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Frailty Assessed by the Edmonton Frail Scale in Maintenance Haemodialysis: A Multicentre Cross-Sectional Study

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Abstract

Background:

Frailty is increasingly recognized as a key determinant of vulnerability and adverse outcomes in patients receiving maintenance haemodialysis. Despite its high prevalence and clinical relevance, frailty is not routinely assessed in dialysis units, and data from Saudi Arabia are lacking. This study aimed to determine the prevalence of frailty and identify factors independently associated with frailty among patients receiving maintenance haemodialysis in Saudi Arabia.

Methods:

In this multicentre, cross-sectional study, adult patients undergoing maintenance haemodialysis across five dialysis centres in Saudi Arabia were enrolled. Frailty was assessed at the bedside using the validated Arabic version of the Edmonton Frail Scale (EFS). Frailty was defined as an EFS score ≥ 6. Demographic, clinical, dialysis-related, and laboratory data were collected from patient interviews and electronic medical records. Associations with frailty were evaluated using univariable and multivariable logistic regression analyses.

Results:

A total of 359 patients were included (mean age 56.7 ± 14.7 years; 51.8% male). The mean EFS score was 5.2 ± 2.7. Overall, 41.5% of patients were classified as frail. Frail patients were older and demonstrated lower serum albumin, lower serum creatinine, and lower dialysis adequacy (Kt/V) compared with non-frail patients. In multivariable analysis, increasing age, diabetes mellitus, cardiovascular disease, prior cerebrovascular accident, intradialytic hypotension, polypharmacy, functional dependence, and mood disturbance were independently associated with frailty. Higher serum albumin, higher serum creatinine, and greater dialysis adequacy were independently associated with lower odds of frailty.

Conclusions:

Frailty is highly prevalent among patients receiving maintenance haemodialysis in Saudi Arabia and is independently associated with multidimensional clinical vulnerability and dialysis-related factors. Routine frailty screening using a feasible tool such as the Edmonton Frail Scale may enhance risk stratification and support more individualized, patient-centred dialysis care.

Introduction

End-stage kidney disease (ESKD) is a stage of chronic kidney disease (CKD) that require kidney replacement therapy including kidney transplant or dialysis modality for patient's survival. The global burden of ESKD has risen substantially over recent decades, reflecting population aging and the increasing prevalence of diabetes and hypertension. Data from the Global Burden of Disease study indicate that the number of individuals receiving kidney replacement therapy increased from approximately 1.6 million in 1990 to more than 4.5 million in 2023 [1]. Current estimates suggest that 5–7 million people worldwide are living with treated ESKD [1].

Saudi Arabia bears a particularly high and growing burden of ESKD. According to registry data from the Saudi Centre for Organ Transplantation, more than 28,000 patients were receiving renal replacement therapy in 2020, the majority of whom were treated with maintenance haemodialysis [2]. The incidence of ESKD in Saudi Arabia remains higher than that reported in many European countries, a pattern largely driven by the high prevalence of diabetes mellitus and hypertension in the general population [3, 4]. As survival on dialysis improves, there is increasing recognition that traditional biochemical and comorbidity-based metrics alone are insufficient to capture patient vulnerability and long-term outcomes.

Haemodialysis, while life-sustaining, exposes patients to recurrent physiological stress, including rapid fluid shifts, hemodynamic instability, inflammation, and cumulative treatment burden. These stressors may accelerate biological aging and contribute to loss of physiological reserve. Frailty, a multidimensional syndrome characterized by decreased resilience to stressors due to dysregulation across multiple physiological systems—has emerged as a critical concern [5, 6] for understanding vulnerability in patients receiving maintenance haemodialysis.

Frailty is highly prevalent among haemodialysis patients and is consistently associated with adverse outcomes, including functional decline, falls, hospitalization, reduced quality of life, and mortality [7, 8]. Systematic reviews and large multicentre studies report frailty prevalence estimates ranging from approximately 35% to 46% in adult haemodialysis populations, with even higher rates among older patients [7, 9–12]. Importantly, frailty is not confined to the elderly; younger patients with ESKD may exhibit frailty due to accelerated biological aging, sarcopenia, vascular disease, and chronic inflammation inherent to kidney failure and dialysis therapy.

