FRAILTY in dialysis patients
Relevance and pitfalls

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Category	Disclosure Information
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Speakers Bureau	Nothing to disclose.
Other Interests or Relationships	Nothing to disclose.

RESULTS BY YEAR

486 results

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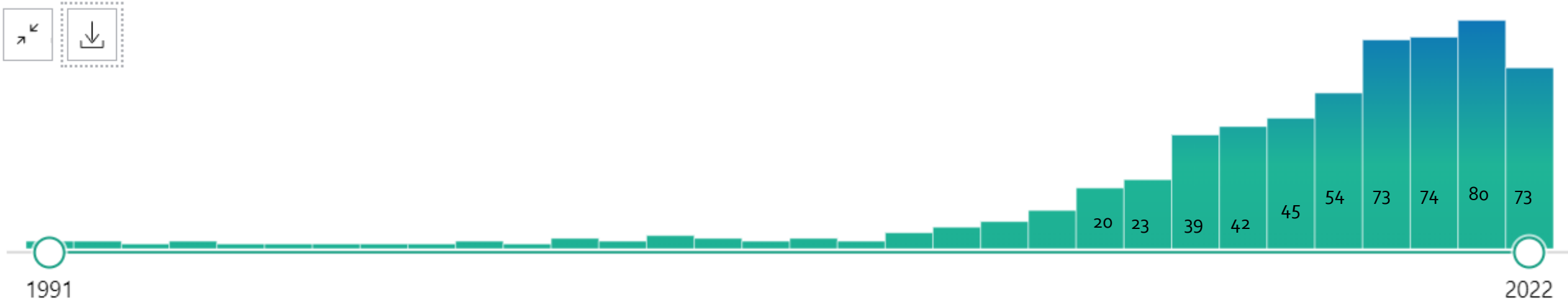
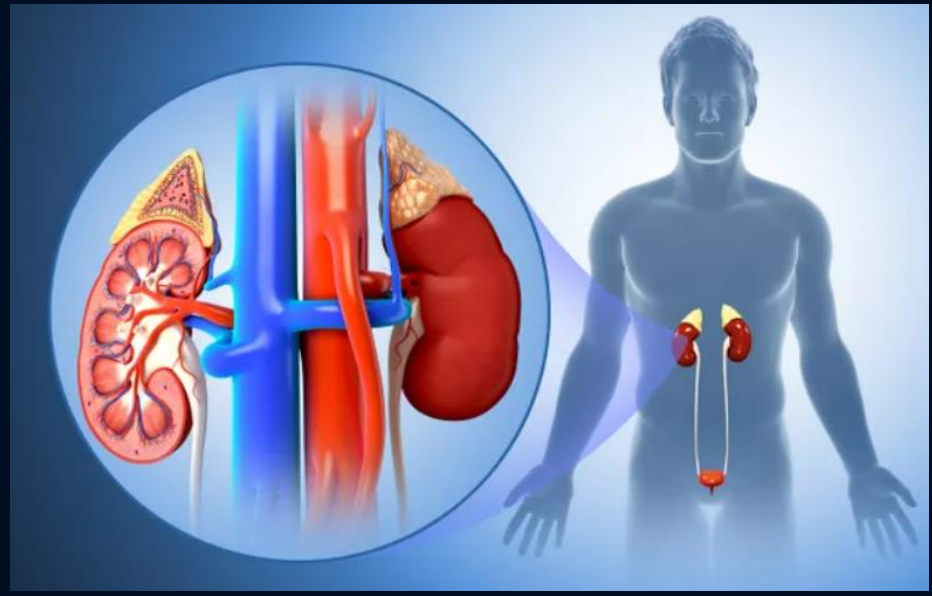


Chronic Kidney Disease



- Role of the kidney:

Metabolite waste excretion (drug excretion)

Control of solutes (ions), acid/base balance and fluids

Blood pressure control

Endocrine function

End stage renal disease (ESRD)

- Hypertension
- Accumulation of uremic toxins (“uremia”)
- Accumulation of fluids (edema, pulmonary congestion)
- Hyperkaliemia and acidosis
- Anemia, hypocalcemia, vitamin D deficit, hyperparathyroidism (renal osteodystrophy)

Renal Replacement therapy

- Hemodialysis
- Peritoneal dialysis
- Renal transplantation

Renal Replacement therapy

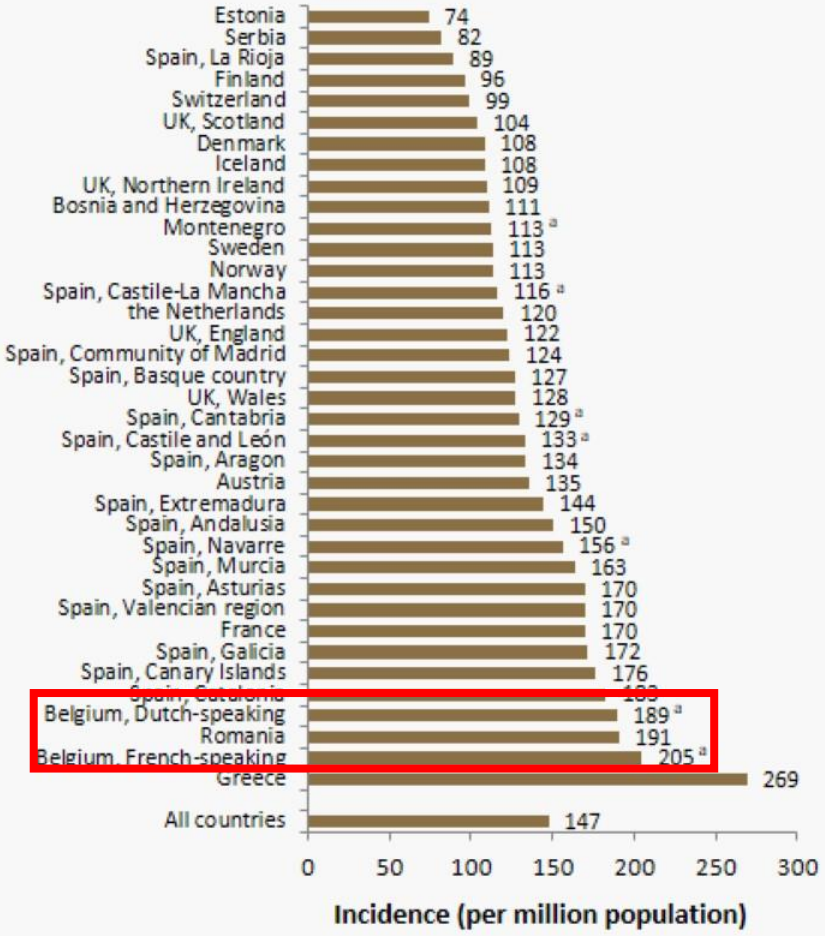
- Hemodialysis: chronic inflammation, oxidative stress
- Peritoneal dialysis
- Renal transplantation

Incident patients accepted for RRT in 2019 at day 1

by country

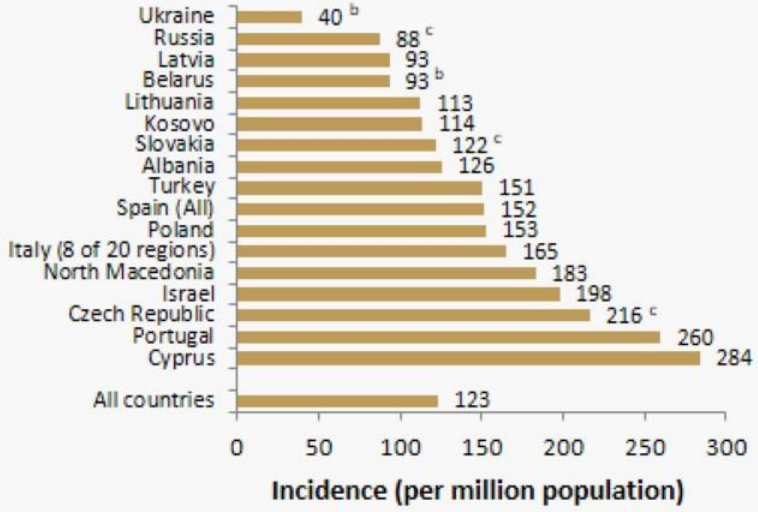
Unadjusted incidence

renal registries providing individual patient data



Unadjusted incidence

renal registries providing aggregated data



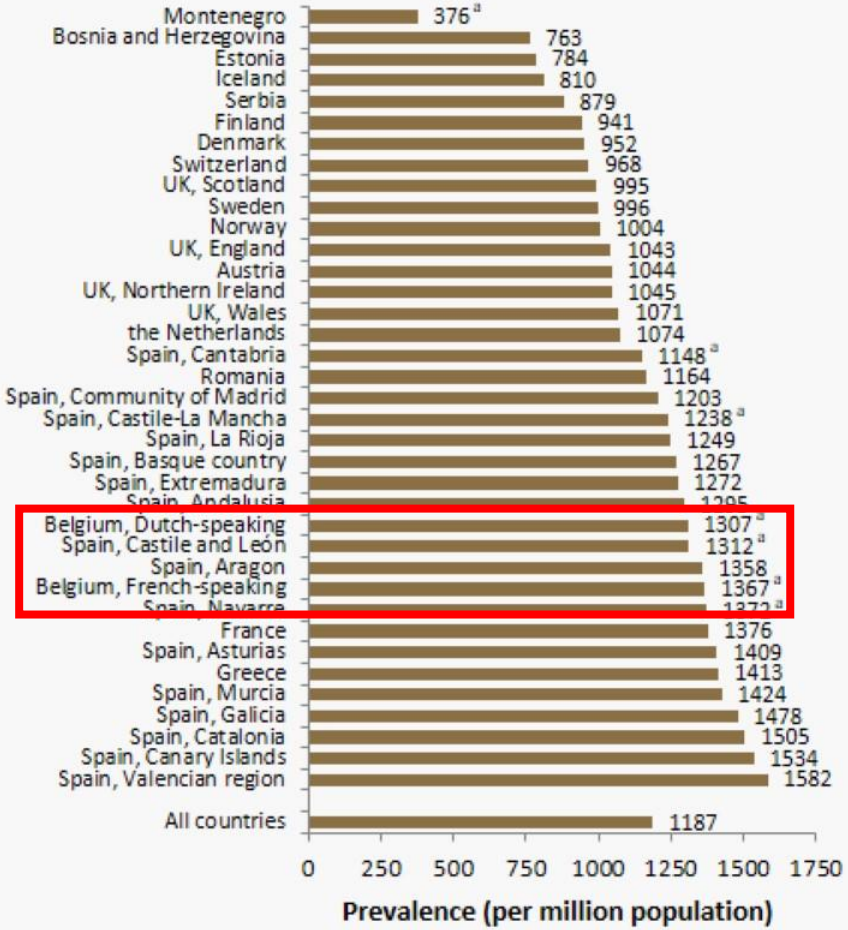
[a] *patients younger than 20 years of age are not included;* [b] *patients younger than 18 years of age are not included;* [c] *data includes patients receiving dialysis only*

