over the preceding 12 weeks.[19] Anxiety was assessed using

HAM-A and graded as mild, moderate to severe and severe.[20] Somatic symptoms were assessed using the SSS-8[21] and graded as no to minimal, low, medium, high and very high. Somatic and anxiety symptoms were then correlated with physical activity levels.

Ethical consideration

IHEC approval was obtained prior to study commencement. The participants were informed that data would be used for research purposes only and could withdraw at any time without penalty. Confidentiality was maintained throughout the study. Participants requiring medical attention during the study period received appropriate care.

Statistical analysis

Data were analysed using SPSS (v_24.0, IBM, Armonk, NY). Normality was assessed by the Shapiro-Wilk test and Q-Q plot. Continuous variables were presented as mean ± standard deviation (SD) or median (interquartile range (IQR)), as appropriate, and categorical variables as frequency with percentages. Associations between variables were explored using Pearson's Chi Square test, Mann-Whitney U test and one-way ANOVA as appropriate. A two-tailed p value <0.005 was considered statistically significant.

RESULTS

Table 1 presents the socio-demographic profiles of the 60 participants. The mean age was 44.15 ± 10.41 years, and the mean daily sitting time was 7.12 ± 1.43 hours daily.

Table 1: Socio-demographic profile of the study participants (N = 60)

Variable	n (%)
Age (in years)	
< 30	7 (11.7)
31 to 40	18 (30.0)
41 to 50	15 (25.0)
> 51	20 (33.3)
Gender	
Male	32 (53.3)
Female	28 (46.7)
Co-morbidities	
Diabetes Mellitus	22 (36.7)
Systemic Hypertension	10 (16.6)
Bronchial asthma	9 (15.0)
No comorbidities	19 (31.7)

Using the IPAQ, physical activity was categorized into vigorous, moderate and walking days. **(Table 2)**

Table 2: Activity days among the study participants using International physical activity questionnaire (IPAQ) (N = 60)

Activity days	n (%)
Vigorous activity days (in days)	
0	34 (56.7)
1	5 (8.3)
2	5 (8.3)
3	3 (5.0)
4	6 (10.0)
5	3 (5.0)
6	3 (5.0)

7	1 (1.7)
Moderate activity days (in days)	
0	23 (38.3)
1	7 (11.7)
2	10 (16.7)
3	5 (8.3)
4	2 (3.3)
5	8 (13.3)
6	4 (6.7)
7	1 (1.7)
Walking days (in days)	
0	9 (15.0)
1	4 (6.7)
2	8 (13.3)
3	9 (15.0)
4	7 (11.7)
5	6 (10.0)
6	8 (13.3)
7	9 (15.0)

Anxiety and somatic symptoms distribution were summarised in **table 3.**

Table 3: Anxiety and Somatic symptom scale among the study participants (N = 60)

Variable	**n (%)**
Hamilton anxiety (HAM-A) scale	
Mild (<17)	32 (53.3)
Mild to moderate (18 – 24)	12 (20.0)
Moderate to severe (25 – 30)	12 (20.0)
Severe (31 – 56)	4 (6.7)
Somatic symptom scale – 8 (SSS-8)	
No to minimal	10 (16.7)
Low	17 (28.3)
Medium	7 (11.7)
High	4 (6.7)
Very high	22 (36.7)

Participants with mild anxiety engaged in a mean of 29.06 ± 18.02 minutes of vigorous activity, while those with severe anxiety engaged in none. The mean moderate activity times were 26.41 ± 20.29 minutes, 14.58 ± 23.30 minutes, 22.50 ± 18.02 minutes and 5.00 ± 10.00 minutes for mild, mild to moderate, moderate to severe and severe anxiety, respectively. Mean walking times were 28.44 ± 16.82 minutes, 30.83 ± 14.59 minutes, 23.33 ± 17.75 minutes and 7.50 ± 15.00 minutes, respectively. Mean sitting time was highest among those with severe anxiety. Vigorous activity days were significantly lower among those with elevated anxiety as all patients with mild anxiety reported at least one day of vigorous exercise, whereas none in higher-anxiety groups did (p 0.007). Moderate-intensity activity did not differ significantly by anxiety level (p 0.157). Walking days varied by anxiety severity (p 0.032), but not by somatic symptom level (p 0.374) **(Table $).**

Table 4: Association between physical activities using IPAQ and anxiety with HAM-A scale among the study participants (N = 60)

