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Association between sedentary behavior, physical activity, and quality of life in renal patients undergoing hemodialysis

Asociación entre el comportamiento sedentario, la actividad física y la calidad de vida en pacientes renales sometidos a hemodiálisis

César Faúndez-Casanova[1,2]; João Vitor Oblanca[2]; Alessandra Precinda Kauffman-Tacada[2]; Kauana Marchini [2,3]; Mariana Ardengue [2,4]; Fabio Torres[2,5]; Pablo Felipe Luna-Villouta[6]; Victor Contreras-Mellado[7]; Michele Caroline de Costa Trinidade[2]; Ademar Avelar[2]

[1] Universidad Católica del Maule (Chile)
[2] Universidade Estadual de Maringá (Brasil)
[3] Centro Universitário Cidade Verde (Brasil)
[4] Universidade Cesumar (Brasil)
[5] Hospital Santa Casa de Maringá (Brasil)
[6] Universidad de Concepción (Chile)
[7] Universidad de Talca (Chile)

*Correspondence Author: César Faúndez-Casanova cfaundez@ucm.cl

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Abstract
End-stage chronic kidney disease (CKD) treated with hemodialysis (HD) is associated with reduced physical activity (PA) and increased sedentary behavior (SB), both of which can negatively impact quality of life (QoL). The aim of this study was to examine the association between levels of PA, SB (assessed through sitting time and screen time), and QoL in patients with CKD undergoing HD. This was a cross-sectional study involving 165 HD patients from a public hospital in southern Brazil. Validated questionnaires were applied (IPAQ-long form and KDQOL-SF 1.3). Patients with better quality of life showed higher levels of total physical activity (p = 0.019), walking (p = 0.044), and lower sitting time (p = 0.002) and screen time (p = 0.025). Better quality of life was significantly associated with walking more than 100 MET-min/week (OR = 2.46), engaging in moderate-to-vigorous physical activity over 1200 MET-min/week (RR = 1.67), and spending less sedentary time (<6 h/day) and screen time (<4 h/day). ROC curve analyses identified the following optimal cut-off points: walking ≥132 MET-min/week, moderate-to-vigorous physical activity ≥1100 MET-min/week, sitting time ≤420 min/day, and screen time ≤3.7 h/day. In conclusion, among patients with CKD on HD, higher PA levels and reduced sedentary behavior are associated with better QoL. These findings provide practical thresholds that can guide personalized clinical interventions in nephrology.
Keywords: chronic kidney disease; healthy lifestyle; physical fitness; risk factors; mental health.

Resumen
La enfermedad renal crónica (ERC) en estadio terminal con tratamiento de hemodiálisis (HD) se asocia a reducida actividad física (AF) y mayor comportamiento sedentario (CS), lo cual puede afectar negativamente la calidad de vida (QV). El objetivo de este estudio de examinar la asociación entre los niveles de AF, el CS (evaluado mediante tiempo sentado y tiempo frente a pantallas) y la QV en pacientes con ERC sometidos a HD. Se trato de un estudio transversal con 165 pacientes en HD de un hospital del sur de Brasil. Se aplicaron cuestionarios validados (IPAQ-largo y KDQOL-SF 1.3). Los pacientes con mejor calidad de vida presentaron niveles más altos de actividad física total (p = 0,019), caminata (p = 0,044) y menores tiempos de sedentarismo (p = 0,002) y de uso de pantallas (p = 0,025). Una mejor calidad de vida se asoció significativamente con realizar caminatas superiores a 100 MET-min/semana (OR = 2,46), actividad física moderada a vigorosa mayor a 1200 MET-min/semana (RR = 1,67) y con menor tiempo sedentario (<6 h/día) y de pantalla (<4 h/día). Los análisis de curvas ROC identificaron los siguientes puntos de corte óptimos: caminata ≥132 MET-min/semana, actividad física moderada a vigorosa ≥1100 MET-min/semana, tiempo sentado ≤420 min/día y tiempo de pantalla ≤3,7 h/día. Se concluye que, en pacientes con ERC en HD, mayores niveles de AF y menor tiempo en CS se asocian a mejor QV. Estos hallazgos ofrecen umbrales útiles para intervenciones clínicas personalizadas en nefrología.
Palabras clave: enfermedad renal crónica; estilo de vida saludable; aptitud física; factores de riesgo; salud mental.

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Introduction

Chronic kidney disease (CKD) results from the interaction of various pathophysiological processes that can reduce the estimated glomerular filtration rate (eGFR) to less than 60 mL/min per 1.73 m², in addition to causing significant alterations in kidney function (KDIGO, 2013). This condition affects approximately 9.5% of the global population (Bello et al., 2024) and has emerged as a significant public health issue, generating a substantial economic burden for healthcare systems in several countries, including Brazil, which faces high financial costs associated with CKD treatment and a decline in the quality of life of patients and their families (Kassebaum et al., 2017; GBD 2019 Diseases and Injuries Collaborators, 2020; Bauer et al., 2024).

