

Frailty, cognitive impairment and quality of life in older people with kidney transplants, more than a scale: Narrative Review.

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Abstract

Introduction: With the increase in the number of deceased donors over 65, transplant programs have been developed for older people with the least frailty at the time of transplant.

Objective of the review: This article is a narrative review to show the importance of frailty and cognitive impairment as parameters for decision-making about a kidney transplant in an older adult.

Essential points of the review:

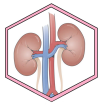
- Cognitive impairment can precede frailty by months, so its early detection and treatment prevents the progression to frailty.
- Frailty has two types: responsive and refractory; both types must be treated intensively during the waiting time on the transplant list.
- The transplant significantly improves frailty in three months, although there is a higher incidence of comorbidities in this postoperative recovery time.
- Both frailty and cognitive impairment are reversible and largely depend on high protein nutrition and increased muscle mass.

Conclusion: Kidney transplantation in older people is an increasingly accessible option, but research is needed to unify eligibility criteria and improve results.

Keywords:

MESH: Frailty; Kidney Transplantation; Mortality; Muscle, Skeletal; Aged; Elderly Nutrition Renal Dialysis.

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Chronic kidney disease (CKD) is a progressive and irreversible condition and a significant cause of death and disability, and its prevalence increases with age [1, 2]. In Colombia, the average age of patients on hemodialysis is 61 years, and hemodialysis is the fifth leading cause of death in older adults. The mortality rate for CKD stage 5 is 14.55 cases per 100,000 inhabitants [3].

Globally, the number of dialysis patients is estimated to increase to 4.9 million by 2030 [4]. Dialysis patients have a 10-fold higher risk of death than the general population, with notably higher hospitalization rates and poorer health-related quality of life [5].

In recent years, with the increase in deceased donors over 65 years of age [6], transplant programs for older adults have been developed to transplant a graft from an older adult into a senior recipient without frailty, which has led to an increase in waiting lists for kidney transplantation in older adults [7].

The selection process for kidney transplantation in older adults is more complex than in younger patients. Factors considered include age, sex, comorbidities, frailty, cognitive status, and quality of life [8, 9]. Additionally, excluding older adults from clinical studies limits the evidence-based medical information available to this population [8].

Understanding these geriatric syndromes is critical for appropriate patient selection for kidney transplantation. However, few guidelines help physicians make decisions in this context.

Therefore, deepening our understanding of frailty, cognitive impairment, and quality of life in older adults with CKD is essential. This will help improve patient selection for kidney transplantation and reduce the impact of complications in the clinical setting [10].

Definition of fragility

Frailty is a geriatric syndrome characterized by decreased functional reserve, leading to vulnerability to stressors [11].

The FRAIL frailty scale (Table 1), developed by Dr. Linda Fried et al. [12], comprises five criteria: unintentional weight loss, fatigue, low physical activity, low grip strength, and slow walking speed.

Frailty is a dynamic and changing condition that can be reversible if detected and treated early [13].

Frailty predicts future complications and adverse clinical outcomes, such as increased mortality, prolonged hospital stay, functional decline, and disability.

Furthermore, frail patients have a higher risk of postoperative morbidity and mortality [14].

Definition of cognitive impairment

Cognitive impairment is one of the components of frailty; therefore, there is an association between physical frailty and cognitive impairment, presenting a higher incidence of functional disability, poor quality of life, and mortality [16].

Consequently, in older patients with kidney disease, early detection of cognitive deterioration is necessary through screening tests, which identify cognitive decline promptly, thus preventing the evolution toward frailty [17].

The most commonly used screening scales are the Montreal Cognitive Assessment (MoCA) and the Mini-Mental State Examination (MMSE) [18]. These scales evaluate the individual's behavior, orientation, attitude, perception, judgment, abstraction, and cognition [19, 20].

Quality of life

Health-related quality of life (HRQoL) is the value a person assigns to their life, considering their functional status, limitations, perceptions, and social opportunities. These factors can be influenced by diseases, injuries, treatments, and health policies [21].