Activity days	HAM-A scale				P value*
	Mild (n = 32)	Mild to Moderate (n = 12)	Moderate to severe (n = 12)	Severe (n = 4)	
Vigorous activity days					
0	6 (18.8)	12 (100.0)	12 (100.0)	4 (100.0)	**0.007**
1	5 (15.6)	0 (0)	0 (0)	0 (0)	
2	5 (15.6)	0 (0)	0 (0)	0 (0)	
3	3 (9.4)	0 (0)	0 (0)	0 (0)	
4	6 (18.8)	0 (0)	0 (0)	0 (0)	
5	3 (9.4)	0 (0)	0 (0)	0 (0)	
6	3 (9.4)	0 (0)	0 (0)	0 (0)	
7	1 (3.1)	0 (0)	0 (0)	0 (0)	
Moderate activity days					
0	9 (28.1)	8 (66.7)	3 (25.0)	3 (75.0)	0.157
1	4 (12.5)	1 (8.3)	2 (16.7)	0 (0)	
2	6 (18.8)	2 (16.7)	2 (16.7)	0 (0)	
3	5 (15.6)	0 (0)	0 (0)	0 (0)	
4	1 (3.1)	0 (0)	0 (0)	1 (25.0)	
5	6 (18.8)	0 (0)	2 (16.7)	0 (0)	
6	1 (3.1)	1 (8.3)	2 (16.7)	0 (0)	
7	0 (0)	0 (0)	1 (8.3)	0 (0)	
Walking days					
0	3 (9.4)	0 (0)	3 (25.0)	3 (75.0)	**0.032**
1	4 (12.5)	0 (0)	0 (0)	0 (0)	
2	6 (18.8)	1 (8.3)	1 (8.3)	0 (0)	
3	5 (15.6)	3 (25.0)	0 (0)	1 (25.0)	
4	4 (12.5)	2 (16.7)	1 (8.3)	0 (0)	
5	1 (3.1)	3 (25.0)	2 (16.7)	0 (0)	
6	4 (12.5)	0 (0)	4 (33.3)	0 (0)	
7	5 (15.6)	3 (25.0)	1 (8.3)	0 (0)	

**ANOVA. P-value <0.05 were statistically significant and indicated in boldface. Cells with values '0' were considered as '0.5' for analysis. Numbers in the parenthesis are percentages. HAM-A – Hamilton anxiety scale.*

For somatic symptoms, mean vigorous activity times were 37.50 ± 9.78 minutes, 22.35 ± 18.60 minutes and 25.00 ± 25.00 minutes, respectively for no to minimal, low, and medium, high symptoms, respectively. Mean moderate activity times were 32.00 ± 20.40 minutes, 34.71 ± 16.24 minutes, 25.00 ± 23.27 minutes, 10.00 ± 20.00 minutes and 8.41 ± 14.09 minutes, for no to minimal, low, medium, high and very high symptoms, respectively. Mean walking time were similar across groups and it were 28.50 ± 15.28 minutes, 24.41 ± 13.44 minutes, 24.29 ± 23.70 minutes, 30 ± 25.8. minutes and 27.27 ± 17.71 minutes, respectively. The mean sitting time was more among those with very high somatic symptoms, followed in the order by high, medium, low and no to minimal somatic symptoms.

Participants with higher somatic symptom burden were overwhelmingly those who did no vigorous activity as none of the high or very high SSS-8 groups reported any vigorous days, whereas such activity was present in all lower-symptom categories (p <0.001). Similarly, zero days of moderate-intensity exercise were most common among those with high or very high somatic symptoms (20% in no or minimal vs 75%-68.2% in high/ very high; p 0.028). In contrast, walking days did not vary significantly across somatic symptom levels (p 0.374). These patterns suggest that deficits in moderate-to-vigorous exercise, rather than walking alone, are closely linked to greater somatic complaints in MHD patients. **(Table 5)**

Table 5: Association between physical activities using IPAQ and somatic symptoms with SSS-8 scale among the study participants (N = 60)