In the final stage of chronic kidney disease (CKD), treatment modalities include hemodialysis (HD), peritoneal dialysis (continuous, intermittent, or automated), and kidney transplantation (Arenas et al., 2009). Among these, HD is the most widely used, accounting for 95.3% of cases (Nerbass et al., 2024). However, despite improving life expectancy, the unadjusted five-year survival rate for patients starting HD or PD is only 42.3%, indicating the high vulnerability of this population compared to the general population (Boenink et al., 2022). HD therapy typically consists of four-hour sessions, three times per week. Despite advances in treatment, HD does not ensure health-related quality of life (HRQoL) comparable to that of patients who do not require this therapy or who have received a kidney transplant (Zhang et al., 2020).

In this context, several studies have explored the benefits of physical activity (PA) during HD, in terms of physiological, functional, and psychological outcomes (Fernández et al., 2018; Jiménez-Prieto et al., 2021). These studies aim to analyze the potential impact of PA on improving HRQoL, considering that HD treatment often imposes a sedentary lifestyle on patients who are typically older and have multiple comorbidities (Fernández et al., 2018; Jiménez-Prieto et al., 2021).

The classic definition of PA is "any bodily movement produced by skeletal muscles that results in energy expenditure above resting level" (Caspersen et al., 1985). In contrast, physical inactivity refers to individuals who do not meet the minimum recommended amounts of moderate-to-vigorous physical activity (WHO, 2021). Sedentary behavior (SB), on the other hand, is a more recent concept, defined as activities

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with low energy expenditure (≤1.5 METs) performed while sitting, reclining, or lying down, regardless of physical activity levels (SBRN, 2012; Cristi-Montero & Rodríguez, 2014).

Despite the well-documented benefits of PA (PAHO, 2019; Koch, 2021), only about 6% of HD patients achieve sufficient levels of PA (Zelle et al., 2017). Therefore, it is crucial to investigate the independent impact of SB, as recent evidence suggests that SB is associated with increased cardiovascular and metabolic risk factors, regardless of PA levels (Leiva et al., 2017; Gómez et al., 2023). The aim of this study was, therefore, to examine the association between sedentary behavior, physical activity levels, and quality of life in patients with CKD undergoing HD.

Methodology

Study design and participants

This was an observational, cross-sectional study conducted in the nephrology unit of Santa Casa Hospital in Maringá. Data collection took place between May and December 2023. The sample was selected using a non-probabilistic, convenience sampling method. All patients with chronic kidney disease (CKD) undergoing hemodialysis (HD) at the hospital who met the study's inclusion criteria were invited to participate, resulting in a final sample of 165 patients. The sample size was not calculated, as all eligible patients from the hospital were included in the study.

The inclusion criteria were: being 18 years of age or older; having a diagnosis of end-stage CKD; undergoing HD for at least one month; being clinically stable; and not presenting with a severe clinical condition, defined as the presence of hemodynamic instability, need for intensive care, or an acute decompensated condition as documented in the medical records. Additionally, only patients without psychiatric or cognitive disorders that would impair their ability to understand and respond to the questionnaires were included. The exclusion criteria were: being in hospital isolation due to active infection; having limb amputation (arms or legs); and/or being permanently bedridden with no ability to ambulate.

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Ethical considerations

The procedures were developed in accordance with the guidelines established by the Declaration of Helsinki and its subsequent amendments (WMA, 2020). The study was approved by the Human Research Ethics Committee of the State University of Maringá (COPEP/UEM) under protocol number 6.004.620 in 2023, as well as by the Human Research Ethics Committee of Santa Casa Hospital in Maringá (SHCM) in 2023.

Participation in the study was voluntary, and before the study began, all participants received detailed information about the procedures that would be used. Those who agreed to participate signed the Free and Informed Consent Form (FICF). Data collection and processing were carried out in accordance with the university's privacy and data protection policy, which ensures the anonymous handling and use of the data exclusively for the purposes of this research, as well as the protection of participants' information. This study is part of a broader research project aimed at "determining the prevalence of sarcopenia in patients with CKD undergoing HD and investigating the impact of sarcopenia on the survival of this population."

Questionnaires and instruments applied

Sociodemographic data

To ensure the quality of data collection, standardized protocols were used. Sociodemographic data were collected from all participants, including age, sex, area of residence, level and duration of education, income, smoking status, and alcohol consumption. In addition, participants' medical records were reviewed to obtain information on treatment duration, details related to hemodialysis, medical history, and comorbidities.