Smaller studies and those using different frailty assessment tools may report higher rates; for instance, a multicenter study in southern China using the Tilburg Frailty Indicator found frailty in 75% of HD patients [13]. However, most studies using the Fried frailty phenotype or similar criteria consistently report prevalence in the 35–46% range for adult HD populations [7, 10, 12, 14]. These findings underscore the importance of routine frailty screening in the hemodialysis population.

Despite its high prevalence and prognostic relevance, frailty remains largely under-recognized in routine dialysis care. Clinical decision-making in dialysis units continues to rely predominantly on chronological age, comorbidity counts, and laboratory parameters, while multidimensional vulnerability is rarely assessed in a structured manner. One barrier to implementation is that many frailty instruments were

developed for geriatric or research settings and are perceived as time-consuming or impractical for busy dialysis units.

The Edmonton Frail Scale is a brief, multidimensional frailty instrument designed for use in clinical settings by non-geriatric specialists. It assesses physical, cognitive, psychological, nutritional, functional, and social domains and can be completed at the bedside within minutes. These characteristics make it particularly attractive for integration into routine haemodialysis practice, where feasibility and efficiency are essential.

Despite growing international recognition of frailty as a key determinant of outcomes in haemodialysis populations, data from Saudi Arabia remain scarce. To date, no published studies have systematically evaluated the prevalence or multidimensional correlates of frailty among patients receiving maintenance haemodialysis in this region. Local evidence is essential, as frailty prevalence and its clinical associations may vary according to ethnicity, comorbidity profiles, nutritional patterns, dialysis practices, and healthcare infrastructure.

Therefore, this study aimed to determine the prevalence of frailty using the Edmonton Frail Scale among maintenance haemodialysis patients in Saudi Arabia and to identify demographic, clinical, dialysis-related, and psychosocial factors independently associated with frailty. By characterizing frailty within this population, this study seeks to inform the integration of frailty assessment into routine dialysis care and support more individualized, patient-centred management strategies.

Methods

Study Design and setting:

This study employed a descriptive cross-sectional methodology conducted across five hemodialysis centers under the umbrella of ministry of national guard health affairs in Saudi Arabia. Participants were recruited over a six-month period from June 2025 to December 2025. A total of 359 adult patients receiving maintenance hemodialysis were enrolled. Figure 1 summarizes patients' selection and screening.

Eligibility Criteria

Patients were eligible if they:

1. Were aged ≥ 16 years, and
2. Were able to provide informed consent and participate in the study assessments.

Exclusion criteria included:

1. Acute infectious or other inflammatory illnesses at the time of assessment,
2. Active malignancy,

3. History of severe cerebrovascular accident or severe cognitive impairment resulting in inability to communicate or complete assessments, and
4. Prolonged hospitalization within the preceding three months.

Data Collection and Frailty Assessment

Data were collected using a combination of direct patient assessments and review of existing electronic medical records at each participating center. Routinely collected clinical data were extracted from the electronic health database, including demographic characteristics, comorbid conditions, dialysis history, and laboratory parameters.

Frailty was assessed using the Edmonton Frail Scale (EFS) [15]. A formal license was obtained for the purpose of this study, and the validated official Arabic version of the scale, along with associated training materials, was provided by the University of Alberta. Assessments were conducted at the bedside during routine dialysis sessions.

The Edmonton Frail Scale is a multidimensional instrument designed for rapid clinical use and consists of the following domains:

- **Cognitive function**: Assessed using a clock-drawing test with a standardized scoring system.
- **General health status**: Self-reported overall health and number of hospital admissions in the preceding year.
- **Functional independence**: Evaluation of activities of daily living, including ability to perform housekeeping tasks, manage medications, and eat independently.
- **Social support**: Assessment of availability of family or social support when assistance is needed.
- **Medication use**: Review of current medications, with polypharmacy defined as the regular use of five or more prescription medications.
- **Nutrition**: Inquiry regarding recent changes in appetite or unintentional weight loss.
- **Mood**: Brief screening for depressive symptoms using standardized questions.
- **Continence**: Self-reported urinary continence.
- **Functional performance**: Timed “get up and go” test, in which participants were asked to stand from a seated position, walk three meters at a comfortable pace, return, and sit down; scoring was based on completion time.