Prevalent patients on RRT in 2019

by country

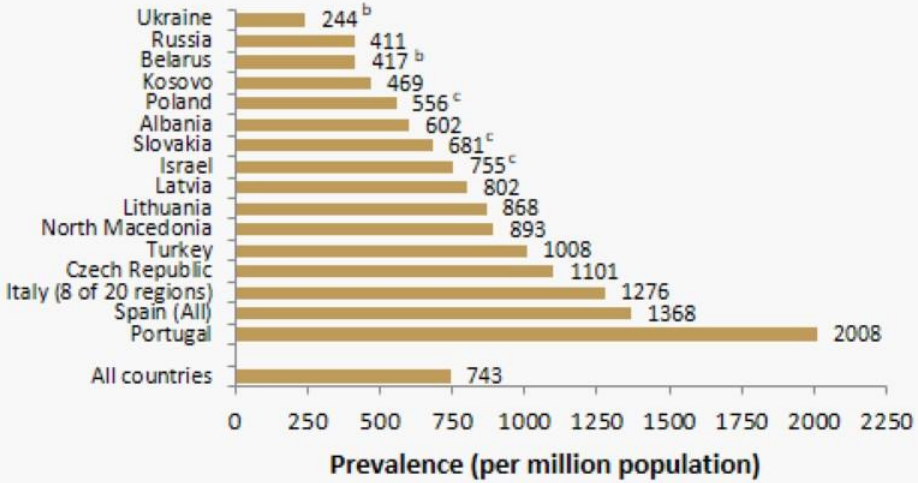
Unadjusted prevalence

renal registries providing individual patient data



Unadjusted prevalence

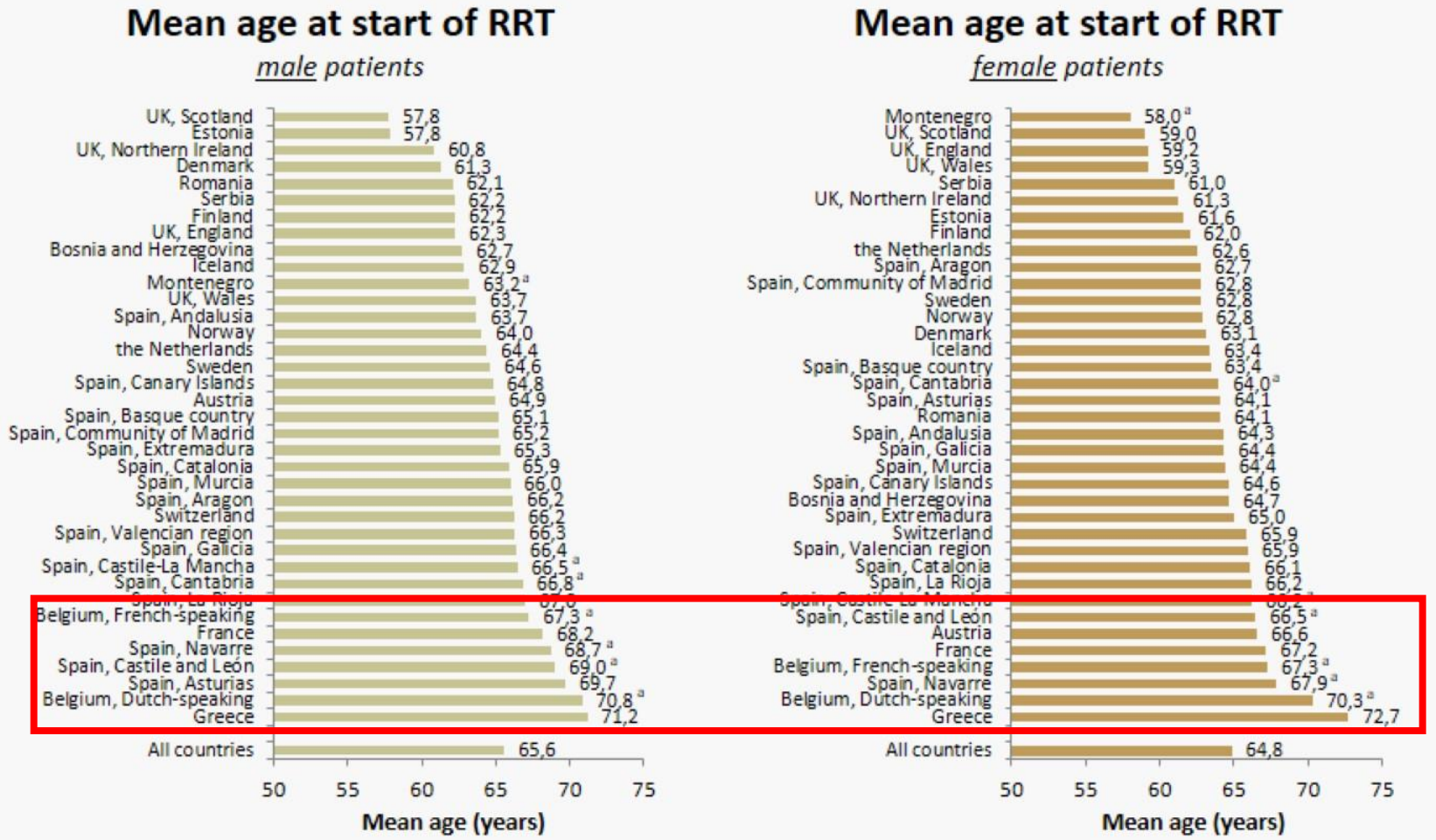
renal registries providing aggregated data



[a] *patients younger than 20 years of age are not included;* [b] *patients younger than 18 years of age are not included;* [c] *data includes patients receiving dialysis only*

Incident patients accepted for RRT in 2019, at day 1

registries providing individual patient data only



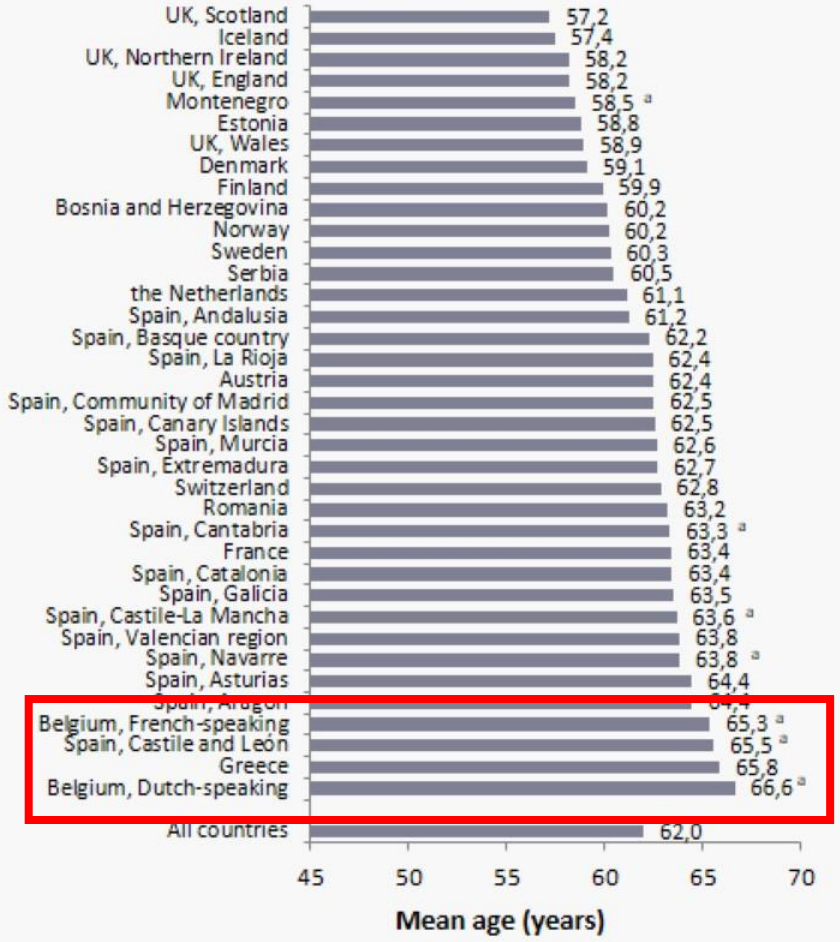
[a] *patients younger than 20 years of age are not included;*

Prevalent patients on RRT in 2019

mean age

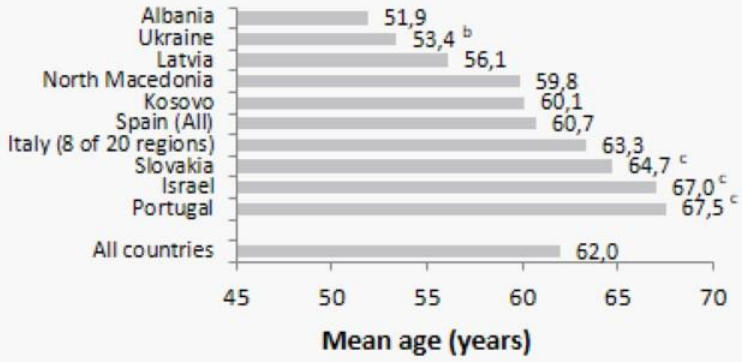
Mean age on 31 December 2019

renal registries providing individual patient data



Mean age on 31 December 2019

renal registries providing aggregated data



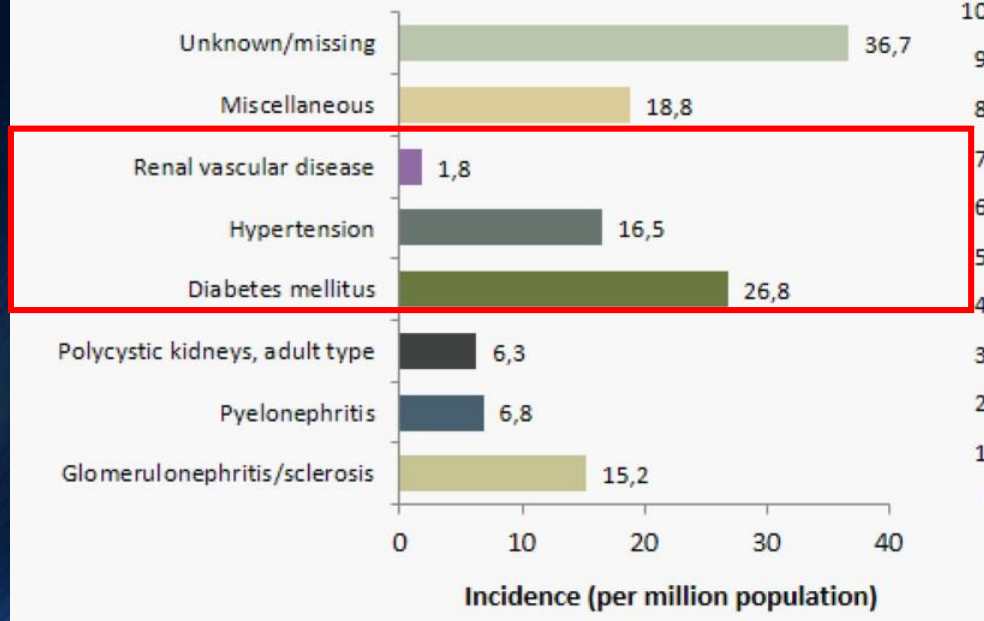
[a] patients younger than 20 years of age are not included; [b] patients younger than 18 years of age are not included; [c] data includes patients receiving dialysis only