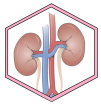
For this reason, HRQoL must be evaluated multidimensionally, considering physical, psychological, social, and environmental aspects.

The SF-36 questionnaire [22] is the most commonly used instrument to measure HRQoL. It consists of 36 questions that cover the following scales:

- Physical function
- physical role
- Bodyache
- General Health
- Vitality
- Social function
- Emotional role
- Mental health

Table 1. FRAIL Scale [15]

Fatigue
In the last 4 weeks, how tired have you felt?
All the time
Most of the time
Some of the time
Very little time
No time
Endurance
You alone, without aid such as a cane or walker: Do you have difficulty climbing ten steps (a staircase)?
Yes
No
Wandering
You alone, without any aid such as a cane or walker: Do you have difficulty walking 100 meters (Two blocks) without resting?
Yes
No
Diseases
Has any doctor told you that you have any of these diseases?



High blood pressure, Diabetes, Cancer (excluding skin cancer), Chronic obstructive pulmonary disease, Ischemic heart disease, Congestive heart failure, Angina, Asthma, Arthritis (Includes osteoarthritis and rheumatoid arthritis), Vascular stroke, chronic kidney disease.

Score if it is 5 or more.

Weightloss

How much did you weigh 1 year ago?

Percent weight change [(weight 1 year ago-Current weight)/Weight 1 year ago]*100

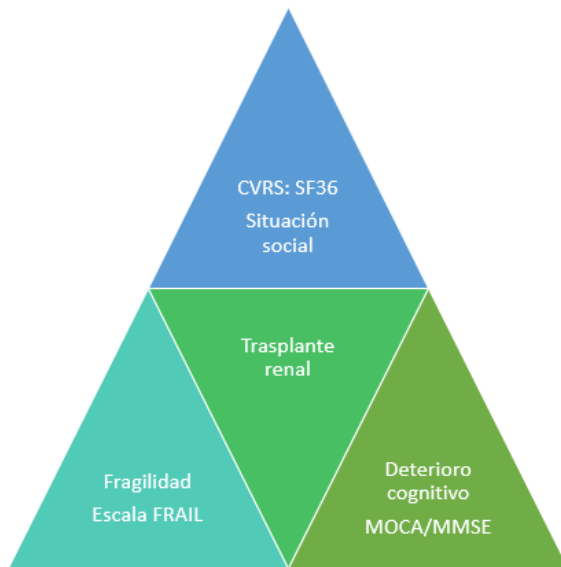
Weight loss > or = 5%

Weight loss < or = 4%

Each positive value will be scored with 1 point. 0 points = Robust, 1 or 2 points = Prefragile, = or > 3 points = fragile.

The K/DOQI guidelines recommend that all patients with a glomerular filtration rate (GFR) less than 60 mL/min be evaluated for HRQoL. HRQoL is related to morbidity and mortality and can help make treatment decisions [23] (Figure 1).

Figure 1 . Relationships between frailty, cognitive impairment, and quality of life in older patients with kidney transplants.



Kidney transplant

Fragility

Frailty is very common in patients in hemodialysis programs; approximately 50% have a diagnosis of frailty, and up to 21% of patients are on the waiting list [9]. Kidney transplants improve the life expectancy of older people compared to dialysis by 3.8 years [24], but older patients are less likely to be on waiting lists [25]. This could be because transplant eligibility factors are not standardized [26].

Frailty is a risk factor for older chronic kidney disease (CKD) patients. Frail patients are more vulnerable to transplant stressors and are at higher risk for postoperative complications. Studies have shown that up to 30.1% of transplant recipients with frailty have a hospital admission 30 days after the transplant, which increases mortality and graft loss [28]. However, frail patients can also benefit from kidney transplantation. One study found that frail patients who underwent kidney transplantation improved their physical function more rapidly than non-frail patients in the first three months [29] due to increased physical activity and improved nutritional status.

Frailty is a dynamic process that may worsen after transplantation but improves significantly over time, beginning in the third month after transplantation [30].