Total EFS scores range from 0 to 17, frailty was defined as below

	Fit	Vulnerable	Mild	Moderate	Severe
EFS Score	1 2 3	4 5	6 7	8 9	10+
			Frailty ⟷		

Data Sources

Data were obtained through the following methods:

- Patient interviews: Structured interviews conducted using the Arabic version of the Edmonton Frail Scale.
- Medical record review: Extraction of comorbidities, dialysis vintage, vascular access type, and relevant clinical data from electronic medical records.
- Laboratory data: Most recent routine laboratory measurements, including serum albumin, body mass index (BMI), and other clinically relevant biomarkers.

Statistical analysis

Statistical analyses were performed using statistical software IBM Corp. IBM SPSS Statistics for Windows, Version 20.0. Armonk (NY): IBM Corp.; 2011. Continuous variables were assessed for normality using visual inspection and distributional characteristics. Normally distributed variables were summarized as mean ± standard deviation (SD), while non-normally distributed variables were presented as median with interquartile range (IQR). Categorical variables were summarized as frequencies and percentages.

Frailty status was defined according to the Edmonton Frail Scale (EFS) and dichotomized into non-frail (fit or vulnerable) and frail (mild, moderate, or severe frailty). Comparisons between frail and non-frail groups were performed using the Student's t-test for normally distributed continuous variables and the Mann–Whitney U test for non-normally distributed continuous variables. The Chi-square test or Fisher's exact test, as appropriate, was used to compare categorical variables.

Univariable associations between frailty and clinical characteristics, comorbidities, dialysis-related factors, and EFS domains were evaluated using binary logistic regression, with results expressed as odds ratios (ORs) and 95% confidence intervals (CI).

Variables demonstrating statistical significance in univariable analyses ($p < 0.10$), as well as clinically relevant variables based on prior literature, were entered into a multivariable logistic regression model to identify factors independently associated with frailty. Continuous predictors were modeled per clinically meaningful increments (e.g., per 10-year increase in age, per 1 g/L increase in serum albumin, per 100 µmol/L increase in serum creatinine, and per 0.1 unit increase in Kt/V). Multicollinearity was assessed prior to model inclusion.

All statistical tests were two-sided, and a p-value < 0.05 was considered statistically significant.

Results

Study population

A total of 359 maintenance hemodialysis patients were included in the analysis. The mean age was 56.7 ± 14.7 years, with a median age of 59 years (IQR 46–67). Men constituted 51.8% (n = 186) of the cohort.

The median dialysis vintage was 7 years (IQR 4–10). Baseline clinical, dialysis, and laboratory characteristics are summarized in Table 1.

The prevalence of major comorbidities included diabetes mellitus (46.2%), hypertension (80.5%), cardiovascular disease (32.3%), peripheral vascular disease (14.5%), and prior cerebrovascular accident.

Table 1
Baseline demographic, clinical, dialysis, and laboratory characteristics of the study population (n = 359)