Incident patients accepted for RRT in 2019, at day 1

by primary renal disease

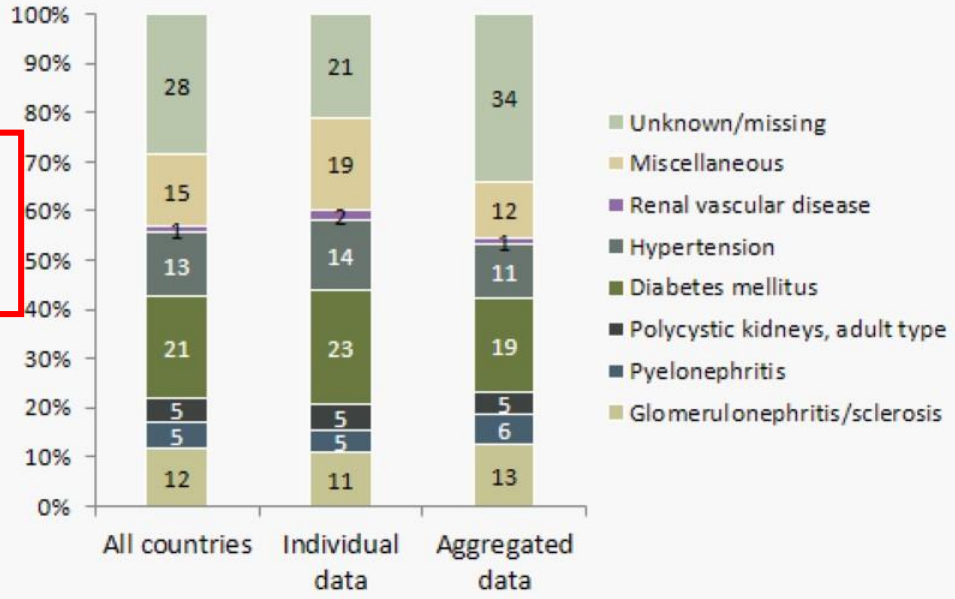
Incidence by primary renal disease

for all registries



Incidence by primary renal disease

by type of data provided by registry

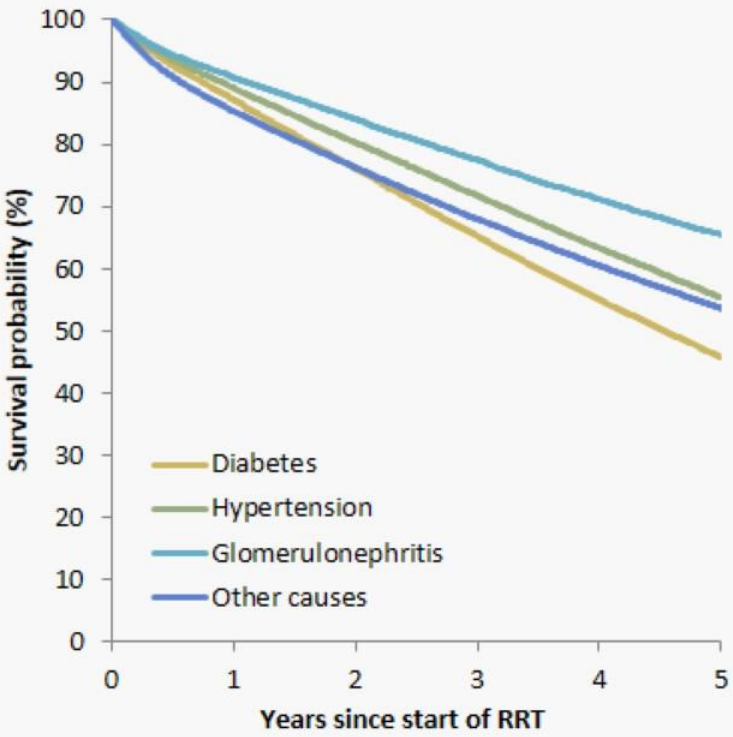


Survival probability cohort 2010-2014

by primary renal disease

Adjusted patient survival by primary renal disease
Incident RRT patients

from day 1, adjusted for age and sex

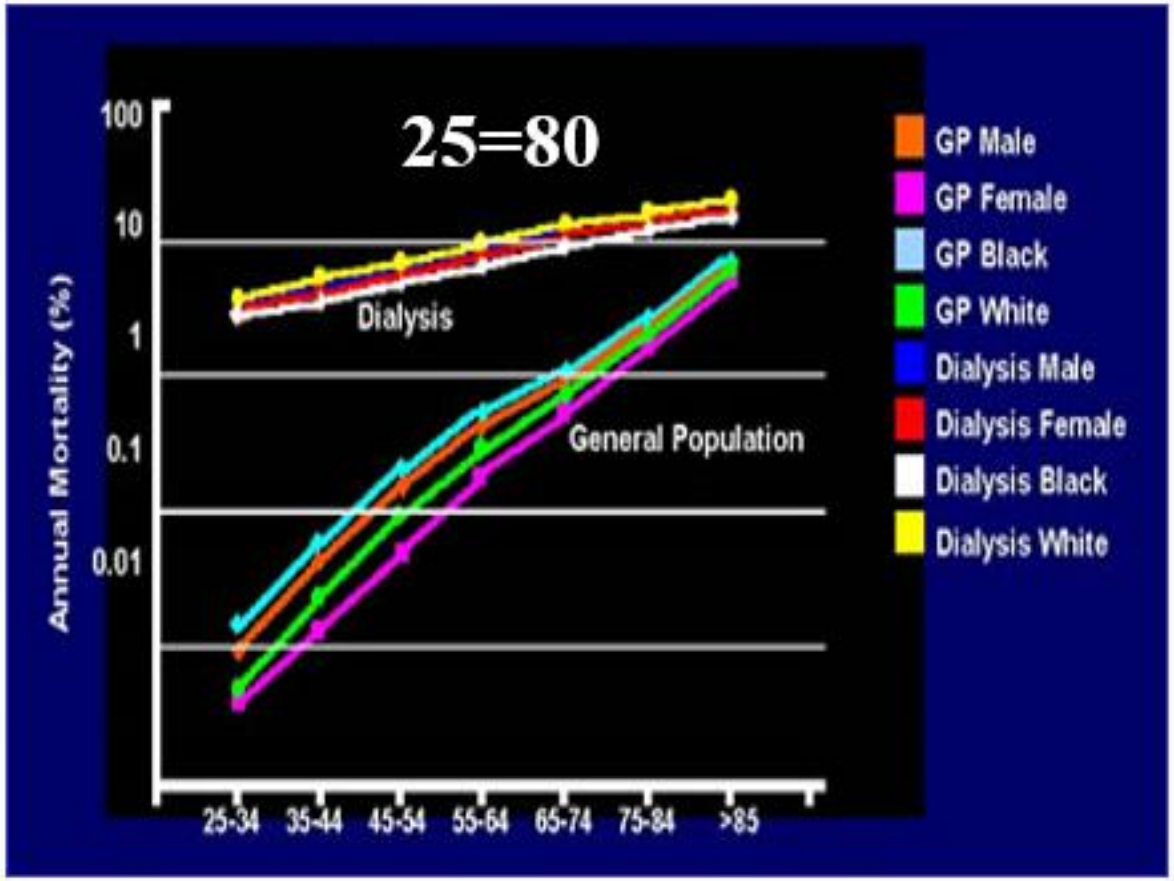


Unadjusted 5-year survival:
42,3% for dialysis
86,6% if graft from deceased donors
94,4% if graft from living kidney donors

Survival probabilities were adjusted for fixed values for age (67 years), sex (63% men), and the primary renal disease distribution (24% diabetes mellitus, 19% hypertension / renal vascular disease, 11% glomerulonephritis and 46% other primary renal diseases).

Cox regression model was used to calculate survival probabilities.

Cardiovascular mortality



Foley RN. Clinical epidemiology of cardiovascular disease in chronic renal disease. Am J Kidney Dis 1998 Nov;32(5 Suppl 3):S112-S119.

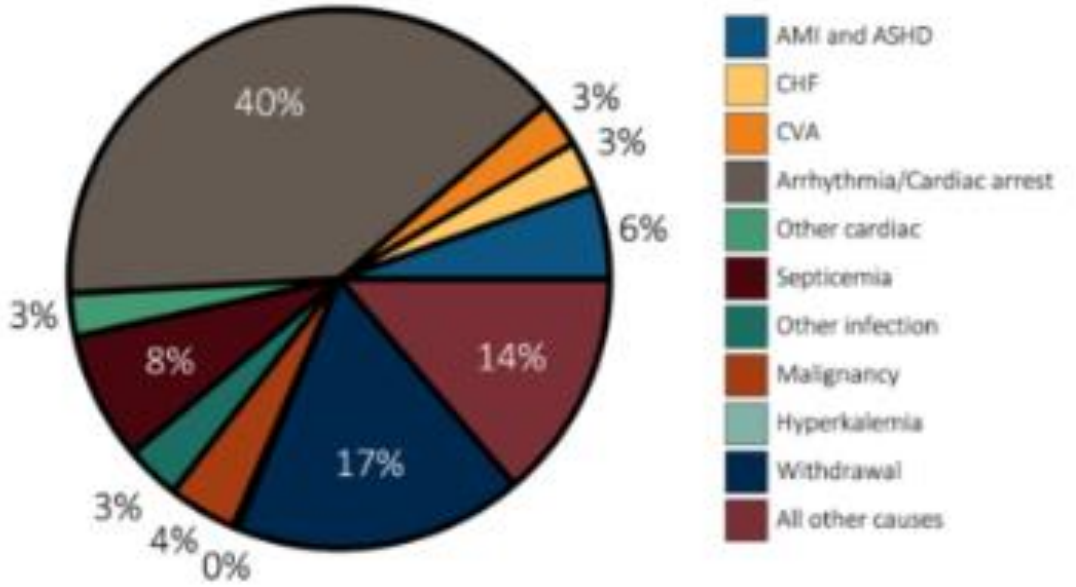


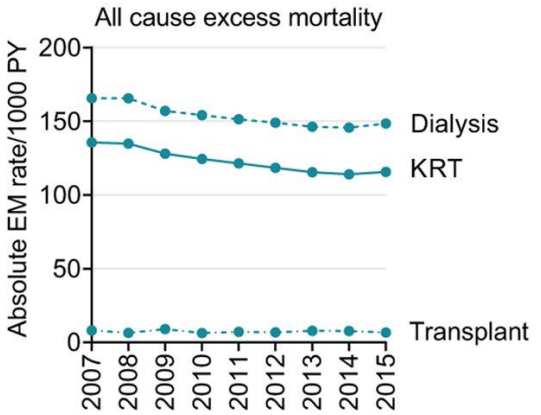
Figure 2. Causes of Death in ESRD Patients (USRDS 2017)

Data from the ERA-EDTA Registry were examined for trends in excess mortality in European adults on kidney replacement therapy.

Does improvement in KRT survival only reflect better survival in the general population?

- Excess mortality (EM): mortality in KRT patients minus expected mortality in the matched general population
- Data from 280,075 incident adult KRT patients from 12 European countries

Cause of death	Relative EM risk per 5 year (95%CI)	
	Dialysis	Transplant
All-cause	0.86 (0.85 - 0.86)	1.16 (1.07 - 1.26)
Atheromatous CVD	0.72 (0.70 - 0.74)	1.29 (0.97 - 1.73)
Non-atheromatous CVD	0.90 (0.88 - 0.92)	1.00 (0.80 - 1.23)
Infections	0.90 (0.87 - 0.92)	0.99 (0.86 - 1.14)
Malignancies	0.95 (0.90 - 1.00)	2.51 (1.35 - 4.68)

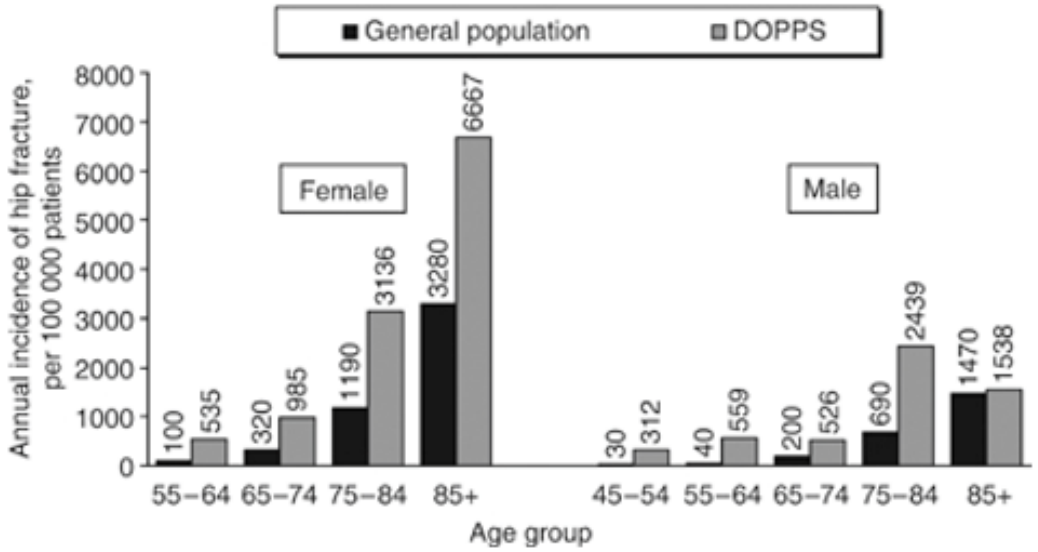


CONCLUSION:
Survival on dialysis has improved more than in the general population, especially for atheromatous CVD. In transplant recipients, the EM risk increased, still the EM rate was low.

ISN kidney INTERNATIONAL
OFFICIAL JOURNAL OF THE INTERNATIONAL SOCIETY OF NEPHROLOGY

Boenink, 2020

Comorbidities



Jadoul M, Kidney Int ,2006, p1358

N=34,579

Kidney Int. 2014 January ; 85(1): 166–173. doi:10.1038/ki.2013.279.