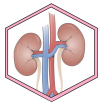
To improve transplant survival in older patients, it is essential to identify and address risk factors for frailty, such as the risk of falls and malnutrition [31]. It is necessary to mention that frailty has two types: responsive frailty, the most common defect characterized by a decreased functional reserve that can be reversed with appropriate interventions. For example, patients with responsive frailty can improve their strength and functional capacity with muscle-building exercises, high-protein nutrition, and medical care. The second type is refractory frailty, a more severe form of frailty that is more resistant to interventions. Patients with refractory frailty may have underlying health problems that contribute to their frailty, such as chronic illness, malnutrition, depression, or severe cognitive loss. This raises a research question: if patients with refractory frailty compared to patients with responsive frailty have worse posttransplant outcomes at the 1-year follow-up, subsequent studies should differentiate these study groups.

Cognitive impairment

In patients with chronic kidney disease (CKD), cognitive impairment is multifactorial and associated with an increased risk of cerebrovascular disease; kidney disease is also a risk factor for cognitive impairment [32]. Approximately 55% of kidney transplant patients have mild to moderate cognitive impairment [33]. This can make it difficult to follow instructions and comply with medical treatments, reducing your chances of an effective transplant or losing posttransplant adherence [17]. Posttransplant follow-up studies have shown that frail and non-frail recipients experience short-term cognitive improvement after transplant. This information is useful for more careful monitoring of cognitive function in patients with frailty, both before and after transplant. This also constitutes evidence that allows patients with mild cognitive impairment to be included on waiting lists [34].

Health-related quality of life

Although renal replacement therapies efficiently improve health-related quality of life (HRQoL), they do not reach the patient's levels before entering dialysis programs [35]. Even kidney transplantation significantly improves HRQoL but fails to restore pre-CKD levels [36]. Compared to the general population, 60% of older transplant patients have a similar HRQoL to the general population, and 40% have a greater impact on anxiety and muscle weakness [38]. Therefore,



psychological support is important to reduce anxiety and fear of disease progression and death. In addition to rehabilitation programs to strengthen muscle mass [39].

Other scales

It is important to know that the scales that assess cognitive impairment have different sensitivities; for example, the MM scale determines that the majority of patients on the waiting list have cognitive impairment (mild or moderate), while the MocA scale determines that 55% of patients on the waiting list have cognitive impairment [33]. Likewise, in the senior clinical setting, the single “Timed standing and walking test” or the “Comprehensive Geriatric Assessment (CGA)” scale is widely used instead of the FRAIL scale for the diagnosis of frailty. Each transplant team should include a specific assessment of frailty, quality of life, and cognitive impairment in each elderly patient entering the kidney transplant preparation program. No studies compare frailty scales prospectively in this group of patients, which constitutes a line of research to follow in the future.

Conclusion

Kidney transplantation is an increasingly accessible therapeutic option for older people with stage 5-d chronic kidney disease. This is due to the improvement in life expectancy and quality of life of transplant patients compared to those receiving dialysis. However, eligibility criteria for kidney transplantation in older people should be adjusted to consider age-related factors, such as frailty and cognitive decline. These geriatric syndromes can be reversible and improve transplant patients' quality of life. Therefore, further research is required to unify frailty and cognitive impairment thresholds for kidney transplant eligibility. Intervention programs are also needed to improve functionality and decrease post-transplant complications in older people.

Abbreviations

HRQoL: Health-related quality of life.
CKD: Chronic kidney disease.

References

1. Heras Benito M, Fernández-Reyes Luis MJ. Shared decision-making in advanced chronic kidney disease in elderly individuals. *Med Clin (Barc)*. 2019 Mar 1;152(5):188-194. English, Spanish. doi: [10.1016/j.medcli.2018.07.011](https://doi.org/10.1016/j.medcli.2018.07.011). Epub 2018 Oct 17. PMID: 30342770.
2. Abuabara-Franco E, Bohórquez-Rivero J, Restom-Arrieta J, Sáenz-López J, Gómez-Franco A, Navarro-Quiróz R. Importance of a nephroprotection model adapted to Colombia: Importancia de un modelo de nefroprevención adaptado para Colombia. *Rev. Colomb. Nefrol.* 2021;8(3):e399. <https://doi.org/10.22265/acnef.8.3.399>
3. Ministerio de Salud y Protección Social. Ministerio de Hacienda y Crédito Público. República de Colombia. Situación de la enfermedad renal crónica, la hipertensión arterial y la diabetes mellitus en Colombia 2021. Cuenta de Alto Costo, Fondo Colombiano de Enfermedades de Alto Costo. [Sitio web de entidad pública]. publicaciones/situacion
4. Sarhan AL, Jarareh RH, Shraim M. Quality of life for kidney transplant recipients and hemodialysis patients in Palestine: a cross-