Variable	Mean ± SD	Median (IQR)	Min-Max
Age (years)	56.7 ± 14.7	59 (46–67)	16–98
Systolic BP (mmHg)	134.6 ± 20.7	133 (119–150)	83–210
Diastolic BP (mmHg)	65.9 ± 12.9	65 (57–74)	22–99
Body mass index (kg/m^2)	28.1 ± 7.1	27 (23–32)	16–69
Dialysis Vintage (years)	7.0 ± 4.5	7 (4–10)	1–25
Hemoglobin (g/dL)	11.7 ± 4.6	11.7 (10.8–12.3)	7.2–14.9
Creatinine (µmol/L)	822.8 ± 250.0	810 (663–987)	32-1569
Blood urea Nitrogen (mmol/L)	18.5 ± 6.0	18 (15.2–21.8)	5–44
Serum albumin (g/L)	39.6 ± 4.0	40 (38–42)	4–48
Calcium (mmol/L)	2.1 ± 0.2	2.1 (2.0-2.3)	1.8-3.0
Phosphorus (mmol/L)	1.6 ± 0.5	1.5 (1.2-2.0)	0.0-4.5
Potassium (mmol/L)	5.0 ± 0.7	5.0 (4.5–5.5)	3.3–7.1
Pparathyroid hormone (pg/mL)	526.0 ± 561.6	384 (108.3–741)	-
Kt/V	1.7 ± 0.4	1.7 (1.4–1.9)	0.7–4.7
Edmonton Frail Scale score	5.2 ± 2.7	5.0 (3–7)	1–14

Frailty burden

The mean Edmonton Frail Scale (EFS) score was 5.2 ± 2.7 (median 5, IQR 3–7; range 1–14). Based on EFS categorization, 30.1% (n = 108) of patients were classified as fit, 28.4% (n = 102) as vulnerable, 20.3% (n = 73) as mildly frail, 13.6% (n = 49) as moderately frail, and 7.5% (n = 27) as severely frail. Overall, 41.5% (n = 149) of patients were classified as frail (mild to severe frailty).

Comparison between non-frail and frail patients

Frail patients were significantly older than non-frail patients (median age 63 vs. 56 years, $p < 0.001$) as shown in Table 2. Diastolic blood pressure was modestly lower among frail patients (median 63 vs. 67 mmg, $p = 0.033$). There were no significant differences between groups with respect to systolic blood pressure, body mass index, dialysis vintage, serum calcium, phosphorus, potassium, or parathyroid hormone levels.

Frail patients demonstrated significantly lower serum creatinine levels (median 743 vs. 859 umol/L, $p < 0.001$) and lower serum albumin levels ($p = 0.016$). Dialysis adequacy, as measured by Kt/V, was also lower among frail patients (median 1.6 vs. 1.7, $p = 0.019$). Dialysis access type differed significantly between groups ($p = 0.016$)

Table 2
Comparison of clinical and laboratory variables between non-frail and frail patients

Variable	**Non-frail (n = 210) Median (IQR)**	**Frail (n = 149) Median (IQR)**	**p-value**
Age (years)	56 (41.8–64)	63 (55–70)	< 0.001
Systolic BP (mmHg)	131 (119–150)	134 (120-148.5)	0.858
Diastolic BP (mmHg)	67 (58–76)	63 (56–70)	0.033
Body mass index (kg/m^2)	27 (23–32)	27 (23–32)	0.544
Dialysis Vintage (years)	7 (4–10)	6 (4–9)	0.223
Hemoglobin (g/dL)	11.7 (11.0-12.4)	11.4 (10.6–12.4)	0.059
Creatinine (µmol/L)	859 (713–1021)	743 (616–890)	< 0.001
Serum albumin (g/L)	40 (38–42)	40 (37–42)	0.016
Kt/V	1.7 (1.4-2.0)	1.6 (1.4–1.8)	0.019

Association of frailty with comorbidities

Frailty was significantly associated with the presence of diabetes mellitus (OR 2.56, 95% CI 1.66–3.94), hypertension (OR 2.62, 95% CI 1.45–4.74), peripheral vascular disease (OR 2.86, 95% CI 1.55–5.26), cardiovascular disease (OR 2.83, 95% CI 1.80–4.47), chronic obstructive pulmonary disease (OR 3.25, 95% CI 1.29–8.17), and prior cerebrovascular accident (OR 6.73, 95% CI 2.47–18.28), all $p < 0.01$. Frailty was also significantly more prevalent among patients experiencing intradialytic hypotension (OR 2.48, 95% CI 1.58–3.89, $p < 0.001$).