High rates of death and hospitalization follow bone fracture among hemodialysis patients

Francesca Tentori, MD[1,2], Keith McCullough, MS[1], Ryan D. Kilpatrick, PhD[3], Brian D. Bradbury, DSc[3,4], Bruce M. Robinson, MD[1,5], Peter G. Kerr, MD[6], and Ronald L. Pisoni, PhD[1]

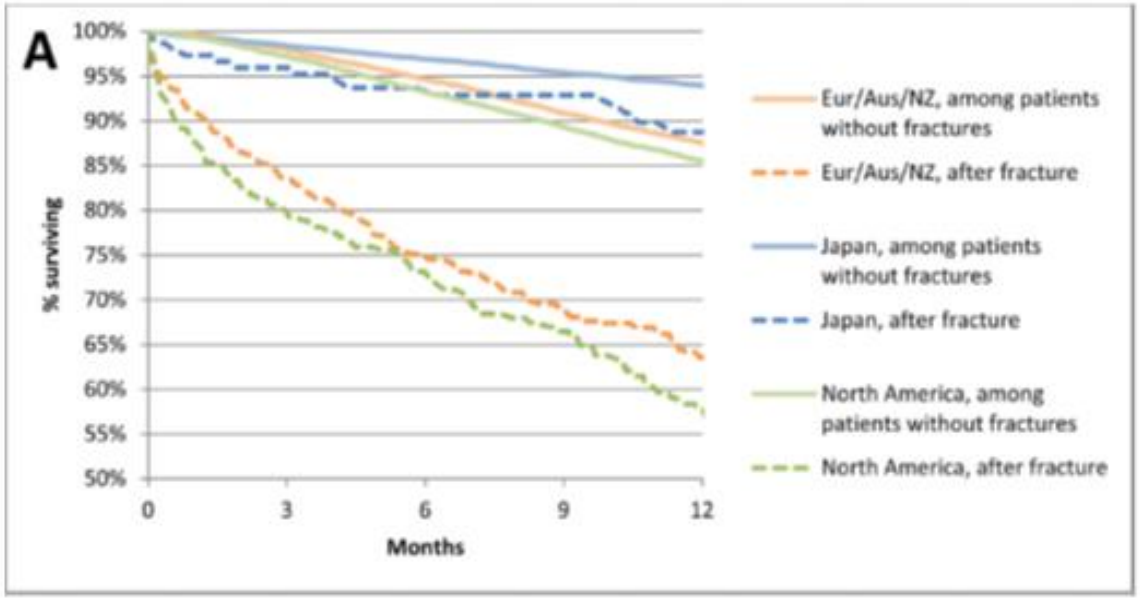


Figure 5A & 5B. Time to death and hospitalization among DOPPS participants who experienced and those who did not experience a fracture requiring hospitalization, by DOPPS region

Panel A: Unadjusted survival (time to death) by DOPPS region.

So, hemodialysis patients

- They are old
- Accumulation of uremic toxins, chronic inflammation, acidosis
- Anorexia and difficulties in diet => protein energy wasting syndrome
- They have (a lot of) comorbidities (diabetes, vascular diseases, bone disease)
- Mortality is high

- A high prevalence of frailty would not be a big surprise !

Definition of Frailty

« Frailty is a biologic syndrome of decreased reserve and resistance to stressors, resulting from cumulative declines across multiple physiologic systems, and causing vulnerability to adverse outcomes »

Fried LA, J Gerontol A Biol Sci Med Sci, 2001, 56, M146

FRAILTY according to FRIED, >65 y

5 CRITERIA
Scoring
0 criteria: robust
1-2 criteria: pre-frailty
≥ 3 criteria: frailty

Easy and inexpensive
Objective and subjective
Functional tests

Criteria	Threshold
Shrinking: Unintentional weight loss (self reported)	4.5 kg or 5% in the past year
Weakness: Hand Grip Strength	
Men	
BMI ≤ 24	≤ 29 kg
BMI 24.1-26	≤ 30 kg
BMI 26.1-28	≤ 30 kg
BMI > 28	≤ 32 kg
Women	
BMI ≤ 23	≤ 17 kg
BMI 23.1-26	≤ 17.3 kg
BMI 26.1-29	≤ 18 kg
BMI > 29	≤ 21 kg
Poor endurance and energy: Self reported exhaustion	two statements are read. (a) I felt that everything I did was an effort (b) I could not get going. Then "How often in the last week did you feel this way?" rarely or none of the time=0, some or a little of the time (1–2 days)=1, moderate amount of the time (3–4 days),=2, most of the time=3. Subjects answering "2" or "3" to either of these questions are categorized as frail
Slowness: Walking speed on 4,5 m	
Men	
Height ≤ 173 cm	≥ 7 seconds
Height > 173 cm	≥ 6 seconds
Women	
Height ≤ 159 cm	≥ 7 seconds
Height > 159 cm	≥ 6 seconds
Level of activity (kcal/week) (Minnesota Leisure Time Activity questionnaire)	
Men	< 383 Kcal/week
Women	< 270 Kcal/week

Fried LA, J Gerontol A Biol Sci Med Sci, 2001, 56, M146

CLINICAL FRAILTY SCALE

1 **VERY FIT** — People who are robust, active, energetic and motivated. They tend to exercise regularly and are among the fittest for their age.

2 **FIT** — People who have **no active disease symptoms** but are less fit than category 1. Often, they exercise or are very **active occasionally**, e.g., seasonally.

3 **MANAGING WELL** — People whose **medical problems are well controlled**, even if occasionally symptomatic, but often are **not regularly active** beyond routine walking.

4 **LIVING WITH VERY MILD FRAILTY** — Previously "vulnerable," this category marks early transition from complete independence. While **not dependent** on others for daily help, often **symptoms limit activities**. A common complaint is being "slowed up" and/or being tired during the day.

5 **LIVING WITH MILD FRAILTY** — People who often have **more evident slowing**, and need help with **high order instrumental activities of daily living** (finances, transportation, heavy housework). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation, medications and begins to restrict light housework.

6 **LIVING WITH MODERATE FRAILTY** — People who need help with **all outside activities** and with **keeping house**. Inside, they often have problems with stairs and need **help with bathing** and might need minimal assistance (cuing, standby) with dressing.

7 **LIVING WITH SEVERE FRAILTY** — **Completely dependent for personal care**, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~6 months).

8 **LIVING WITH VERY SEVERE FRAILTY** — Completely dependent for personal care and approaching end of life. Typically, they could not recover even from a minor illness.

9 **TERMINALLY ILL** — Approaching the end of life. This category applies to people with a **life expectancy <6 months**, who are **not otherwise living with severe frailty.** (Many terminally ill people can still exercise until very close to death.)

SCORING FRAILTY IN PEOPLE WITH DEMENTIA

The degree of frailty generally corresponds to the degree of dementia. Common **symptoms in mild dementia** include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.

In **moderate dementia**, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting.

In **severe dementia**, they cannot do personal care without help.

In **very severe dementia** they are often bedfast. Many are virtually mute.

DALHOUSIE UNIVERSITY

Rockwood K et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173:489–495.

FRAILTY IN DIALYSIS PATIENTS

CLINICAL EPIDEMIOLOGY www.jasn.org

Significance of Frailty among Dialysis Patients

Kirsten L. Johansen,*†‡ Glenn M. Chertow,†‡ Chengshi Jin,‡ and Nancy G. Kutner§

*Nephrology Section, San Francisco VA Medical Center, †Division of Nephrology, University of California, San Francisco, and ‡Department of Epidemiology and Biostatistics, University of California, San Francisco, San Francisco, California; and §Department of Rehabilitation Medicine, Emory University, Atlanta, Georgia

J Am Soc Nephrol 18: 2960–2967, 2007.

Dialysis Morbidity and Mortality Study (DMMS) Wave 2, 1996-1997: n=2275
Incident dialysis representative of US dialysis population
PD over-represented
One-year follow-up (death and hospitalization)

Table 1. Baseline characteristics by availability of frailty criteria

Variable	Complete Data (n = 2275)
Age (yr; mean ± SD)	58.2 ± 15.5
Gender (% male)	53.4
Race (%)	
white	65.4
black	26.5
Asian	2.3
other	5.8
Serum albumin (mg/dl; mean ± SD)[b]	3.5 ± 0.6
BMI (kg/m^2; mean ± SD)	25.8 ± 5.8
Peritoneal dialysis (%)	48.1
Comorbidity (%)	
diabetes	47.6
CAD	31.4
cerebrovascular disease	8.7
peripheral vascular disease	15.3
cancer	8.4
Current smoker (%)	13.9
Married (%)	56.4
Employed (%)	13.8
High school graduate (%)	69.8
Medicaid (%)	26.8

[a]BMI, body mass index; CAD, coronary artery disease.
[b]To convert mg/dl to g/L, multiply by 10.

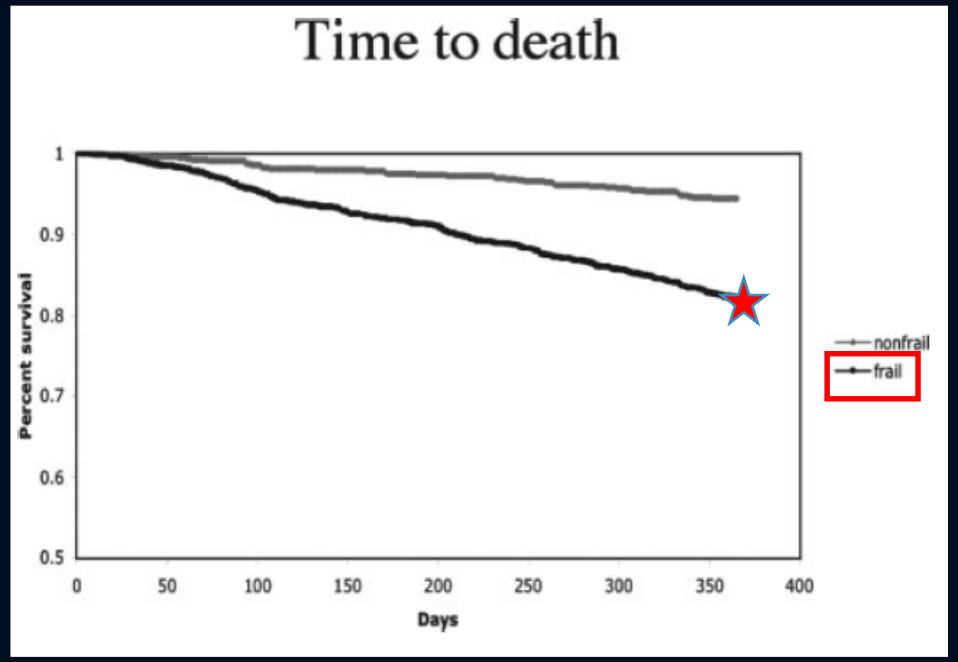
Table 2. Proportion of patients overall and by age meeting individual and collective criteria for frailty

Patients	n	Frail
Overall	2275	67.7
Age (yr)		
<40	306	44.4
40 to 50	352	61.1
50 to 60	440	66.4
60 to 70	570	74.2
70 to 80	475	78.1
>80	132	78.8

Table 3. Predictors of frailty[a]

Variable	OR	95% CI
Age	1.02	1.01 to 1.03
Female gender	1.55	1.27 to 1.88
Race		
white	1.0 (referent)	
black	0.90	0.72 to 1.13
Asian	0.56	0.30 to 1.05
other	1.01	0.26 to 3.92
BMI (kg/m^2)		
<19	1.41	0.93 to 2.13
19 to <25	1.0 (referent)	
25 to <30	0.98	0.78 to 1.22
≥30	1.00	0.77 to 1.30
Serum albumin concentration (g/dl)		
<3.2	1.89	1.43 to 2.49
3.2 to <3.5	1.32	1.00 to 1.76
3.5 to <3.9	1.06	0.84 to 1.35
≥3.9	1.0 (referent)	
Dialysis modality (PD)	0.80	0.65 to 0.97
Comorbidity		
diabetes	1.35	1.10 to 1.65
CAD	1.17	0.92 to 1.48
PAOD	1.19	0.88 to 1.60
CVA	1.55	1.05 to 2.29
cancer	1.39	0.95 to 2.04

[a]CVA, cerebrovascular accident; PAOD, peripheral arterial occlusive disease; PD, peritoneal dialysis.