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Nutritional Status

Body mass (kg) was measured prior to dialysis using a digital scale with a resolution of 0.1 kg. Participants were barefoot and wore light clothing. Waist circumference (WC) was measured at the midpoint between the lower edge of the ribs and the top of the iliac crest using a non-stretchable measuring tape with a 0.1 cm resolution. Height was obtained from the patients' nutritional records. Body mass index (BMI) was calculated as [body mass/height^2], and nutritional status was classified according to BMI based on WHO recommendations: normal weight: 18.5–24.9 kg/m^2; overweight: 25.0–29.9 kg/m^2; and obesity: ≥30.0 kg/m^2 (Weir; Jan. 2020). Central obesity was defined, according to NCEP (2002), as a waist circumference ≥94 cm in men and ≥80 cm in women, and was considered abdominal obesity when values reached ≥102 cm in men and ≥88 cm in women. Additionally, BMI and WC quintiles were established for analysis.

Quality of life (QoL)

Patients' QoL was assessed using the Kidney Disease Quality of Life Short Form (KDQOL-SF) questionnaire. The KDQOL-SF (version 1.3) was validated in Brazil in 2003 (Hays et al., 1997; Duarte et al., 2003). It consists of four sections: patient health, kidney disease, the effects of kidney disease on daily life, and satisfaction with care. The items generate 19 scales: physical functioning (10 items), physical role (4 items), pain (2 items), general health (5 items), emotional well-being (5 items), emotional role (3 items), social function (2 items), energy/fatigue (4 items), symptoms (12 items), effects 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), encouragement from dialysis staff (2 items), and patient satisfaction (1 item).

Scores for each dimension range from 0 to 100, with scores closer to zero indicating worse QoL. The instrument also provides summary scores for physical and mental components: the physical component score is derived from the physical functioning, physical role, pain, and general health items, while the mental component score is derived from the vitality, social functioning, emotional role, and mental health items.

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Physical activity (PA) and Sedentary behavior (SB)

Physical activity level was assessed using the International Physical Activity Questionnaire (IPAQ), long version, as it serves as the standard from which the short version was developed and is a valid and reliable instrument for use in Brazil (Matsudo et al., 2001; Craig et al., 2003). The IPAQ aims to capture physical activity across four domains: work, household chores, transportation, and leisure. Results were expressed in MET-min/week.

SB was determined through self-reported time spent sitting or reclining during leisure or work activities, using two questions from the sitting time domain, in order to identify how many hours per day, during the week and on weekends, each patient remained in this position. This variable was calculated by summing the total sitting time reported for weekdays and weekends, dividing the result by seven (the number of days in the week), and obtaining the average hours per day of sitting time.

Screen time (time spent in front of digital devices such as smartphones, television, computers, and video games) was assessed using two questions to identify how many hours per day, during the week and on weekends, individuals spent using these types of screen devices.

Data analysis

Data were analyzed using IBM SPSS Statistics software (version 22) and Python (version 3.10) for complementary analyses. The normality of continuous variables was verified through graphical inspection (histograms and boxplots) and the Kolmogorov–Smirnov test. Quantitative variables were described using mean and standard deviation, while categorical variables were presented as absolute and relative frequencies.

To compare levels of physical activity, sedentary behavior, and screen time between groups with quality of life above or below the mean (according to the KDQOL-SF 1.3 instrument), a reference value of 69 points was adopted, in line with previous studies that use similar criteria in the absence of a validated cutoff point (Pretto et al., 2024). The Student's t-test for independent samples was applied. Additionally, effect size (Cohen's *d*) was calculated and interpreted according to López-Martín and Ardura (2023): very small (< 0.20), small (0.20–0.49), moderate (0.50–0.79), and large (≥ 0.80).

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Bivariate association analyses were also performed using 2×2 contingency tables to examine the probability of having good quality of life based on: PA levels (categorized as <600, 600–1200, and >1200 MET-min/week), weekly walking volume (>100, >300, >600 MET-min/week) (WHO, 2020; Strain et al., 2024), sitting time (4 h/day, 6 h/day, and 8 h/day), and screen time (4 h/day, 6 h/day, and 8 h/day) (Ekelund et al., 2016; Martins et al., 2020; McLaughlin et al., 2020).

Corresponding odds ratios (OR), relative risks (RR), and Cramer's V were calculated as measures of effect size, interpreted as: small (< 0.07), moderate (0.21), and large (≥ 0.35) (López-Martín & Ardura, 2023).