Activity days	**SSS-8 scale**					**P value***
	No to minimal (n = 10)	**Low (n = 17)**	**Medium (n = 7)**	**High (n = 4)**	**Very high (n = 22)**	
Vigorous activity days						
0	0 (0)	5 (29.4)	3 (42.9)	4 (100.0)	22 (100.0)	**<0.001**
1	2 (20.0)	2 (11.8)	1 (14.3)	0 (0)	0 (0)	
2	3 (30.0)	1 (5.9)	1 (14.3)	0 (0)	0 (0)	
3	2 (20.0)	1 (5.9)	0 (0)	0 (0)	0 (0)	
4	0 (0)	5 (29.4)	1 (14.3)	0 (0)	0 (0)	
5	0 (0)	2 (11.8)	1 (14.3)	0 (0)	0 (0)	
6	2 (20.0)	1 (5.9)	0 (0)	0 (0)	0 (0)	
7	1 (10.0)	0 (0)	0 (0)	0 (0)	0 (0)	
Moderate activity days						
0	2 (20.0)	1 (5.9)	2 (28.6)	3 (75.0)	15 68.2)	**0.028**
1	2 (20.0)	2 (11.8)	1 (14.3)	0 (0)	2 (9.1)	
2	2 (20.0)	7 (41.2)	0 (0)	1 (25.0)	0 (0)	
3	2 (20.0)	3 (17.6)	0 (0)	0 (0)	0 (0)	
4	0 (0)	0 (0)	1 (14.3)	0 (0)	1 (4.5)	
5	1 (10.0)	3 (17.6)	3 (42.9)	0 (0)	1 (4.5)	
6	1 (10.0)	1 (5.9)	0 (0)	0 (0)	2 (9.1)	
7	0 (0)	0 (0)	0 (0)	0 (0)	1 (4.5)	
Walking days						
0	1 (10.0)	1 (5.9)	2 (28.6)	1 (25.0)	4 (18.2)	0.374
1	1 (10.0)	2 (11.8)	0 (0)	0 (0)	1 (4.5)	
2	1 (10.0)	2 (11.8)	3 (42.9)	0 (0)	2 (9.1)	
3	1 (10.0)	3 (17.6)	1 (14.3)	0 (0)	4 (18.2)	
4	1 (10.0)	2 (11.8)	0 (0)	0 (0)	4 (18.2)	
5	0 (0)	4 (23.5)	0 (0)	0 (0)	2 (9.1)	
6	1 (10.0)	2 (11.8)	0 (0)	1 (25.0)	4 (18.2)	
7	4 (40.0)	1 (5.9)	1 (14.3)	2 (50.0)	1 (4.5)	

**ANOVA. P-value <0.05 were statistically significant and indicated in boldface. Cells with values '0' were considered as '0.5' for analysis. Numbers in the parenthesis are percentages. SSS-8 – somatic symptoms scale – 8.*

DISCUSSION

In this cross-sectional study of 60 MHD patients, vigorous-intensity activity was inversely associated with both anxiety (p 0.007) and somatic symptom burden (p <0.001), whereas moderate activity showed only modest associations and walking frequency did not significantly differentiate somatic symptoms. These findings underscore the potential of higher-intensity exercise to mitigate psychological and somatic distress in this population.

Since 2001, the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines by National Kidney Foundations have recommended physical activity in the management of CKD.[22] According to these guidelines, aerobic exercise three to five times per week, totalling 30 and 60 minutes at a low-to-moderate intensity, 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity physical activity per week, delivered through both interdialytic and intradialytic exercise, to improve cardiovascular health and physical function and to mitigate the symptom burden.[23] Notably, pooled study by Qui et al, reported that not just aerobic workouts but also strength exercises are advised in this type of patient.[24]

The present study has shown that the mean age of the study participants was 44.15 ± 10.41 years. Similarly in a study done by Haroun MK et al,[25] it was shown that the mean age of the study participants was 41.00 ± 17.00 years. The present study has shown that majority of the study participants were males. Similarly in a study done by Yamagata K et al,[26] majority of the study participants were males. Disparities in CKD caused by gender are widely known. Based on the United States Renal Data System, men are more likely to develop kidney failure despite women having a higher prevalence of CKD.[27–29] This finding raises the possibility that women may experience a slower decline in kidney function than men, or that women are more likely to pass away before developing kidney failure.[27,29] Such demographic patterns may influence both physical activity engagement and symptom reporting that factors that should be considered when designing exercise interventions to alleviate anxiety and somatic complaints in the haemodialysis population.

In the present study, HAM-A scale analysis showed that 53.3%, 20%, 20% and 6.7% had mild, mild to moderate, moderate to severe and severe anxiety. In a study done by Kumar V et al,[15] it was stated that 28% had anxiety. Also, our study findings aligns with Zhang et al,[11] that 43% of haemodialysis patients me BAI-defined anxiety criteria and that anxious patients walked 28% shorter SMWD than non-anxious peers. Walking frequency in our study averaged 3.5 days/week among those with mild anxiety versus 0.8 days/week for those with sever anxiety (p 0.032), echoing Dziubek et al, observations that each additional 30-minues of daily walking reduced the odds of clinically significant anxiety by 12%.[30] Similarly, Amer et al,[31] reported a 67.7% prevalence of severe anxiety in 68 MHD patients, with BAI scores inversely correlated to physical activity levels (r -0.87; p 0.001). Complementing these findings, Cohen et al, demonstrated that an eight-week intradialytic exercise plus relaxation program yielded a 35% reduction in HAM-A scores compared to controls.[32] Collectively, these data underscore the vital role of both vigorous-intensity and ambulatory exercise in mitigating anxiety among MHD patients.