Cognitive, functional, and psychosocial domains

Impairment on the Clock Drawing Test was strongly associated with frailty (p = 0.001), with a higher proportion of frail patients demonstrating major errors. Increasing levels of functional dependence were strongly associated with frailty (p < 0.001), as was poorer self-rated health status (p < 0.001). Frailty was significantly associated with reduced social support (p = 0.027), polypharmacy (OR 4.20, 95% CI 2.66–6.61), missed medications (OR 2.23, 95% CI 1.42–3.50), nutritional impairment (OR 4.24, 95% CI 2.38–7.56), mood disturbance (OR 5.76, 95% CI 3.49–9.53), and urinary incontinence (OR 3.53, 95% CI 1.32–9.40), all p ≤ 0.01

Healthcare utilization and physical performance

Frailty was strongly associated with higher hospital admission rates, with 86.0% of patients experiencing more than two admissions classified as frail (p < 0.001). Slower functional performance times were also strongly associated with frailty, with 83.0% of patients requiring more than 20 seconds classified as frail (p < 0.001)

Multivariable analysis

In multivariable logistic regression analysis (Table 3), increasing age was independently associated with frailty, with a 68% higher odds per 10-year increase (p < 0.001). Frailty was also independently associated with diabetes mellitus, cardiovascular disease, and a history of cerebrovascular accident. Patients experiencing intradialytic hypotension had significantly higher odds of frailty.

Markers of nutritional and muscle status demonstrated inverse associations with frailty, with higher serum albumin, higher serum creatinine, and greater dialysis adequacy (Kt/V) independently associated with lower odds of frailty. In addition, polypharmacy and functional dependence were strongly associated with frailty, with functional dependence demonstrating the largest effect size in the model.

Mood disturbance also remained independently associated with frailty after adjustment for demographic, clinical, and dialysis-related factors.

Table 3: Multivariable logistic regression analysis of factors independently associated with frailty in hemodialysis patients

Outcome: Frailty (Edmonton Frail Scale ≥ mild frailty)

Model: Binary logistic regression

n = 359

Variable	Adjusted OR	95% CI	p-value
Age (per 10-year increase)	1.68	1.32–2.13	< 0.001
Diabetes mellitus	1.94	1.23–3.07	0.004
Cardiovascular disease	1.88	1.18–2.99	0.007
Prior cerebrovascular accident	3.91	1.45–10.53	0.007
Intradialytic hypotension	1.79	1.14–2.80	0.011
Serum albumin (per1g/Increase)	0.91	0.86–0.97	0.003
Serum creatinine (per 100 µmol/L increase)	0.84	0.76–0.93	0.001
Kt/V (per 0.1 unit increase)	0.94	0.90–0.99	0.018
Polypharmacy	2.43	1.55–3.82	< 0.001
Functional dependence (moderate-severe)	5.67	3.24–9.92	< 0.001
Mood disturbance	3.12	1.97–4.94	< 0.001

Discussion

In this multicentre study of maintenance haemodialysis patients in Saudi Arabia, frailty assessed using the Edmonton Frail Scale was highly prevalent, affecting more than 40% of the cohort. Frailty was not confined to older patients and was independently associated with adverse clinical characteristics, healthcare utilization, and multidimensional vulnerability across physical, cognitive, psychological, and social domains. Frailty was not confined to the elderly and was strongly associated with adverse outcomes, including increased mortality, hospitalization, dependency, and diminished quality of life [7, 16]. These findings underscore frailty as a multidimensional syndrome with direct relevance to routine dialysis care, rather than a purely geriatric construct.

The observed frailty prevalence is consistent with, and in some domains exceeds, prior reports using alternative frailty instruments in dialysis populations. Prevalence varies by age, region, and assessment tool, but remains consistently elevated compared to the general population and other chronic disease cohorts [9, 17]. Among older adults (≥ 60 years), frailty prevalence is similarly high, with pooled estimates around 41% and increasing to 45% in those over 70 years [9].