Supplementary information

Supplementary materials have not been declared.

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Author contributions

Zulay Milena Quiroga Trillos: Conceptualization, Data curation, Formal analysis, Funding acquisition, Research, Methodology, Project administration, Resources, Software, Writing – original draft.

Martha Patricia Rodríguez: Conceptualization, Supervision, Validation, Visualization, Writing: review and editing.

All the authors have read and approved the final version of the manuscript.

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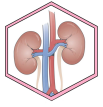
Conflicts of interest

The authors report having no conflicts of interest.

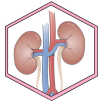
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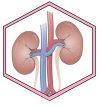
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- sectional study. *BMC Nephrol.* 2021 Jun 3;22(1):210. doi: [10.1186/s12882-021-02412-z](https://doi.org/10.1186/s12882-021-02412-z). PMID: 34082724; PMCID: PMC8173862.
5. Gil-Casares B, Portolés J, López-Sánchez P, Tornero F, Marques M, Rojo-Álvarez JL. Análisis de las transiciones en el modelo integrado de tratamiento sustitutivo renal en un sistema regional de salud. *Nefrología* 2022;42(4):438–447. <https://doi.org/10.1016/j.nefro.2021.07.004>
 6. Lloveras J, Arcos E, Comas J, Crespo M, Pascual J. A paired survival analysis comparing hemodialysis and kidney transplantation from deceased elderly donors older than 65. *Transplantation.* 2015 May;99(5):991-6. doi: [10.1097/TP.0000000000000474](https://doi.org/10.1097/TP.0000000000000474). PMID: 25340611.
 7. Sanchez-Avila Y, Patiño-Jaramillo N, Garcia Lopez A, Giron-Luque F. Patient and Graft Survival in the Elderly Kidney Transplant Recipients. *Rev. Colomb. Nefrol.* 2021;8(2):e512. <https://doi.org/10.22265/acnef.8.2.512>
 8. Mora-Gutiérrez JM, Slon Roblero M, Castaño Bilbao I, Izquierdo Bautista D, Arteaga Coloma J, Martínez Velilla N. Enfermedad renal crónica en el paciente anciano. *Revista Española de Geriátría y Gerontología* 2017;52(3):152–158. <https://doi.org/10.1016/j.regg.2016.03.006>
 9. Shrestha P, Van Pilsun Rasmussen SE, King EA, Gordon EJ, Faden RR, Segev DL, Humbyrd CJ, McAdams-DeMarco M. Defining the ethical considerations surrounding kidney transplantation for frail and cognitively impaired patients: a Delphi study of geriatric transplant experts. *BMC Geriatr.* 2022 Jul 8;22(1):566. doi: [10.1186/s12877-022-03209-x](https://doi.org/10.1186/s12877-022-03209-x). PMID: 35804289; PMCID: PMC9264705.
 10. Gandolfini I, Regolisti G, Bazzocchi A, Maggiore U, Palmisano A, Piotti G, Fiaccadori E, Sabatino A. Frailty and Sarcopenia in Older Patients Receiving Kidney Transplantation. *Front Nutr.* 2019 Nov 12;6:169. doi: [10.3389/fnut.2019.00169](https://doi.org/10.3389/fnut.2019.00169). PMID: 31781571; PMCID: PMC6861371.
 11. Vasquez-Goñi GAJ, Papuico-Romero BM, Urrunaga-Pastor D, Runzer-Colmenares FM, Parodi JF. The depressed frail phenotype as a risk factor for mortality in older adults: A prospective cohort in Peru. *Heliyon.* 2021 Dec 20;8(1):e08640. doi: [10.1016/j.heliyon.2021.e08640](https://doi.org/10.1016/j.heliyon.2021.e08640). PMID: 35028442; PMCID: PMC8741456.