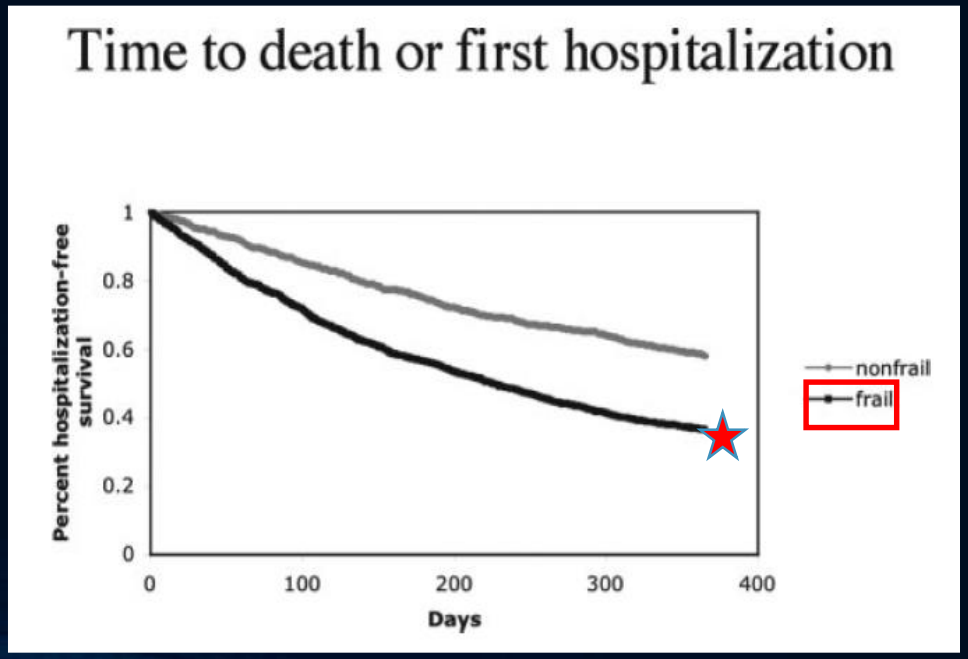


Table 4. Multivariable analysis of the association of frailty with 1-yr mortality

Variable	HR (95% CI)
Frailty	2.24 (1.60 to 3.15)
Age	1.03 (1.02 to 1.04)
Female gender	1.09 (0.86 to 1.38)
Race	
white	1.0 (referent)
black	1.01 (0.75 to 1.36)
Asian	0.91 (0.40 to 2.06)
other	0.84 (0.12 to 6.02)
Hispanic	1.20 (0.82 to 1.78)
BMI (kg/m^2)	
<19	1.11 (0.78 to 1.58)
19 to <25	1.0 (referent)
25 to <30	0.62 (0.46 to 0.82)
≥30	0.57 (0.40 to 0.81)
Serum albumin concentration (g/dl)[a]	
<3.2	1.83 (1.30 to 2.59)
3.2 to <3.5	1.09 (0.74 to 1.59)
3.5 to <3.9	1.04 (0.73 to 1.49)
≥	1.0 (referent)
Dialysis modality (PD)	1.03 (0.81 to 1. 31)
Comorbidity	
diabetes	1.10 (0.86 to 1.41)
CAD	1.36 (1.07 to 1.73)
peripheral vascular disease	1.55 (1.19 to 2.00)
CVA	1.13 (0.81 to 1.56)
cancer	1.26 (0.90 to 1.76)
Employment status	0.47 (0.25 to 0.87)
Marital status	0.86 (0.68 to 1.09)
Smoking	1.25 (0.88 to 1.77)

[a]To convert mg/dl to g/L, multiply by 10.

Components of Frailty	CHS N=5888, >65 years	WHI Woods et al	USRDS DMMS Wave 2
Slowness/ weakness	Slowness: Slowest quintile on a 15-ft walk test, stratified by gender and height Weakness: Weakest quintile in grip strength measured by handheld dynamometer, stratified by gender and BMI quartiles	Rand-36 PF <75. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much? Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf Lifting or carrying groceries Climbing several flights of stairs Climbing one flight of stairs Bending, kneeling, or stooping Walking more than a mile Walking several blocks Walking one block Bathing or dressing yourself	Rand-36 PF <75 =2points
Poor endurance/ exhaustion	Based on two questions from the CES-D Depression Scale: a. I felt that everything I did was an effort. b. I could not get going. How often in the last week did you feel this way? 0 = rarely or none of the time (<1 d) 1 = some or a little of the time (1 to 2 d) 2 = a moderate amount of the time (3 to 4 d) 3 = most of the time. Individuals answering 2 or 3 to either of these questions were categorized as meeting the exhaustion criterion.	Rand-36 Vitality <55 How much of the time during the last 30 d. . . Did you feel worn out? Did you feel tired? Did you have a lot of energy? Did you feel full of pep?	Rand-36 Vitality <55
Physical inactivity	Based on the short version of the Minnesota Leisure Time Activity questionnaire. The lowest quintile of activity stratified by gender was considered inactive.	Detailed physical activity questionnaire assessing frequency and duration of walking and mild, moderate, and strenuous activities. Kcal of weekly energy expenditure was calculated, and those in the lowest quartile were scored positive for inactivity.	How often do you *exercise* (do physical activity during your leisure time)? Daily or almost daily 4 to 5 times a week 2 to 3 times a week About once a week Less than once a week Almost never or never Individuals answering "almost never or never" were classified as inactive.
Unintentional weight loss	"In the last year, have you lost more than 10 pounds unintentionally (*i.e.*, not due to dieting or exercise)?" Individuals who responded "yes" met the weight loss criterion.	No measure was available at baseline. At follow-up, measured weight loss or subject-reported weight loss was used.	Undernourished or cachectic (malnourished), as assessed by data abstractor

Retrospective analysis
Cohort relatively young
Questionnaires (QoL, SF36)="self-reported" frailty

« Self-reported » versus « measured » frailty

Hemodialysis International 2013; 17:41–49

A closer look at frailty in ESRD: Getting the measure right

Patricia PAINTER,[1] Michael KUSKOWSKI[2]

[1]*Department of Physical Therapy, University of Utah, Salt Lake City, Utah, USA;* [2] *Geriatric Research Education and Clinical Center (GRECC), Minneapolis VA Medical Center, Minneapolis, Minnesota, USA*

N=188 prevalent home dialysis
Frailty measured: 33,7%
Frailty self-reported: 78,2%

AJKD

Am J Kidney Dis. 2014 Oct;64(4):600-7.

Original Investigation

Comparison of Self-report–Based and Physical Performance–Based Frailty Definitions Among Patients Receiving Maintenance Hemodialysis

Kirsten L. Johansen, MD,[1,2,3,4] Lorien S. Dalrymple, MD, MPH,[1,5] Cynthia Delgado, MD,[1,2,3] George A. Kaysen, MD, PhD,[1,5] John Kornak, PhD,[1,4] Barbara Grimes, PhD,[1,4] and Glenn M. Chertow, MD, MPH[1,6]

ACTIVE/ADIPOSE study
N=731 prevalent hemodialysis
Frailty measured: 29%
Frailty self-reported: 53%
Only 3% of frail when measured are not self-reported frail

Salter *et al. BMC Geriatrics* (2015) 15:52
DOI 10.1186/s12877-015-0051-y

BMC Geriatrics

RESEARCH ARTICLE Open Access

Perceived frailty and measured frailty among adults undergoing hemodialysis: a cross-sectional analysis

Megan L Salter[1,2,3*†], Natasha Gupta[3†], Allan B Massie[1,3], Mara A McAdams-DeMarco[1,3], Andrew H Law[1,3], Reside Lorie Jacob[5], Luis F Gimenez[6], Bernard G Jaar[1,4,6,7], Jeremy D Walston[2,8,9] and Dorry L Segev[1,3*]

N=146 prevalent hemodialysis
Very poor concordance between measured frailty, self-reported frailty (κ =0,07)and frailty estimated by nurses (κ =0,27) or nephrologists (κ =0,24) (especially in the elderly)

ORIGINAL RESEARCH

J Ren Nutr. 2013 Sep;23(5):356-62.

Association of Frailty With Body Composition Among Patients on Hemodialysis

Cynthia Delgado, MD, Julie W. Doyle, MS, and Kirsten L. Johansen, MD

N=80 prevalent hemodialysis
Frailty measured: 59%
Frailty self-reported: 63%
Frail by both: 55%

Archives of Gerontology and Geriatrics 68 (2017) 135–142

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Review

Frailty and chronic kidney disease: A systematic review

Rakin Chowdhury*, Nancye M. Peel, Mitchell Krosch, Ruth E. Hubbard

Centre for Research in Geriatric Medicine, The University of Queensland, Brisbane, Queensland, Australia

Table 2
Dialysis Patients.

Study	Study Characteristics	Study Population	Primary Outcome	Study Design	EAI	Frailty Assessment	Prevalence of frailty
Bao et al. (2012)	N= 1576 %female = 45 Mean age= 59.6 years	Comprehensive Dialysis Study HD% = 89.3 *USA*	Frailty prevalence dialysis cohort. GFR at dialysis initiation and its relationship with frailty	Secondary analysis of an established cohort	1.62	Modified Fried	73%
McAdams-DeMarco et al. (2013a)	N= 146 %female = 47 Mean age= 61 years (+/− 13.6)	Single haemodialysis centre HD% = 100 *USA*	Prevalence of frailty and outcome assessment	Primary prospective study	1.67	Fried	41.8%
Delgado et al. (2013)	N= 80 %female = 37 Mean age= 55 years (+/− 13)	Nandrolone and Exercise Study HD% = 100 *USA*	A comparison of function based frailty assessment and performance based tests. Body composition and frailty status.	Secondary analysis of an established cohort	1.19	Modified Fried: Performance based and Function Based Criteria	59% (performance based)
Painter and Kuskowski (2013)	N= 188 %female = 56 Mean age= 54.4 (+/− 16) years	Renal Exercise Demonstration Study HD% = 100 *USA*	Analysis of two methods of applying the Fried phenotype for frailty: questionnaire based physical function vs measurement	Secondary analysis of an established cohort	1.81	Fried	24% (measured physical function)
Johansen et al. (2007)	N= 2275 %female = 47 Mean age= 58 years (+/− 16)	Dialysis Morbidity/ Mortality Study HD% = 51.9 *USA*	Investigation of the prevalence and predictors of frailty amongst dialysis patients and correlation with adverse health outcomes. Prospective cohort study	Secondary analysis of an established cohort	1.71	Modified Fried	68%
Kutner et al. (2014)	N= 742 %female = 40.6 Mean age= 57 years (+/− 14.1)	ACTIVE/ADIPOSE Study HD% = 100 *USA*	Frailty and its association with ADL difficulties	Secondary analysis of an established cohort	1.71	Fried	14%
McAdams-DeMarco et al. (2013b)	N= 95 %female = 46 Mean age= 61 years (+/− 12.6)	Single dialysis centre HD% = 100 *USA*	Association of frailty with risk of falls in patients with ESKD	Primary prospective study	1.71	Fried	46.3%
Orlandi and Gesualdo (2014)	N= 60 %female = 30 Mean age= 71 years (+/− 6.9)	Single dialysis centre HD% = 100 *Brazil*	Assessment of frailty in elderly patients undergoing dialysis	Primary prospective study	1.10	Edmonton Frailty scale	38%
Salter, Gupta, & Massie (2015)	N= 146 %female = 46.6 Mean age= 61 years	Single dialysis centre HD% = 100 *USA*	Comparison between measured frailty and clinician perceived frailty	Primary prospective study	1.71	Fried	41.7%
Chao, Hsu, & Chang (2015)	N= 46 %female = 53 Mean age= 67.3 (+/− 11.9) years	Single dialysis centre HD% = 100 *Taiwan*	Exploring frailty in a rural dialysis centre in Taipei and comparison between different self-reported measures of Frailty.	Primary prospective study	1.52	FRAIL scale amongst others.	19.6%
Alfaadhel et al. (2015)	N= 390 %female = 33 Mean age= 63 years (+/− 15)	Single dialysis centre HD% = 100 *USA*	Assessed whether the clinicians perception of frailty correlated with outcomes in a population of patients on dialysis.	Primary prospective study	1.81	Clinical frailty scale	26%
Iyasere, Brown, & Johansson (2016)	N= 251 %female = 40.7 Median age = 76 (70-81 years IQR)	Single Dialysis Centre HD% = 48.6 *UK*	Comparison of frailty and quality of life between patients on haemodialysis with those on peritoneal dialysis. Cross sectional analysis	Primary prospective study	1.57	Clinical frailty scale	47.4% (overall)
McAdams-DeMarco, Tan, & Salter (2015)	N= 324 %female = 43.5 Mean age= 54.8 years (+/− 13.3)	Predictors of arrhythmic and cardiovascular risk in ESKD Study. HD% = 100 *USA*	Investigated the relationship between frailty and cognition both at base line and at one year of follow up. Prospective cohort study	Secondary analysis of an established cohort	1.76	Fried	34%
Drost, Kalf, Vogtlander, & van Munster (2016)	N= 95 %female = 43 Mean age= 65.2 years (+/− 12)	Single dialysis centre HD% = 44 *Netherlands*	Comparison between prevalence of frailty assessed using the frailty index versus the Fried Frailty Phenotype. Cross sectional analysis	Primary prospective Study	1.76	Fried and Frailty Index	36.8% (measured using FI)

N=14

14 to 73%

RENAL FAILURE
2019, VOL. 41, NO. 1, 567–575
https://doi.org/10.1080/0886022X.2019.1628061

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CLINICAL STUDY

OPEN ACCESS Check for updates

Frailty in hemodialysis and prediction of poor short-term outcome: mortality, hospitalization and visits to hospital emergency services

Cesar Garcia-Canton[a,b], Ana Rodenas[a], Celia Lopez-Aperador[b], Yaiza Rivero[a], Gloria Anton[c], Tania Monzon[c], Noa Diaz[a], Nicanor Vega[d], Juan F. Loro[b], Angelo Santana[e] and Noemi Esparza[a]