Importantly, the Edmonton Frail Scale enabled identification of a substantial proportion of patients categorized as vulnerable, a transitional state that is often overlooked in binary frailty models. This group represents a critical intervention window, where targeted measures may prevent progression to overt frailty. The wide distribution of EFS scores highlights the heterogeneity of physiological reserve among patients receiving long-term dialysis, even within a single facility. The EFS is notable for its brevity

(typically completed in less than 5 minutes) and its suitability for administration by non-geriatricians, making it practical for routine use in busy clinical environments [18, 19].

Frailty Beyond Chronological Age

Although frail patients were older on average, frailty was not synonymous with aging. A meaningful proportion of younger patients met frailty criteria, supporting the concept of accelerated biological aging in end-stage kidney disease [20, 21]. This finding has important implications for clinical decision-making, particularly in access planning, transplant candidacy evaluation, and discussions around treatment goals. Reliance on chronological age alone in patients receiving dialysis substantially underestimates clinical vulnerability and risk because age does not capture the multidimensional impairments and reduced physiological reserve characteristic of end-stage kidney disease (ESKD). Chronological age fails to account for the high prevalence of frailty, cognitive impairment, functional decline, and comorbidity burden that are common in dialysis populations and are independently associated with adverse outcomes such as mortality, hospitalization, and loss of independence [22, 23]. For example, frailty and geriatric syndromes can be present in younger dialysis patients due to accelerated biological aging, and older patients may vary widely in their functional status and resilience.

Frailty and Co-morbidities

Frailty demonstrated strong associations with diabetes mellitus, hypertension, peripheral vascular disease, cardiovascular disease, and prior cerebrovascular events, with robust evidence demonstrating both the presence and strength of these associations. In a large cross-sectional study, older adults with diabetes and these comorbidities had significantly increased odds of frailty compared to robust individuals, with the risk rising in proportion to the number and severity of comorbid conditions [24].

The particularly high odds of frailty among patients with cerebrovascular disease suggest a close interplay between vascular pathology, cognitive impairment, and functional decline.

Peripheral vascular disease is closely linked to frailty, with frail individuals demonstrating a higher incidence of peripheral vascular disease compared to non-frail counterparts. Prospective cohort data show that frailty is associated with an increased risk of developing peripheral vascular disease (HR 1.80, 95% CI 1.44–2.27) [25]. Cardiovascular disease (including coronary heart disease, heart failure, and myocardial infarction) is both a risk factor for and a consequence of frailty. Frailty is highly prevalent in patients with established cardiovascular disease, and is a strong independent predictor of adverse cardiovascular outcomes, including mortality, major adverse cardiovascular events (MACE), and functional decline [25, 26]. The association is bidirectional: cardiovascular disease increases the risk of frailty, and frailty increases the risk of incident cardiovascular events.

Prior cerebrovascular events (stroke) are among the strongest predictors of frailty. Individuals with a history of stroke have a markedly increased risk of developing frailty, with hazard ratios exceeding 4 in

large population-based studies [25, 27]. Frailty also increases the risk of incident stroke and worsens outcomes after cerebrovascular events. These relationships likely reflect shared pathophysiological mechanisms, including chronic inflammation, oxidative stress, sarcopenia, and endothelial dysfunction, which are amplified in the uremic milieu.

Nutritional Status, Muscle Mass, and Dialysis Adequacy

Frail patients exhibited lower serum creatinine and albumin levels, findings that likely reflect reduced muscle mass and protein-energy wasting, rather than improved renal clearance or nutritional adequacy [28–30]. The association between frailty and lower Kt/V further suggests that frail patients may receive less effective dialysis, potentially due to shorter treatment times, intradialytic instability, or access-related issues. This bidirectional relationship raises the possibility that frailty both contributes to and is

One of the strengths of this study is the demonstration that frailty in hemodialysis extends well beyond physical weakness. Frailty was strongly associated with impaired clock-drawing performance, reduced functional independence, slower physical performance, mood disturbance, poor self-rated health, and limited social support. These findings reinforce frailty as a whole-person syndrome, encompassing cognitive, psychological, and social domains. Importantly, many of these factors are potentially modifiable through multidisciplinary interventions.