Additionally, receiver operating characteristic (ROC) curves were generated to assess the discriminative capacity of the following continuous variables in relation to quality of life (dichotomized): moderate-to-vigorous physical activity (MVPA, in MET-min/week), walking (MET-min/week), sitting time (min/day), and total screen time (h/day).

For each ROC curve, the area under the curve (AUC) was calculated along with its 95% confidence interval. The optimal cutoff point was determined using the Youden index (sensitivity + specificity – 1), selecting the threshold that maximized the combined sensitivity and specificity. The interpretation of AUC was as follows: AUC ≈ 0.5: no or very low discriminative capacity; AUC 0.6–0.7: moderate capacity; AUC >0.7: good discriminative capacity (Çorbacıoğlu et al., 2023; Roy-García et al., 2023).

A significance level of $p < 0.05$ was adopted for all statistical analyses.

Results

The study sample consisted of 165 patients undergoing hemodialysis (HD), with a mean age of 53.5 ± 16.1 years. The majority of participants were male (57.6%). The average duration of HD treatment was 43.6 ± 39.5 months, and 58.8% of the patients had been on HD for more than two years. The mean quality of life (QoL) score was 69.0 ± 15.3, reflecting variability in well-being among the population with chronic kidney disease (CKD) undergoing HD (Table 1).

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Table 1. General description of the sample.

Variable	M ± SD / n (%)
Age (years)	53.5 ± 16.1
Height (m)	1.66 ± 0.09
Body mass (kg)	72.5 ± 15.8
BMI (kg/m²)	26.2 ± 5.5
HD duration (months)	43.6 ± 39.5
Years of education (mean ± SD)	8.9 ± 4.7
KDQOL-SF 1.3 score	69.0 ± 15.3
Sex	
Male	95 (57.6%)
Female	70 (42.4%)
Race	
White	104 (63.0%)
Mixed-race	29 (17.6%)
Black	21 (12.7%)
Asian	9 (5.5%)
Indigenous	2 (1.2%)
Educational attainment	
Incomplete elementary school	66 (40.0%)
Complete elementary school	23 (13.9%)
Complete high school	50 (30.3%)
University degree	19 (11.5%)
Specialization	5 (3.0%)
Master's degree	2 (1.2%)
Current employment status	
Employed	34 (20.6%)
Unemployed	131 (79.4%)
Retired	61 (37.0%)
Tobacco use	21 (12.7%)
Alcohol use	30 (18.2%)
HD duration (months)	
0 to 6 months	17 (10.3%)
7 to 18 months	40 (24.2%)
19 to 24 months	11 (6.7%)
More than 24 months	97 (58.8%)

Note: Mean (M); Standard Deviation (SD); Body Mass Index (BMI); Hemodialysis (HD)

The results indicate that individuals with QoL scores above the mean had higher levels of PA (MET-min/week) in the leisure-time domain (236.4 vs. 86.5 [$p = 0.021$, $d = 0.34$]) and in total PA (3401.8 vs. 2078.9 [$p = 0.019$, $d = 0.37$]), although with an effect size considered small to moderate [Cohen's *d*: 0.20–0.49; 0.50–0.79]. Likewise,

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individuals with better QoL walked significantly more (915.4 vs. 493.7 [p = 0.044, *d* = 0.30]), suggesting that mobility may be associated with higher QoL. Regarding sedentary behavior, sitting time was lower among those with better QoL (5.1 vs. 6.9 hours/day [p = 0.002, *d* = –0.50]), with a moderate effect size [Cohen's *d*: 0.50–0.79]. Similarly, screen time was also lower in individuals with better QoL (3.7 vs. 4.9 ± 3.5 hours/day [p = 0.025, *d* = –0.37]), with a small-to-moderate effect size [Cohen's *d*: 0.20–0.49; 0.50–0.79] (Table 2).

These findings highlight the importance of promoting leisure-time PA and reducing SB in patients on HD, given the association with better perceived QoL. Moreover, the effect size suggests that reducing CS could have a clinically relevant impact on this population.

Table 2. Comparison of PA, SB, and screen time scores by quality of life (below or above the mean) in patients with CKD undergoing HD (n = 165).