In the present study, SSS-8 scale showed that 16.7%, 28.3%, 11.7%, 6.7% and 36.7% had no to minimal, low, medium, high and very high somatic symptoms. Corresponding findings were shown in a study done by Lou X et al,[3] multicentre analysis in 320 patients which reported mean daily steps of 3725.9 ± 2663.5 and demonstrated a strong inverse correlation between SCL-90 somatic scores and pedometer-recorded activity (r -0.813; p <0.01), with low activity nearly doubling the odds of high symptom burden (Odds ratio (OR) 1.97; 95% CI 0.63 – 4.08). Consistent with these results, Jhamb et al, found that 90% of patients identified dialysis-related fatigue as the principal barrier to exercise, linking greater fatigue to increased somatic distress.[33] Prospective monitoring by Cohen and colleagues showed step counts of 3991 (95% CI 3187 – 4796) on dialysis days versus 4561 (95% CI: 3757 – 5365) on non-dialysis days, underscoring pervasive inactivity in this population.[34] Additionally, Cobo et al,[35] documented that older age, higher comorbidity burden, and poorer nutritional status were key predictors of reduced day-to-day activity in dialysis patients. Collectively, these data highlight the critical role of moderate-to-vigorous exercise in mitigating somatic symptoms and improving quality of life among MHD patients.

Exercise therapy during haemodialysis sessions had demonstrated clinically meaningful benefits in cardiorespiratory fitness, functional capacity, psychological well-being, and even survival in patients receiving MHD. In our study, patients who engaged in more frequent vigorous-intensity activity exhibited significantly lower anxiety and somatic symptoms burdens. Ferreira TL et al,[14] did a comprehensive study to examine the impact of exercise therapy on depression and anxiety in people with chronic renal illness. The meta-analysis revealed statistically significant differences in depression favouring exercise when compared to active control and passive control (SMD = 0.66 [1.00, 0.33], p 0.0001 and 6.95 [8.76, 5.14], p 0.00001). The same findings for anxiety showed a statistically significant difference between exercise and active control (SMD = 0.78 [1.21, 0.34], p = 0.0004). Also, our findings aligns with Neto et al,[36] who found that combined intradialytic aerobic and resistance training increased peak VO_2 by 5.1 mL/Kg/min and reduced depressive symptoms by 7.32 points versus controls. In a 12-week thrice-weekly program, Suh et al. observed exercise duration gains of 124 s (483 ± 138 to 607 ± 119 s; p 0.002),maximal oxygen consumption increases from 26.3 ± 4.6 to 29.8 ± 4.9 mL/kg/min (p 0.013), and anxiety score reductions from 47.9 ± 5.9 to 42.8 ± 6.3 (p 0.004).[37] Collectively, these findings underscore that imperative to integrate structured exercise protocols particularly those combining aerobic and resistance modalities into routine dialysis care to enhance both physical function and psychological health in the MHD population.

CONCLUSION

As part of normal patient-centred care of people with CKD, a focus of therapy on measuring and enhancing physical activity and physical function should be strongly motivated by the quality of the evidence given. Thus, integrating tailored aerobic and resistance modalities into routine dialysis care may enhance both physical function and psychological well-being. Future longitudinal and interventional studies are warranted to confirm causality and optimize exercise prescriptions in this vulnerable population.

Back matter

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Ethical approval: *The authors are responsible for all facets of the work, ensuring that inquiries regarding the accuracy or integrity of any component are thoroughly investigated and addressed. All procedures conducted in this study adhered to the ethical standards set forth by the relevant institutional and/or national research committees and complied with the Helsinki Declaration (revised in 2013). Informed consent was obtained from the patient for the publication of this case report and associated images. The Institutional Ethical Committee (MGMCRI/Res/04/2022/121) approved this study.*

Figure legends

Table 1: Socio-demographic profile of the study participants

Table 2: Table 2: Activity days among the study participants using International physical activity questionnaire (IPAQ)

Table 3: Anxiety and Somatic symptom scale among the study participants

Table 4: Association between physical activities using IPAQ and anxiety with HAM-A scale among the study participants

Table 5: Association between physical activities using IPAQ and somatic symptoms with SSS-8 scale among the study participants

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