Polypharmacy and Healthcare Utilization

Frailty and polypharmacy are strongly and bidirectionally associated in older adults, with each condition amplifying the risks and adverse outcomes of the other [31, 32]. Non-adherence and missed doses are particularly problematic in frail, polymedicated patients. Frailty is associated with cognitive and functional decline, which impairs the ability to manage complex medication regimens, leading to both intentional and unintentional non-adherence [32, 33]. Routine frailty assessment may help identify patients who would benefit from medication simplification, pharmacist-led reviews, and enhanced education.

Frailty was strongly associated with recurrent hospital admissions, reinforcing its role as a powerful marker of healthcare utilization and vulnerability [34, 35]. The graded relationship between frailty and hospitalization frequency suggests that frailty assessment could be used for risk stratification at the facility level, enabling proactive care planning, early intervention, and potentially reduced hospital burden [36].

Strengths and limitations

This study benefits from a relatively large, multicentre cohort and comprehensive assessment across multiple frailty domains using a validated and practical instrument. However, its cross-sectional design precludes causal inference, and longitudinal outcomes such as mortality were not assessed. Frailty was

evaluated during routine dialysis sessions, which may have influenced performance-based measures, although assessments were conducted uniformly across participants. The facility-based nature of the cohort may limit generalizability to other healthcare settings. Future longitudinal studies are needed to evaluate whether frailty-guided interventions can improve clinical outcomes and reduce healthcare utilization in haemodialysis populations.

Conclusion

Frailty is highly prevalent among patients receiving maintenance haemodialysis in Saudi Arabia and is independently associated with multidimensional vulnerability and markers of adverse clinical trajectories (Fig. 2). Routine frailty screening using a feasible tool such as the Edmonton Frail Scale has the potential to enhance risk stratification, personalize dialysis care, and improve patient-centred outcomes. Frailty assessment should be viewed as an integral component of contemporary dialysis care rather than an optional geriatric add-on. At a facility level, frailty burden may serve as a quality indicator, reflecting not only patient complexity but also the adequacy of supportive services available within the unit.

Abbreviations

• End stage kidney disease (ESKD)

• Chronic kidney disease (CKD)

• Haemodialysis (HD)

• Edmonton Frail Score (EFS)

• Institutional Review Board (IRB)

• King Abdullah International medical research Centre (KAIMRC)

• Major Cardiovascular events (MACE)

Declarations

Ethics Approval and Consent to participate

The study was approved by the Ethics Committee and Institutional Review Board (IRB) of King Abdullah International Medical Research Centre (KAIMRC) Approval No: 00000160025 (Approval on 20/05/2025).

Informed consent to participate was obtained from all the participants in our study.

Consent for publication:

Informed Consent was obtained from participants

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Data Availability

Research Data and Consent available with Corresponding Author. (The datasets used and analyzed during the current study are available from the corresponding author on reasonable request)

Clinical trial number:

Not applicable.