	Total (n = 165)	Low QoL (n = 91)	High QoL (n = 74)	p-value	Cohen's d (95% CI)
PA (MET-min/week)					
Work PA	947.2 ± 2783.9	1295.2 ± 3374.4	519.3 ± 1742.5	0.059	0.28 (0.03 to 0.59)
Transport PA	292.4 ± 753.6	379.1 ± 922.9	185.8 ± 452.8	0.081	0.26 (0.05 to 0.57)
Household PA	1275.2 ± 1950.1	1328.6 ± 1796.5	1209.5 ± 2134.7	0.698	0.06 (–0.25 to 0.37)
Leisure-time PA	169.2 ± 441.8	236.4 ± 542.2	86.5 ± 252.1	0.021	0.34 (0.03 to 0.65)
Total PA	2808.5 ± 3649.1	3401.8 ± 3786.0	2078.9 ± 3356.4	0.019	0.37 (0.06 to 0.68)
Vigorous PA	125.4 ± 874.1	183.4 ± 1138.2	54.1 ± 331.3	0.346	0.16 (–0.16 to 0.46)
Moderate PA	1956.9 ± 2817.8	2303.0 ± 2908.8	1531.2 ± 2659.6	0.080	0.28 (0.03 to 0.58)
Walking	726.3 ± 1394.6	915.4 ± 1598.4	493.7 ± 1058.2	0.044	0.30 (0.00 to 0.61)
Sedentary behavior					
Sitting time (h/day)	5.9 ± 3.7	5.1 ± 3.2	6.9 ± 4.0	0.002	–0.50 (–0.81 to –0.19)
Screen time (h/day)	4.2 ± 3.3	3.7 ± 3.0	4.9 ± 3.5	0.025	–0.37 (–0.68 to –0.06)

Note: Mean (M); Standard Deviation (SD); 95% Confidence Interval (CI).

Table 3 presents the analysis of the association between moderate-to-vigorous physical activity (MVPA) levels and quality of life (QoL). It was found that achieving a volume greater than 1200 MET-min/week was significantly associated with a higher likelihood of good QoL (OR = 2.42; RR = 1.67; p = 0.008; V = 0.207), with a moderate effect size. These findings highlight the importance of tailoring physical activity goals to the individual capacities of patients with chronic kidney disease.

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The analysis of the association between weekly walking volume and QoL showed that walking more than 100 MET-min/week was significantly associated with better QoL (OR = 2.46; RR = 0.64; p = 0.005; *V* = 0.220), with a small to moderate effect size. These results reinforce that even relatively low volumes of regular walking are positively associated with QoL among patients undergoing hemodialysis.

On the other hand, a statistically significant association was observed between sedentary behavior (SB), particularly prolonged sitting time, and QoL, at cutoff points of >6 and >8 hours/day (p = 0.028 and p = 0.010, respectively), with a small to moderate effect size (Cramér's *V*: 0.171 to 0.201). The >4 hours/day cutoff showed a similar trend, but did not reach statistical significance. These findings suggest that reducing sitting time, especially to less than six hours per day, may represent a relevant strategy to improve QoL in this population.

The analysis of daily screen time and QoL showed that spending more than 4 or 6 hours per day in front of screens was significantly associated with poorer QoL (OR = 0.52; RR = 0.70; p < 0.05; V ≈ 0.16), with a small effect size. These results suggest that prolonged screen exposure may negatively impact QoL in patients undergoing HD.

Table 3. Association between MVPA, walking, sedentary behavior, screen time, and quality of life in patients with CKD undergoing HD (n = 165).

Variable	OR	RR	p-value	Cramer's *V* (95% CI)
MVPA level				
<600 MET-min/week	1.61	0.77	0.157	0.10 (0.00 – 0.25)
600–1200 MET-min/week	0.44	1.60	0.016	0.18 (0.03 – 0.33)
>1200 MET-min/week	0.88	1.07	0.748	0.01 (0.00 – 0.16)
Walking threshold				
>100 MET-min/week	2.46	0.61	0.005	0.20 (0.05 – 0.35)
>300 MET-min/week	1.94	0.68	0.054	0.14 (0.00 – 0.29)
>600 MET-min/week	1.66	0.74	0.209	0.09 (0.00 – 0.24)
Sedentary time threshold				
>4 h/day sitting	0.47	1.54	0.034	0.16 (0.01 – 0.31)
>6 h/day sitting	0.40	1.63	0.007	0.21 (0.06 – 0.36)
>8 h/day sitting	0.35	1.66	0.008	0.20 (0.05 – 0.35)
Screen time threshold				
>4 h/day screen time	0.61	1.31	0.150	0.10 (0.00 – 0.25)
>6 h/day screen time	0.40	1.56	0.024	0.17 (0.02 – 0.32)
>8 h/day screen time	0.41	1.52	0.068	0.13 (0.00 – 0.28)

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Note: Odds Ratio (OR); Relative Risk (RR); 95% Confidence Interval (CI).

In the analysis of ROC curves applied to the different IPAQ dimensions, only total PA showed a statistically significant discriminative ability to predict good QoL (AUC = 0.634, 95% CI: 0.537–0.716, p = 0.026), with an optimal cutoff point of 3564 MET-minutes/week. The other individual dimensions did not reach statistical significance: PA at work (AUC = 0.466, 95% CI: 0.399–0.534, p = 0.324), transportation (AUC = 0.546, 95% CI: 0.462–0.630, p = 0.253), household activities (AUC = 0.491, 95% CI: 0.403–0.584, p = 0.689), and leisure time (AUC = 0.530, 95% CI: 0.461–0.601, p = 0.398).