[a]Department of Nephrology, Insular University Hospital of Gran Canaria, Gran Canaria, Spain; [b]Faculty of Health Sciences, University of Las Palmas de Gran Canaria, Gran Canaria, Spain; [c]Avericum Dialysis Center, Gran Canaria, Spain; [d]Department of Nephrology, University Hospital of Gran Canaria Dr Negrin, Las Palmas, Spain; [e]Faculty of Mathematics, University of Las Palmas de Gran Canaria, Gran Canaria, Spain

- Spain
- N=277, prevalent dialysis patients, median age 65 years

RENAL FAILURE
2019, VOL. 41, NO. 1, 567–575
https://doi.org/10.1080/0886022X.2019.1628061

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CLINICAL STUDY

OPEN ACCESS Check for updates

Frailty in hemodialysis and prediction of poor short-term outcome:

al emergency services

Yaiza Rivero[a]
Noemi Espa
Canaria, Spain; E
ran Canaria, Spa
Mathematics, Uni

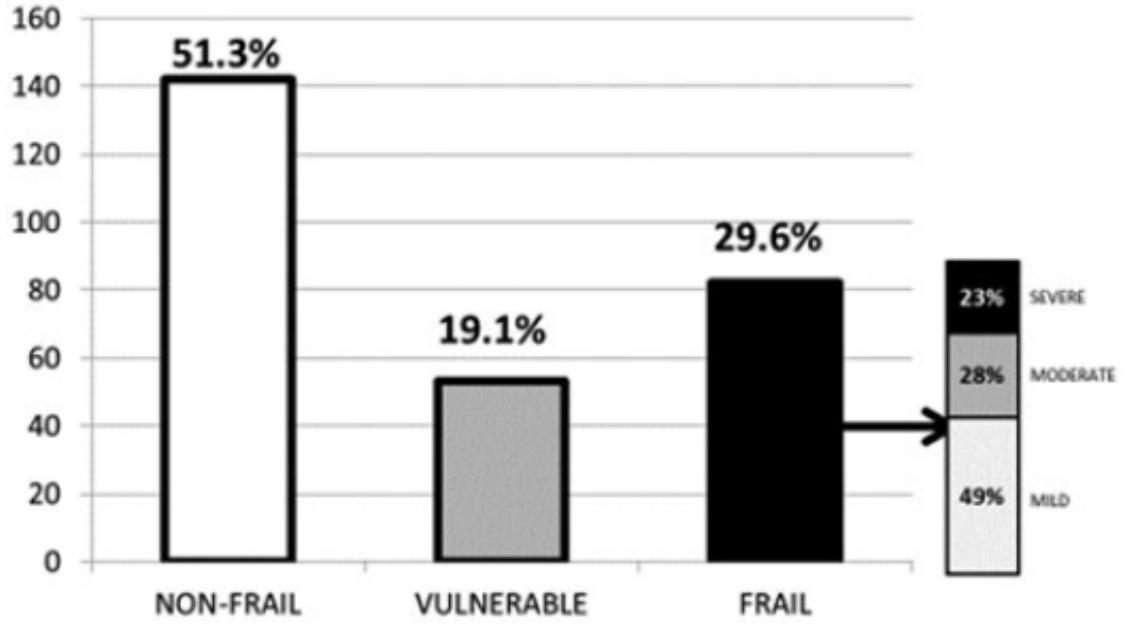

Figure 1. Prevalence of frailty among our hemodialysis population according to the Edmonton Frail Scale (EFS)

median a

Questionnaire

Demographics:
Patient chart no:
Date of birth:
Male/Female:

Cancer diagnosis:
Stage:
Treatment (Gy/Fr, Chemotherapy):
Previous radiotherapy/chemotherapy:

Marital status:
Single / Married / long term partnership / Widowed / Divorced or separated

Occupation:
Retired Self employed Employed full-time Employed part-time Unemployed
Care for grandchildren regularly Other_____

Edmonton Frail Scale

FRAILTY DOMAIN	ITEM	0 POINT	1 POINT	2 POINTS
Cognition (clock test)	Please imagine that this pre-drawn circle is a clock. I would like you to place the numbers in the correct positions then place the hands to indicate a time of 'ten after eleven'.	No errors	Minor spacing errors	Other errors
General health status	In the past year, how many times have you been admitted to a hospital?	0	1-2	>2
	In general, how would you describe your health?	Excellent Very good Good	Fair	Poor
Functional independence	With how many of the following activities do you require help? (Meal preparation, shopping, transportation, telephone, housekeeping, laundry, managing money, taking medications)	0-1	2-4	5-8
Social support	When you need help, can you count on someone who is willing and able to meet your needs?	Always	Sometimes	Never
Medication use	Do you use five or more different prescription medications on a regular basis?	No	Yes	
	At times, do you forget to take your prescription medications?	No	Yes	
Nutrition	Have you recently lost weight such that your clothing has become looser?	No	Yes	
Mood	Do you often feel sad or depressed?	No	Yes	
Continence	Do you have a problem with losing control of urine when you don't want to?	No	Yes	
Functional performance	I would like you to sit in this chair with your back and arms resting. Then, when I say 'GO', please stand up and walk at a safe and comfortable pace to the mark on the floor (approx. 3m away), return to the chair and sit down.	0-10 sec	11-20 sec	>20 sec Patient unwilling Requires assistance
TOTAL				

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CLINICAL STUDY

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Frailty in hemodialysis and prediction of poor short-term outcome:

al emergency services

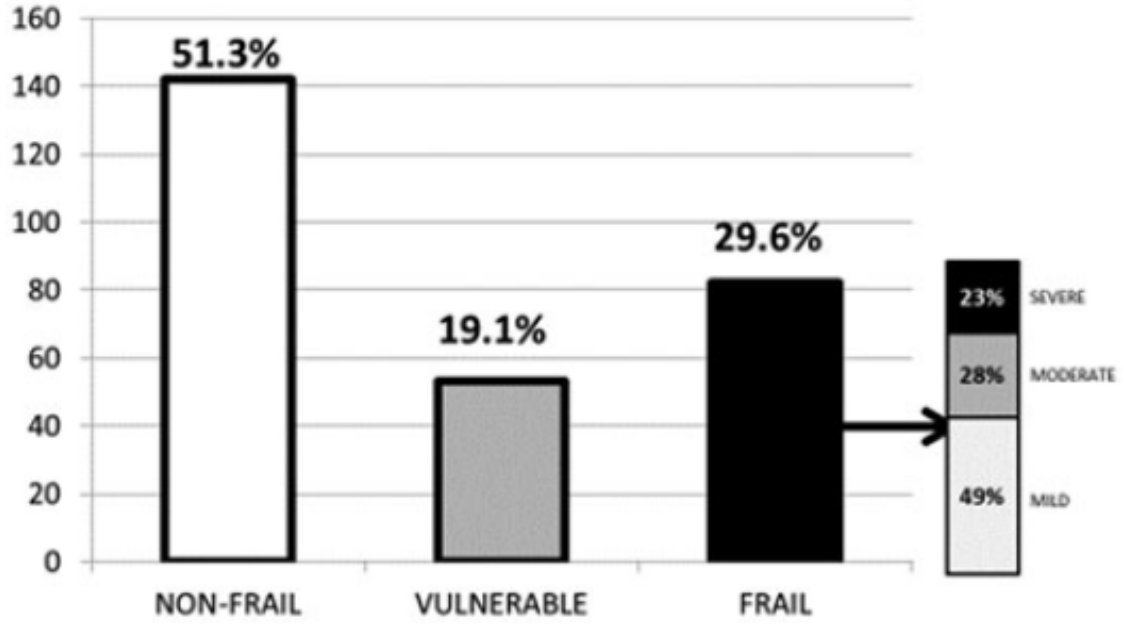
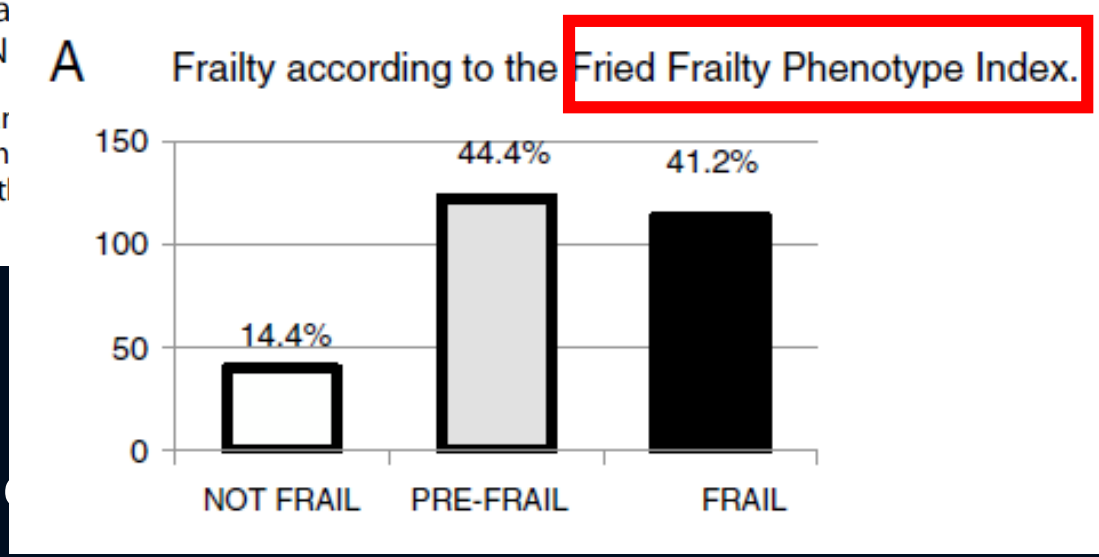


Figure 1. Prevalence of frailty among our hemodialysis population according to the Edmonton Frail Scale (EFS)



Clinical Kidney Journal, 2022, vol. 15, no. 1, 145–152

doi: 10.1093/ckj/sfab137
Advance Access Publication Date: 16 July 2021
Original Article

ORIGINAL ARTICLE

Correlations, agreement and utility of frailty instruments in prevalent haemodialysis patients: baseline cohort data from the FITNESS study

Benjamin M. Anderson [1,2], Muhammad Qasim[1,3], Gonzalo Correa[4], Felicity Evison[5], Suzy Gallier[5,6], Charles J. Ferro [1,7], Thomas A. Jackson [2,8] and Adnan Sharif [1,3]

- 485 hemodialysis patients in UK, median age 63 years
- Frailty phenotype, Frailty index, Edmonton Clinical Frailty, Clinical Frailty Score

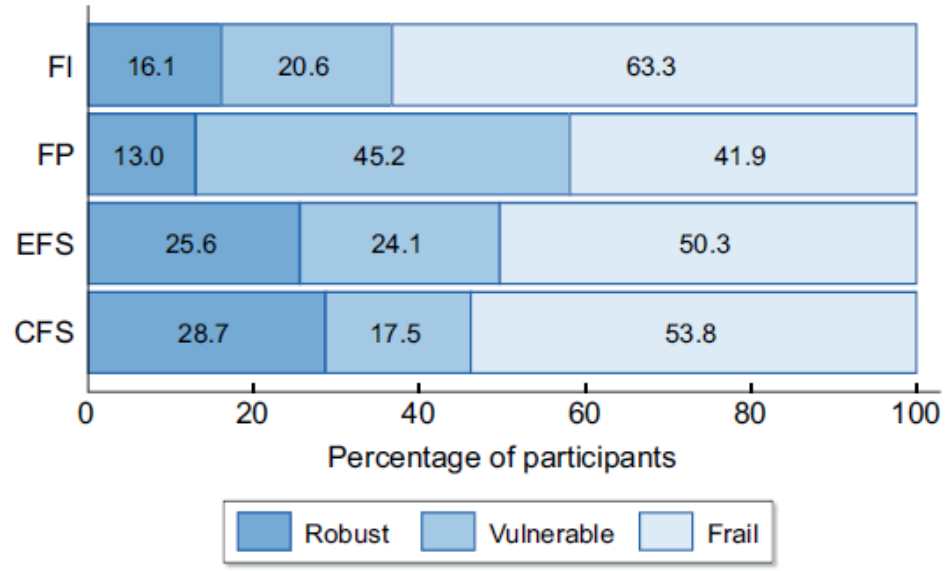


FIGURE 2: Percentage of participants classified as robust, vulnerable or frail by different frailty instruments: FI, FP, EFS and CFS.