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Figures

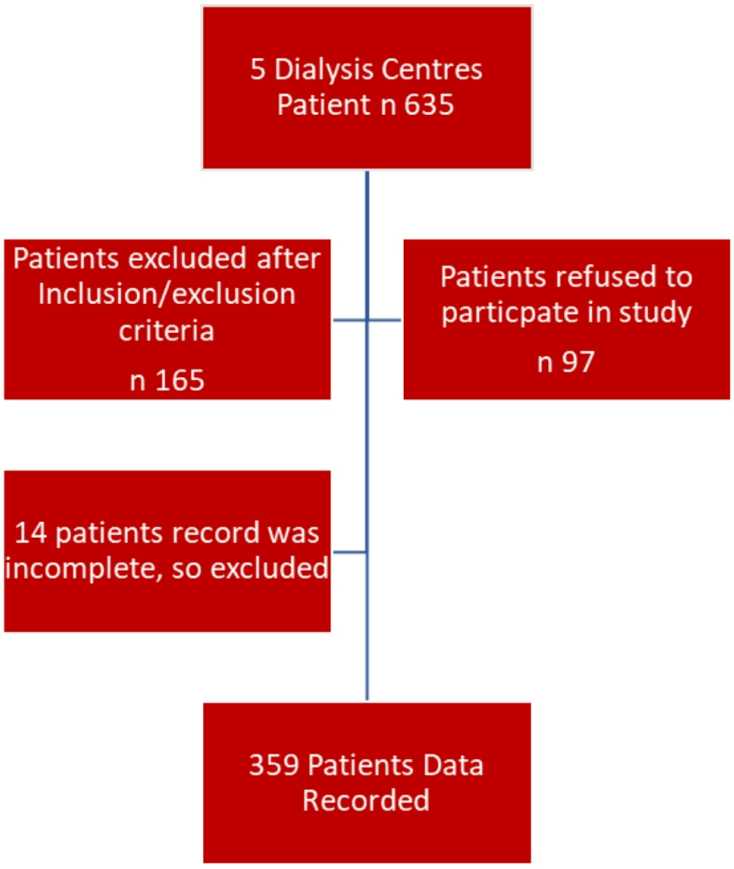


Figure 1

Flow Diagram of Patients Screening and Recruitment for study

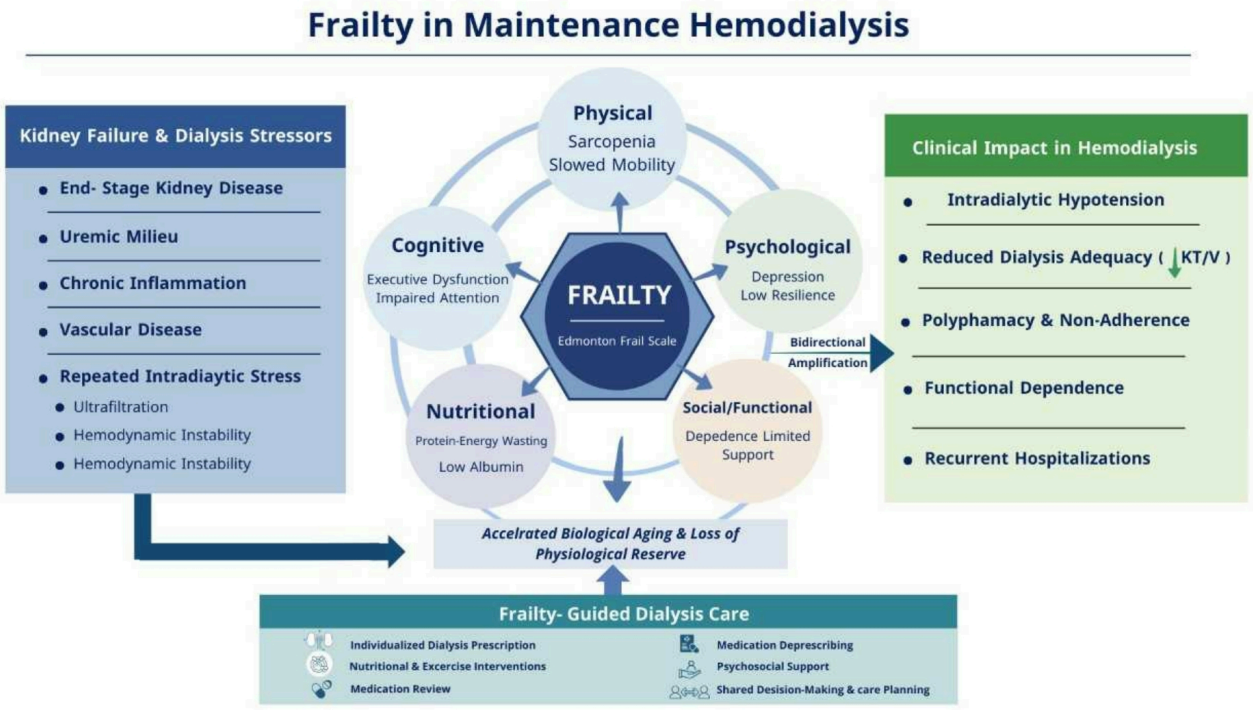


Figure 2

Integrated conceptual Frailty Framework