This finding highlights that the accumulated volume of PA, rather than the specific context in which it is performed, is the primary determinant of its impact on quality of life in individuals undergoing HD. Nevertheless, the IPAQ dimensions should not be dismissed clinically. Although their individual predictive power is limited, they may serve as practical tools for identifying the areas of daily life in which a patient exhibits lower activity levels. As such, these dimensions may have complementary and guiding diagnostic value, even if their isolated predictive value is not high.

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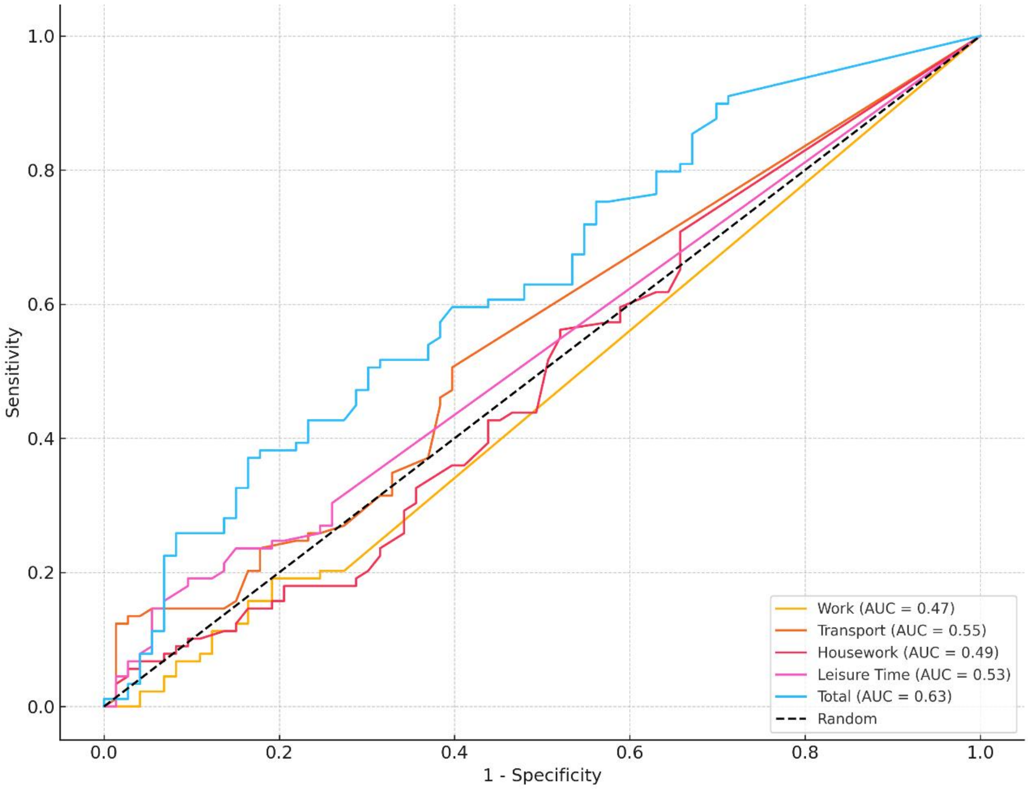
Figure 1. ROC Curve of IPAQ Dimensions in Relation to Quality of Life



In the ROC curve analysis, the predictive capacity of various lifestyle factors on QoL was evaluated. Total sitting time showed the best discriminative performance (AUC = 0.66, 95% CI: 0.57–0.75, p = 0.001), with an optimal cutoff point of 420 minutes/day, indicating that sitting for more than 7 hours is associated with lower QoL. Screen time was also significantly associated with poorer QoL (AUC = 0.60, 95% CI: 0.51–0.68, p = 0.025), with a cutoff point of 3.7 hours/day. MVPA showed an optimal cutoff point of 1100 MET-minutes/week (~39 minutes/day or 275 minutes/week of MVPA) (AUC = 0.62, 95% CI: 0.53–0.71, p = 0.070), while weekly walking had a minimum threshold of 132 MET-minutes/week (~40 minutes/week), with moderate predictive capacity (AUC = 0.62, 95% CI: 0.52–0.68, p = 0.276). This suggests that although walking has potential effects, in low doses it is not a strong isolated predictor of good QoL in this population. These findings support the importance of reducing SB and promoting sufficient levels of PA to improve QoL in chronic populations.