The intraclass correlation coefficient across the scores was 0.628 (95% CI 0.585–0.669) = Weak agreement

Prevalence of frailty in CHU Liège n = 108 (unpublished data)

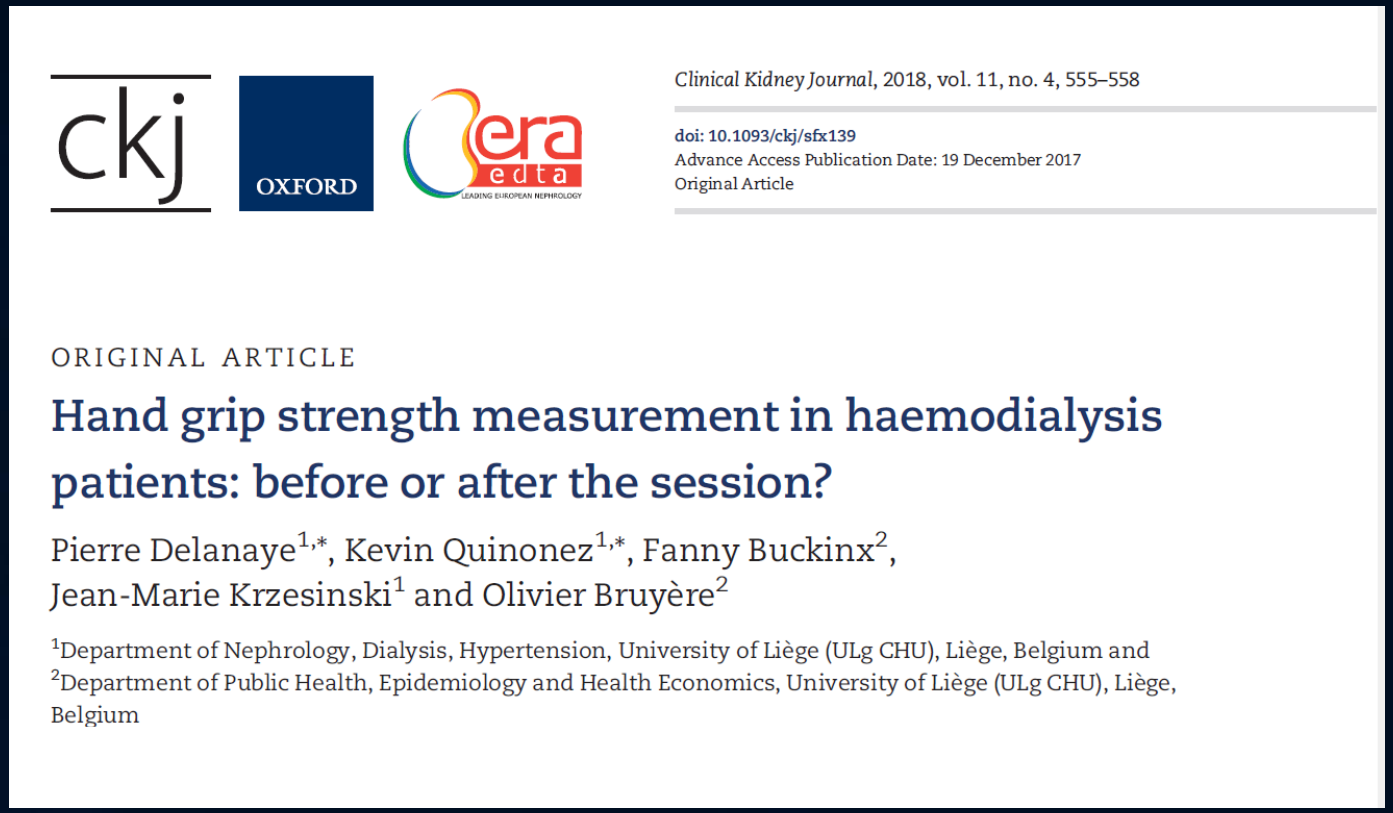
n =108	Hommes : n=71	Femmes : n=37
% de Fragiles	38/71 (53%)	23/37 (62%)
Fragiles à 3 critères / 5	20%	16%
Fragiles à 4 critères / 5	23%	35%
Fragiles à 5 critères / 5	11%	11%
Fragiles de moins de 50 ans	5/31 (16%)	
Fragiles de plus de 50 ans	58/77 (75%)	
Fragiles de plus de 60 ans	51/64 (80%)	
Fragiles de plus de 70 ans	29/34 (84%)	

Tableau 3 : Prévalence de patients fragiles, ventilation sur la base du genre, de l'âge et du score obtenu selon les critères de Fried.

56%

66% of men
Age: 64 [28] y
BMI: 24 [7] kg/m²

Even considering the "true" Fried criteria, the methodology is important



ckj OXFORD era edta

Clinical Kidney Journal, 2018, vol. 11, no. 4, 555–558

doi: 10.1093/ckj/sfx139
Advance Access Publication Date: 19 December 2017
Original Article

ORIGINAL ARTICLE

Hand grip strength measurement in haemodialysis patients: before or after the session?

Pierre Delanaye[1,*], Kevin Quinonez[1,*], Fanny Buckinx[2], Jean-Marie Krzesinski[1] and Olivier Bruyère[2]

[1]Department of Nephrology, Dialysis, Hypertension, University of Liège (ULg CHU), Liège, Belgium and [2]Department of Public Health, Epidemiology and Health Economics, University of Liège (ULg CHU), Liège, Belgium

- 101 prevalent hemodialysis patients, 64% men, median age (66 years)
- HGS measured before and after dialysis session
- Measurements repeated three times with an interval of 5 s between measurements and the higher value used for analysis

Table 2. HGS results in the global population and according to gender

	Median (P25; P75) HGS (kg) before dialysis	Median (P25; P75) HGS (kg) after dialysis	P-values (before and after dialysis) (Wilcoxon test)	Percentage decrease in HGS
All ($n = 101$)	28 (20–38.5)	24 (16–36)	<0.0001	41
Men ($n = 65$)	34 (24–40.5)	30 (20–40)	<0.0001	42
Women ($n = 36$)	20 (14–26)	18 (12–22)	<0.0001	39

HGS results are significantly lower in women. All results after dialysis were significantly lower than results before dialysis. P25 and P75 for 25th and 75th percentiles, respectively.

Table 3. Absolute and relative differences between HGS according to gender and baseline HGS (low versus normal)

	Absolute median (P25; P75) difference of HGS before and after dialysis	Relative median (P25; P75) difference of HGS before and after dialysis (%)	P-values (before and after dialysis) (Wilcoxon test)
All ($n = 101$)	−4 (0; −6)	−11 (0; −20)	<0.0001
Men ($n = 65$)	−4 (0; −6)	−9 (0; −17)	<0.0001
Women ($n = 36$)	−2 (1; −4)	−14 (−3; −23)	<0.0001
Low baseline results ($n = 41$)	−2 (0; −4)	−14 (0; −22)	<0.0001
Normal baseline results ($n = 60$)	−4 (0; −6)	−10 (0; −17)	<0.0001

P25 and P75 for 25th and 75th percentiles, respectively.

-4

« Low » values: from 41 to 54 % (p=0,001)

Frailty as a risk factor (independent of age) for mortality, hospitalisation, falls is confirmed

Frailty, Dialysis Initiation, and Mortality in End-Stage Renal Disease

Yeran Bao, MD; Lorien Dalrymple, MD, MPH; Glenn M. Chertow, MD, MPH; George A. Kaysen, MD, PhD; Kirsten L. Johansen, MD

Arch Intern Med. 2012;172(14):1071-1077.

Frailty as a Novel Predictor of Mortality and Hospitalization in Individuals of All Ages Undergoing Hemodialysis

Mara A. McAdams-DeMarco, PhD,*† Andrew Law, ScM,*† Megan L. Salter, PhD,*† Brian Boyarsky, BA,* Luis Gimenez, MD,‡§¶ Bernard G. Jaar, MD, MPH,†‡§¶ Jeremy D. Walston, MD,** and Dorry L. Segev, PhD, MD*†

J Am Geriatr Soc 61:896–901, 2013.

Frailty and Cognitive Function in Incident Hemodialysis Patients

Mara A. McAdams-DeMarco,*† Jingwen Tan,* Megan L. Salter,*† Alden Gross,* Lucy A. Meoni,‡§ Bernard G. Jaar,*§‖ Wen-Hong Linda Kao,*a Rulan S. Parekh,§¶** Dorry L. Segev,*† and Stephen M. Sozio§

Clin J Am Soc Nephrol 10: 2181–2189, 2015.

ORIGINAL RESEARCH

The Prevalence, Association, and Clinical Outcomes of Frailty in Maintenance Dialysis Patients

So-Young Lee, MD, PhD,* Dong Ho Yang, MD, PhD,* Eunah Hwang, MD, PhD,† Seock Hui Kang, MD, PhD,‡ Sun-Hee Park, MD, PhD,§ Tae Woo Kim, MD, PhD,¶ Duk Hyun Lee, MD, PhD,** Kisoo Park, MD, PhD,†† and Jun Chul Kim, MD, PhD‡‡

Journal of Renal Nutrition, Vol 27, No 2 (March), 2017: pp 106-112

McAdams-DeMarco et al. BMC Nephrology 2013, 14:224
http://www.biomedcentral.com/1471-2369/14/224

BMC Nephrology

RESEARCH ARTICLE Open Access

Frailty and falls among adult patients undergoing chronic hemodialysis: a prospective cohort study

Mara A McAdams-DeMarco[1,2], Sunitha Suresh[3], Andrew Law[1,2], Megan L Salter[1,2], Luis F Gimenez[4,5,6], Bernard G Jaar[2,4,5,6], Jeremy D Walston[7] and Dorry L Segev[1,2,8*]

Archives of Gerontology and Geriatrics 101 (2022) 104673
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journal homepage: www.elsevier.com/locate/archger

Frailty index and adverse outcomes in older patients in haemodialysis.

Anna Soldati[a,#], Marta Maria Poggi[a,#], Domenico Azzolino[b,c,*], Simone Vettoretti[d], Matteo Cesari[a,b]

[a] Specialization School in Geriatrics, University of Milan, Italy
[b] Department of Clinical and Community Sciences, University of Milan, Milan, Italy
[c] Geriatric Unit, IRCCS Istituti Clinici Scientifici Maugeri, Milan, Italy
[d] Unit of Nephrology, Dialysis and Kidney Transplantation, Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico di Milano, Italy

Frailty and Mortality in Dialysis: Evaluation of a Clinical Frailty Scale

Talal A. Alfaadhel,* Steven D. Soroka,* Bryce A. Kiberd,* David Landry,* Paige Moorhouse,† and Karthik K. Tennankore*

Clin J Am Soc Nephrol 10: 832–840, 2015

Canadian Society of Nephrology/Société canadienne de néphrologie
CANADIAN JOURNAL OF KIDNEY HEALTH AND DISEASE

Original Clinical Research Quantitative

Frailty Severity and Hospitalization After Dialysis Initiation

David Clark[1], Kara Matheson[1], Benjamin West[2], Amanda Vinson[1], Kenneth West[1], Arsh Jain[3],

Canadian Journal of Kidney Health and Disease
Volume 8: 1–11
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DOI: 10.1177/20543581211023330
journals.sagepub.com/home/cjk
SAGE

Clinical Interventions in Aging
Dovepress
open access to scientific and medical research
Open Access Full Text Article
ORIGINAL RESEARCH

Frailty in Older Patients Undergoing Hemodialysis and Its Association with All-Cause Mortality: A Prospective Cohort Study

Yidan Guo[1], Ru Tian[1], Pengpeng Ye[2], Yang Luo[1]

Nephrol Dial Transplant (2016) 31: 2041–2048
doi: 10.1093/ndt/gfw074
Advance Access publication 21 April 2016

Factors influencing withdrawal from dialysis: a national registry study

Comparison of the association between six different frailty scales and clinical events in patients on hemodialysis

Background

Frailty is highly prevalent in patients who require hemodialysis (HD) therapy and is associated with an increased risk of adverse health outcomes.

Few studies have compared the relationship between various frailty scales and prognosis in patients undergoing HD therapy.

Methods

Two hemodialysis clinics in Japan (n = 315) 68 y

Frailty scales:

Combined assessment (objective + questionnaire)

Objective assessment

Questionnaire-based assessment

Medical staff impression assessment

Outcomes:

Death +

Hospitalization +

Fracture

Results

	Prevalence	Outcomes (incidence rate ratio)
Fried Frailty Phenotype	24.1%	**1.62 (1.49–1.76)**
Study of Osteoporotic Fractures Index	14.6%	**1.42 (1.10–1.83)**
Short Physical Performance Battery	29.2%	**1.79 (1.11–2.88)**
Frail Screening Index	33.7%	1.38 (0.60–3.18)
FRAIL scale	27.6%	1.30 (0.88–1.92)
Clinical Frailty Scale	17.8%	**1.65 (1.04–2.61)**

K between 0,24-0,58

Conclusion

Objective assessments and medical staff impression assessment may be useful prognostic predictors for patients on HD. Questionnaire-based assessment should be carefully considered when used as a measurement of frailty.