 12. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, McBurnie MA; Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci.* 2001 Mar;56(3):M146-56. doi: [10.1093/gerona/56.3.m146](https://doi.org/10.1093/gerona/56.3.m146). PMID: 11253156.
 13. Abellan van Kan G, Rolland Y, Bergman H, Morley JE, Kritchevsky SB, Vellas B. The I.A.N.A Task Force on frailty assessment of older people in clinical practice. *J Nutr Health Aging.* 2008 Jan;12(1):29-37. doi: [10.1007/BF02982161](https://doi.org/10.1007/BF02982161). PMID: 18165842.
 14. Quint EE, Zogaj D, Banning LBD, Benjamins S, Annema C, Bakker SJL, Nieuwenhuijs-Moeke GJ, Segev DL, McAdams-DeMarco MA, Pol RA. Frailty and Kidney Transplantation: A Systematic Review and Meta-analysis. *Transplant Direct.* 2021 May 18;7(6):e701. doi: [10.1097/TXD.0000000000001156](https://doi.org/10.1097/TXD.0000000000001156). PMID: 34036171; PMCID: PMC8133203.
 15. Chavarro D, Heredia R, Venegas L, Caicedo S, Gómez R, Pardo A, Cano C. Escalas de uso frecuente en geriatría. ISBN 978-958-781-310-4. Fundación Cultural Javeriana de Artes Gráficas – JAVEGRAF. Bogotá 2da edición , 2020. repository.javeriana.edu.co
 16. Arai H, Satake S, Kozaki K. Cognitive Frailty in Geriatrics. *Clin Geriatr Med.* 2018 Nov;34(4):667-675. doi: [10.1016/j.cger.2018.06.011](https://doi.org/10.1016/j.cger.2018.06.011). Epub 2018 Aug 16. PMID: 30336994.
 17. Chu NM, Gross AL, Shaffer AA, Haugen CE, Norman SP, Xue QL, Sharrett AR, Carlson MC, Bandeen-Roche K, Segev DL, McAdams-DeMarco MA. Frailty and Changes in Cognitive Function after Kidney Transplantation. *J Am Soc Nephrol.* 2019 Feb;30(2):336-345. doi: [10.1681/ASN.2018070726](https://doi.org/10.1681/ASN.2018070726). Epub 2019 Jan 24. PMID: 30679381; PMCID: PMC6362628.
 18. Nasreddine ZS, Phillips NA, Bédirian V, Charbonneau S, Whitehead V, Collin I, Cummings JL, Chertkow H. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. *J Am Geriatr Soc.* 2005 Apr;53(4):695-9. doi: [10.1111/j.1532-5415.2005.53221.x](https://doi.org/10.1111/j.1532-5415.2005.53221.x). Erratum in: *J Am Geriatr Soc.* 2019 Sep;67(9):1991. PMID: 15817019.
 19. Rojas-Gualdrón DF, Segura C A, Cardona A D, Segura C Ángela, Garzón D MO. Análisis Rasch del Mini Mental State Examination (MMSE) en adultos mayores de Antioquia, Colombia. *CES Psico [Internet].* 19 de mayo de 2017;10(2):17-2. <https://doi.org/10.21615/cesp.10.2.2>
 20. Lopez Pérez-Díaz AG, Calero MD , Navarro-González E. Predicción del deterioro cognitivo en ancianos mediante el análisis del rendimiento en fluidez verbal y en atención sostenida. *Rev Neurol* 2013;56 (01):1-7 doi: [10.33588/rn.5601.2012281](https://doi.org/10.33588/rn.5601.2012281)
 21. Abizanda P, Romero L, Luengo C, Sánchez P, Jordan J. *Medicina Geriátrica: una aproximación basada en problemas.* Elsevier Madrid 2012. ISBN [978-84-458-2184-8](https://doi.org/10.1016/j.elsevier.2012.11.001).
 22. Vilagut G, Ferrer M, Rajmil L, Rebollo P, Permanyer-Miralda G, Quintana J, Santed R, Valderas J, Ribera A, Domingo-Salvany A, Alonso J. (2005). El Cuestionario de Salud SF-36 español: una