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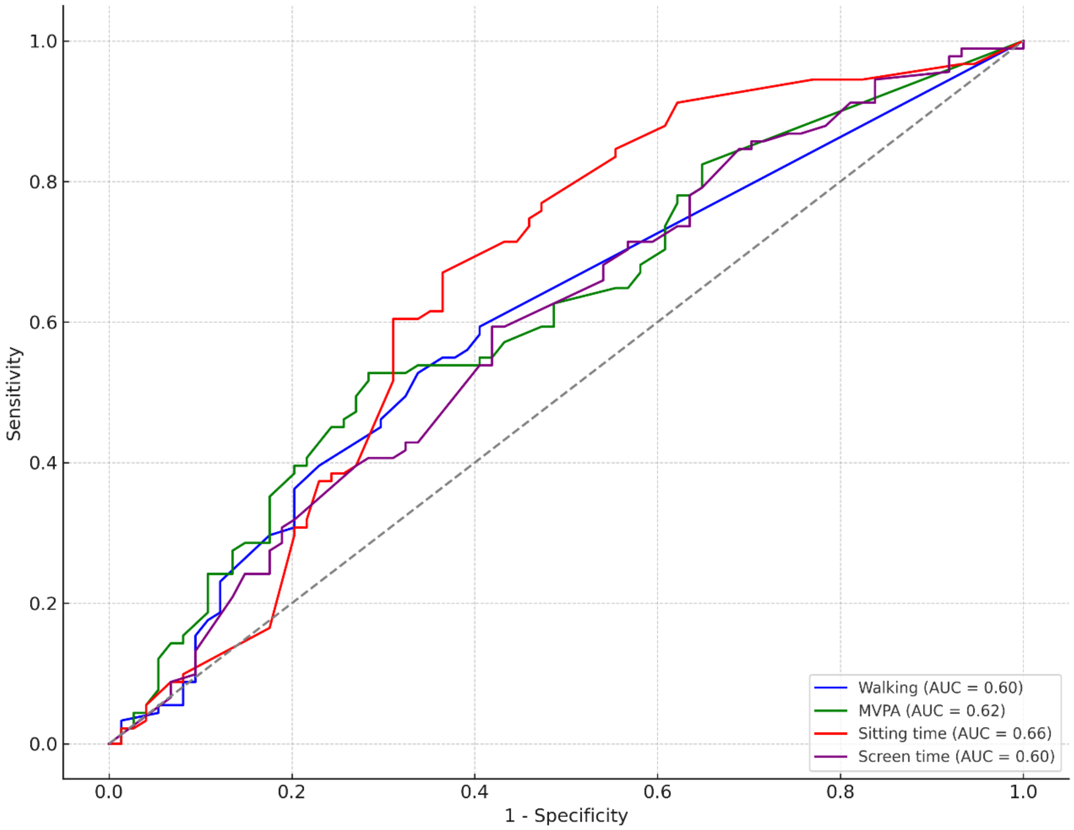
Figure 2. ROC Curve Comparing Lifestyle Factors and Quality of Life



Discussion

The aim of this study was to examine the association between sedentary behavior, physical activity levels, and quality of life in patients with chronic kidney disease undergoing hemodialysis.

Among the main results, patients with better QoL presented higher levels of total PA, leisure-time PA, and weekly walking, as well as lower levels of SB and screen time. These results are in line with previous studies in HD patients that consistently highlight the positive influence of regular PA on various domains of QoL, including vitality, physical functioning, and mental health (Katayama et al., 2016; Marín et al., 2022; Pozzato et al., 2024). In particular, the finding that even relatively low volumes of walking (>100 MET-min/week) are significantly associated with better QoL (OR = 2.46; p = 0.005) reinforces studies that promote active modes of transportation, such as

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walking, which can effectively improve health outcomes in the general population and among HD patients (Bronas, 2022; Xiong et al., 2022; Vásquez-Gómez et al., 2025).

Regarding SB, our results show that patients with lower QoL reported spending more time seated and more time exposed to screens. These findings are consistent with recent reviews identifying sedentary time as a predictor of frailty, chronic inflammation, depression, and cardiovascular risk in HD patients (Wang et al., 2019; Liang et al., 2022; Goyal et al., 2024). Based on the ROC curve analysis, total sitting time showed the highest discriminative capacity for predicting poor QoL (AUC = 0.66; 95% CI: 0.57–0.75; p = 0.001), with an optimal cutoff point of 420 minutes/day (7 hours). This threshold provides an objective and novel reference for monitoring the risk of perceived health decline and surpasses general recommendations that advise reducing SB without defining a clinically applicable limit for dialysis patients (McLaughlin et al., 2020; Tsai et al., 2022; Suo et al., 2024). Additionally, it should be noted that prolonged sitting time may increase the risk of mortality (Poses-Ferrer et al., 2022; Gao et al., 2024; Sugahara et al., 2024).