- década de experiencia y nuevos desarrollos por los investigadores de la Red-IRYSS*. In *Gac Sanit* 2005;19(2):135-150. [scielo.S0213](https://doi.org/10.1016/j.gacsan.2005.02.013)
23. Osuna-Pozo C, Ortiz-Alonso J, Vidán M, Ferreira G, Serra-Rexach J. Revisión sobre el deterioro funcional en el anciano asociado al ingreso por enfermedad aguda. In *Revista Española de Geriatria y Gerontología* 2014;49(2):77-89. <https://doi.org/10.1016/j.regg.2013.08.001>
 24. Hiramatsu T, Okumura S, Asano Y, Mabuchi M, Iguchi D, Furuta S. Quality of Life and Emotional Distress in Peritoneal Dialysis and Hemodialysis Patients. *Ther Apher Dial*. 2020 Aug;24(4):366-372. doi: [10.1111/1744-9987.13450](https://doi.org/10.1111/1744-9987.13450). Epub 2019 Dec 12. PMID: 31671240.
 25. Beerli N, Denhaerynck K, Binet I, Dahdal S, Dickenmann M, Golshayan D, Hadaya K, Huynh-Do U, Schnyder A, De Geest SM, Mauthner O. Age at Time of Kidney Transplantation as a Predictor for Mortality, Graft Loss and Self-Rated Health Status: Results From the Swiss Transplant Cohort Study. *Transpl Int*. 2022 Jan 27;35:10076. doi: [10.3389/ti.2021.10076](https://doi.org/10.3389/ti.2021.10076). PMID: 35185365; PMCID: PMC8842256.
 26. Hwang Y, Kim M, Min K. Factors associated with health-related quality of life in kidney transplant recipients in Korea. *PLoS One*. 2021 Mar 11;16(3):e0247934. doi: [10.1371/journal.pone.0247934](https://doi.org/10.1371/journal.pone.0247934). PMID: 33705454; PMCID: PMC7951930.
 27. Montoya Hincapié S, Paja Becoche R, Salas Zapata C. Calidad de vida en pacientes trasplantados renales de una institución prestadora de servicios de salud en Medellín, Colombia. *Universidad y Salud*. 2017;19(2):237. <https://doi.org/10.22267/rus.171902.86>
 28. Haugen CE, King EA, Bae S, Bowring MG, Holscher CM, Garonzik-Wang J, McAdams-DeMarco M, Segev DL. Early Hospital Readmission in Older and Younger Kidney Transplant Recipients. *Am J Nephrol*. 2018;48(4):235-241. doi: [10.1159/000492338](https://doi.org/10.1159/000492338). Epub 2018 Sep 18. PMID: 30227406; PMCID: PMC6212310.
 29. McAdams-DeMarco MA, Olorundare IO, Ying H, Warsame F, Haugen CE, Hall R, Garonzik-Wang JM, Desai NM, Walston JD, Norman SP, Segev DL. Frailty and Postkidney Transplant Health-Related Quality of Life. *Transplantation*. 2018 Feb;102(2):291-299. doi: [10.1097/TP.0000000000001943](https://doi.org/10.1097/TP.0000000000001943). PMID: 28885489; PMCID: PMC5790611.
 30. McAdams-DeMarco MA, Isaacs K, Darko L, Salter ML, Gupta N, King EA, Walston J, Segev DL. Changes in Frailty After Kidney Transplantation. *J Am Geriatr Soc*. 2015 Oct;63(10):2152-7. doi: [10.1111/jgs.13657](https://doi.org/10.1111/jgs.13657). Epub 2015 Sep 29. PMID: 26416770; PMCID: PMC4618021.
 31. Chu NM, Shi Z, Berkowitz R, Haugen CE, Garonzik-Wang J, Norman SP, Humbyrd C, Segev DL, McAdams-DeMarco MA. Poor Outcomes in Kidney Transplant Candidates and Recipients With History of Falls. *Transplantation*. 2020 Aug;104(8):1738-1745. doi: [10.1097/TP.0000000000003057](https://doi.org/10.1097/TP.0000000000003057). PMID: 32732854; PMCID: PMC7237294.