Similarly, screen time, with an optimal cutoff point of 3.7 hours/day, was also significantly associated with poorer QoL (AUC = 0.60; p = 0.025). Although there are few specific studies on screen time in HD patients, research in older adults and populations with chronic diseases suggests that prolonged exposure to digital devices is associated with social isolation, sleep disturbances, anxiety, and depression (Martins et al., 2020; Ling et al., 2023; Nunes et al., 2024), which are highly prevalent conditions in dialysis populations (Jiménez et al., 2022; Choudhary et al., 2024; Santos et al., 2025).

The ROC analysis for PA revealed that a volume of MVPA ≥1100 MET-min/week was the optimal cutoff point for better QoL AUC = 0.62 (95% CI: 0.53–0.71; p = 0.070), equivalent to approximately 39 minutes/day of MVPA. Although the p-value did not reach strict statistical significance, the effect size and observed trend indicate that this recommendation exceeds the lower limit of current guidelines, which suggest at least 600 MET-min/week, and approaches the upper limit of 1200 MET-min/week (equivalent to 150–300 minutes of weekly PA) (OMS, 2021; Strain et al., 2024). Therefore, it seems justified to consider that even moderate levels of PA may have a clinically significant impact on QoL in people undergoing HD (Kot et al., 2024; Battaglia et al., 2024).

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As for walking, an optimal cutoff point of 132 MET-min/week was identified (AUC = 0.60; 95% CI: 0.52–0.68; p = 0.276), equivalent to ~40 minutes/week of walking at 3.3 METs, according to IPAQ equivalence. Our findings suggest that this may represent a clinically meaningful minimum to maintain or improve perceived well-being in HD patients, particularly given the common physical limitations in this population. This aligns with studies showing that low levels of habitual walking are associated with lower mortality and better functional capacity (Matsuzawa et al., 2012; Hu et al., 2024), supporting the relevance of promoting mobility as an essential component of comprehensive renal care (Vásquez-Gómez et al., 2025).

In the ROC curve analysis applied to the IPAQ domains, only total PA showed a significant predictive capacity to discriminate good QoL (AUC = 0.634; p = 0.026), with a cutoff point of 3564 MET-min/week, equivalent to approximately 891 minutes/week of moderate-intensity activity (~127 minutes/day). This threshold exceeds general PA recommendations for the healthy population, which is expected given the multiple limitations and physiological demands of dialysis treatment. The other domains (work, household, transport, leisure) did not show individual predictive value, suggesting that the cumulative sum of physical effort, rather than its context, is the decisive factor in QoL perception in dialysis patients, although the IPAQ domains remain useful as complementary diagnostic guides.

Limitations and strengths of the study

Among the strengths of this study are the representative sample size, which included all active HD patients at the hospital, the use of validated questionnaires, and the rigorous statistical approach, which incorporated effect size analyses, ROC curves, and the establishment of clinically relevant cutoff points for this population. However, the study has some limitations, including its cross-sectional design, which does not allow for causal inference, and the use of self-reported measures for PA and SB, which may be subject to reporting bias. Nevertheless, the instruments used (long-form IPAQ and KDQOL-SF 1.3) have shown good validity and reliability in previous studies conducted in Brazil.

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Practical Implications

From a clinical perspective, our findings allow for the establishment of quantifiable benchmarks for both PA and SB, with potential to guide individualized interventions in the field of nephrology. The identification of specific cutoff points (MVPA ≥1100 MET-min/week; walking ≥132 MET-min/week; sedentary time ≤420 minutes/day; screen time ≤3.7 hours/day) represents an original contribution to the literature, providing practical and context-specific thresholds for monitoring quality of life in patients undergoing HD.

Conclusión

There are significant associations between SB, levels of PA (particularly MVPA and walking), and QoL in patients with CKD undergoing HD. Reducing sedentary time (<7 hours/day), limiting screen time (<3.7 hours/day), and promoting walking (>132 MET-min/week) or MVFA (>1100 MET-min/week) may represent effective and clinically relevant strategies to support improved QoL in this vulnerable population. Clinically meaningful cutoff points were established to guide personalized interventions, highlighting that even low volumes of walking or PA can produce noticeable benefits in this group.

Given that both SB and physical inactivity have previously been linked to increased mortality risk in individuals with CKD, the findings of this study reinforce the importance of incorporating accessible strategies for promoting PA and reducing sedentary time into clinical care protocols. Future longitudinal or cohort studies will be essential to confirm these associations and determine whether such behaviors directly influence the survival prognosis of these patients.

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