 32. Drew DA, Weiner DE, Sarnak MJ. Cognitive Impairment in CKD: Pathophysiology, Management, and Prevention. *Am J Kidney Dis*. 2019 Dec;74(6):782-790. doi: [10.1053/j.ajkd.2019.05.017](https://doi.org/10.1053/j.ajkd.2019.05.017). Epub 2019 Aug 1. PMID: 31378643; PMCID: PMC7038648.
 33. Castellano M, Bernarte M, Castellano C, Favaro M, Mateo V. Deterioro cognitivo sin demencia en la insuficiencia renal crónica terminal. *Rev Nefrol Dial Traspl*;2020;40(02):119-147. [redalyc.ar/5642](https://doi.org/10.1016/j.redalyc.2020.02.002)
 34. Belleville S, Hudon C, Bier N, Brodeur C, Gilbert B, Grenier S, Ouellet MC, Viscogliosi C, Gauthier S. MEMO+: Efficacy, Durability and Effect of Cognitive Training and Psychosocial Intervention in Individuals with Mild Cognitive Impairment. *J Am Geriatr Soc*. 2018 Apr;66(4):655-663. doi: [10.1111/jgs.15192](https://doi.org/10.1111/jgs.15192). Epub 2018 Jan 4. PMID: 29313875.
 35. Palmer S, Vecchio M, Craig JC, Tonelli M, Johnson DW, Nicollucci A, Pellegrini F, Saglimbene V, Logroscino G, Fishbane S, Strippoli GF. Prevalence of depression in chronic kidney disease: systematic review and meta-analysis of observational studies. *Kidney Int*. 2013 Jul;84(1):179-91. doi: [10.1038/ki.2013.77](https://doi.org/10.1038/ki.2013.77). Epub 2013 Mar 13. PMID: 23486521.
 36. Wang Y, Hemmelder MH, Bos WJW, Snoep JD, de Vries APJ, Dekker FW, Meuleman Y. Mapping health-related quality of life after kidney transplantation by group comparisons: a systematic review. *Nephrol Dial Transplant*. 2021 Dec 2;36(12):2327-2339. doi: [10.1093/ndt/gfab232](https://doi.org/10.1093/ndt/gfab232). PMID: 34338799; PMCID: PMC8643597.
 37. Knobbe TJ, Kremer D, Eisenga MF, Corpeleijn E, Annema C, Spikman JM; Transplantlines Investigators; Navis G, Berger SP, Bakker SJL. Hand dexterity, daily functioning and health-related quality of life in kidney transplant recipients. *Sci Rep*. 2022 Sep 28;12(1):16208. doi: [10.1038/s41598-022-19952-5](https://doi.org/10.1038/s41598-022-19952-5). PMID: 36171358; PMCID: PMC9519570.
 38. Villeneuve C, Laroche ML, Essig M, Merville P, Kamar N, Coubret A, Lacroix I, Bouchet S, Fruit D, Marquet P, Rousseau A; EPI-GREN study group. Evolution and Determinants of Health-Related Quality-of-Life in Kidney Transplant Patients Over the First 3 Years After Transplantation. *Transplantation*. 2016 Mar;100(3):640-7. doi: [10.1097/TP.0000000000000846](https://doi.org/10.1097/TP.0000000000000846). PMID: 26569063.
 39. Perales Montilla C, Duschek S, Reyes Del Paso G. Quality of life related to health chronic kidney disease: Predictive importance of mood and somatic symptoms. *Nefrología: Publicación Oficial*



de La Sociedad Espanola Nefrologia,2016;36(3):275–282.
<https://doi.org/10.1016/j.nefro.2015.12.002>

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