ERA NDT NEPHROLOGY DIALYSIS TRANSPLANTATION

Imamura, K. et al. NDT (2022)
@NDTSocial

Comparison of the association between six different frailty scales and clinical events in patients on hemodialysis

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ERA NDT NEPHROLOGY DIALYSIS TRANSPLANTATION

Imamura, K. et al. NDT (2022)
@NDTSocial

Standardization

- In the definition (FRIED)
- Objecitve measurements (strict adherence to FRIED criteria) are probably better than self-reported
- Standardization of the measurement

What about guidelines?

KDOQI
KIDNEY DISEASE OUTCOMES QUALITY INITIATIVE
National Kidney Foundation

eat right® Academy of Nutrition and Dietetics

KDOQI CLINICAL PRACTICE GUIDELINE FOR NUTRITION IN CKD: 2020 UPDATE

T. Alp Ikizler, Jerrilynn D. Burrowes, Laura D. Byham-Gray, Katrina L. Campbell, Juan-Jesus Carrero, Winnie Chan, Denis Fouque, Allon N. Friedman, Sana Ghaddar, D. Jordi Goldstein-Fuchs, George A. Kaysen, Joel D. Kopple, Daniel Teta, Angela Yee-Moon Wang, and Lilian Cuppari

1.3 Statement on Handgrip Strength

1.3.1 In adults with CKD 1-5D, we suggest that handgrip strength may be used as an indicator of protein-energy status and functional status when baseline data (prior measures) are available for comparison (*2B*).

Nephrol Dial Transplant (2016) 31: ii1–ii66
doi: 10.1093/ndt/gfw356

ndt Nephrology Dialysis Transplantation

Clinical Practice Guideline

Clinical Practice Guideline on management of older patients with chronic kidney disease stage 3b or higher (eGFR <45 mL/min/1.73 m^2)

Ken Farrington, Adrian Covic, Fillipo Aucella, Naomi Clyne, Leen de Vos, Andrew Findlay, Denis Fouque, Tomasz Grodzicki, Osasuyi Iyasere, Kitty J. Jager, Hanneke Joosten, Juan Florencio Macias, Andrew Mooney, Dorothea Nitsch, Marijke Stryckers, Maarten Taal, James Tattersall, Dieneke Van Asselt, Nele Van den Noortgate, Ionut Nistor and Wim Van Biesen for the ERBP guideline development group

Q4a: What is the best alternative method to assess functional decline in older and/or frail patients with advanced CKD

4a.1 We recommend a simple score be used on a regular basis to assess functional status in older patients with CKD stage 3b–5d) with the intention to identify those who would benefit from a more in-depth geriatric assessment and rehabilitation (1C).

4a.2 We recommend most simple scores, including self-report scales and field tests ([sit-to-stand (STS), gait speed or 6-min walk test] have comparable and sufficient discriminating power to identify patients with decreased functional status (1C).

PERSPECTIVES

- Standardization of the definition (and of the measurements)
- Role of biomarkers to detect frailty?

ORIGINAL RESEARCH

Myostatin and Insulin-Like Growth Factor 1 Are Biomarkers of Muscle Strength, Muscle Mass, and Mortality in Patients on Hemodialysis

Pierre Delanaye, MD, PhD,[*,1] *Stanislas Bataille, MD,*[†,‡,§,1] *Kevin Quinonez, MD,*[*] *Fanny Buckinx, PhD,*[¶] *Xavier Warling, MD, PhD,*[**] *Jean-Marie Krzesinski, MD, PhD,*[*] *Hans Pottel, PhD,*[††] *Stéphane Burtey, MD, PhD,*[†,§] *Olivier Bruyère, PhD,*[¶] *and Etienne Cavalier, EuSpLM, PhD*[‡‡]

Journal of Renal Nutrition, Vol 29, No 6 (November), 2019: pp 511-520

- Two hospitals in Liège (n=123), one in Marseille (n=81)
- HGS
- Muscle by bioimpedance (Marseille)
- One-year mortality

Table 1. Demographics and Biochemistry Description of Cohorts

Variables	Whole (n = 204)	Liège1 (n = 67)	Liège2 (n = 56)	Marseille (n = 81)	*P* Value
Age	71 [58; 81]	65 [46; 77]	70 [58; 77]	77 [69; 85]*	<.0001
Gender (% of men)	60	64	55	60	NS
Residual renal function (>200 mL/day) (%)	69	49	88†	72*	<.0001
Dialysis vintage (months)	29.5 [15.0; 54.5]	24 [14.0; 51.5]	33.5 [18.0; 56.0]	32.0 [13.8; 70.0]	NS
Height (cm)	166 ± 10	168 ± 11	166 ± 10	165 ± 9	NS
Dry weight (kg)	71 ± 16	71 ± 17	73 ± 17	69 ± 15	NS
Dialysis time per session (hour)	4.0 ± 0.4	3.9 ± 0.3	3.8 ± 0.4	4.2 ± 0.5*	<.0001
Hemodiafiltration (%)	50	69	100†	0*	<.0001
Diabetes (%)	42	42	41	42	NS
Bicarbonates (mmol/L)	23.5 ± 3.8	21.3 ± 2.8	22.7 ± 2.8†	26.0 ± 3.7*	<.0001
Hemoglobin (g/dL)	10.9 ± 1.2	10.7 ± 1.2	11.4 ± 1.1*	10.7 ± 1.3	.0038
Calcium (mmol/L)	2.20 ± 0.18	2.22 ± 0.18	2.18 ± 0.19	2.19 ± 0.18	NS
Phosphorus (mmol/L)	1.56 [1.25; 1.92]	1.75 [1.35; 2.06]	1.46 [1.19; 1.92]	1.50 [1.2; 1.7]†	.0169
PTH (multiples of the upper normal limit values)	4.9 [2.6; 8.4]	4.8 [2.6; 7.8]	7.8 [5.6; 11.2]*	3.2 [1.8; 5.8]	<.0001
25OH-vitamin D (ng/mL)	30 [21; 39]	38 [27; 45]	21 [13; 31]*	31 [23; 38]	<.0001
CRP (mg/L)	6 [2; 15]	7 [2; 15]	5 [2; 10]	8 [3; 23]	.0489
Creatinine (mg/dL)	7.51 ± 2.61	8.02 ± 2.82	7.74 ± 2.56	6.92 ± 2.37‡	.0283
Albumin (g/L)	38 [35; 40]	40 [38; 42]*	36 [34; 39]	38 [34; 39]	<.0001
Prealbumin (g/L)	0.28 [0.22; 0.33]	0.30 [0.24; 0.35]	0.28 [0.25; 0.32]	0.26 [0.20; 0.33]†	.0066
Handgrip strength	20 [14; 29]	26 [20; 36]*	21 [16; 29]	17 [12; 24]	<.0001
Handgrip strength (men)	25 [19; 34]	32 [22; 40]	26 [20; 31]	20 [14; 26]	<.0001
Handgrip strength (women)	16 [11; 20]	20 [18; 24]	16 [10; 20]	12 [9; 14]	<.0001
Decreased handgrip strength (%)	67	42	66†	88*	<.0001
Myostatin (pg/mL)	2573 [1662; 3703]	3008 [1978; 4295]	3357 [2184; 4892]	1755* [1163; 2670]	<.0001
IGF-1 (μg/L)	118 [84; 172]	152 [88; 208]	123 [90; 168]	104 [76; 152]†	.002

CRP, C-reactive protein; IGF-1, insulin-like growth factor 1; NS, not significant; PTH, parathyroid hormone.
*If $P < .05$ in comparison with the two other cohorts.
†If $P < .05$ in comparison with Liège1.
‡If $P < .05$ in comparison with Liège2.

Table 2. Pearson Correlations Between Biomarkers and Handgrip Strength in the Exploratory Liège1 Cohort (n = 67)

Biomarkers	Correlation (r) (95% CI)	*P* Values
Activin A	−0.09 (−0.33 to 0.16)	NS
Follistatin	0.007 (−0.23 to 0.25)	NS
PIIINP	0.0008 (−0.23 to 0.25)	NS
IGF-1	0.44 (0.22 to 0.61)	.0002
Myostatin	0.50 (0.30 to 0.66)	<.0001

CI, confidence interval; IGF-1, insulin-like growth factor 1; NS, not significant; PIIINP, procollagen III N-terminal peptide.

N=204

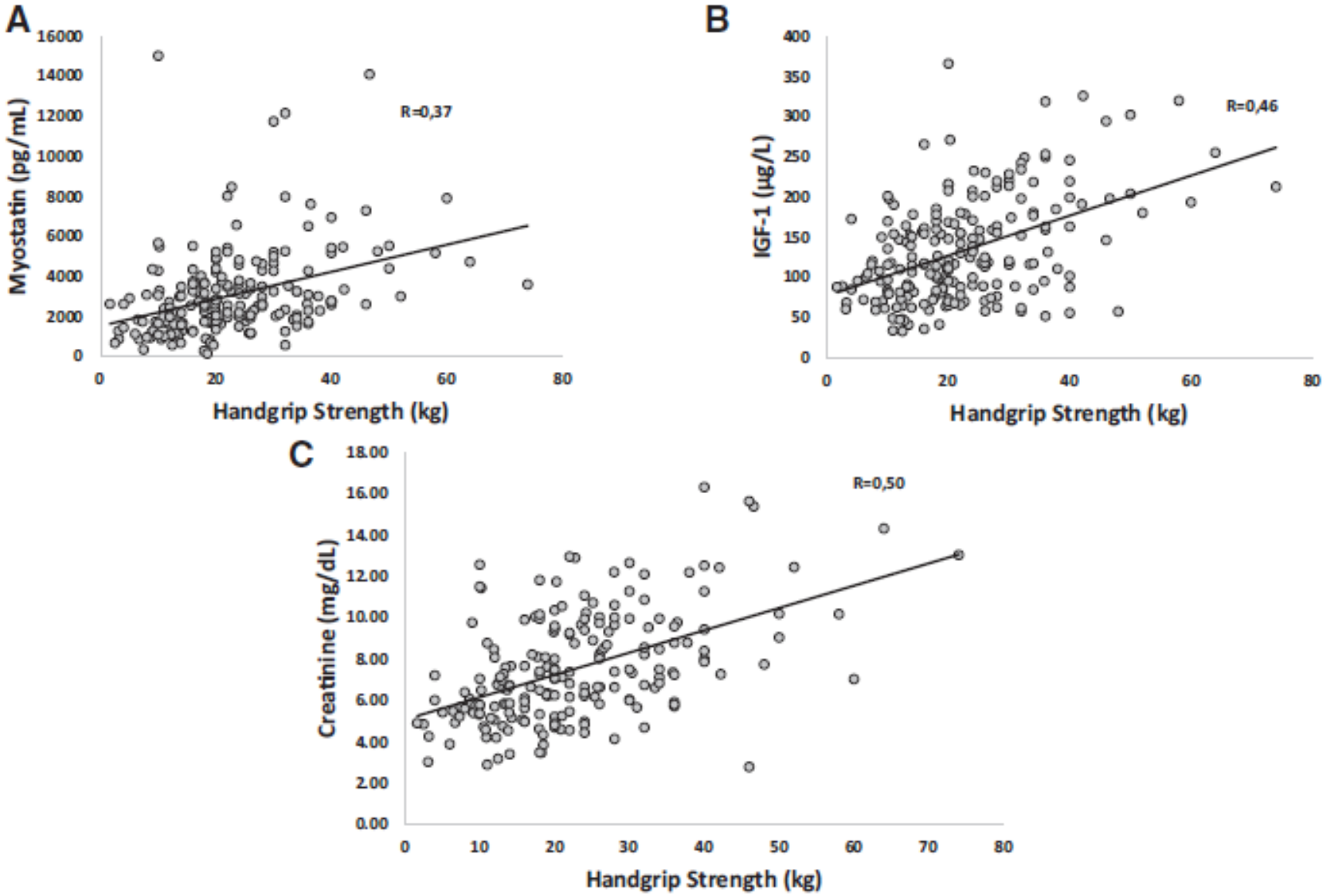


Figure 1. Coefficient of correlation between handgrip strength and myostatin (A), IGF-1 (B), and serum creatinine (C). IGF-1, insulin-like growth factor 1.

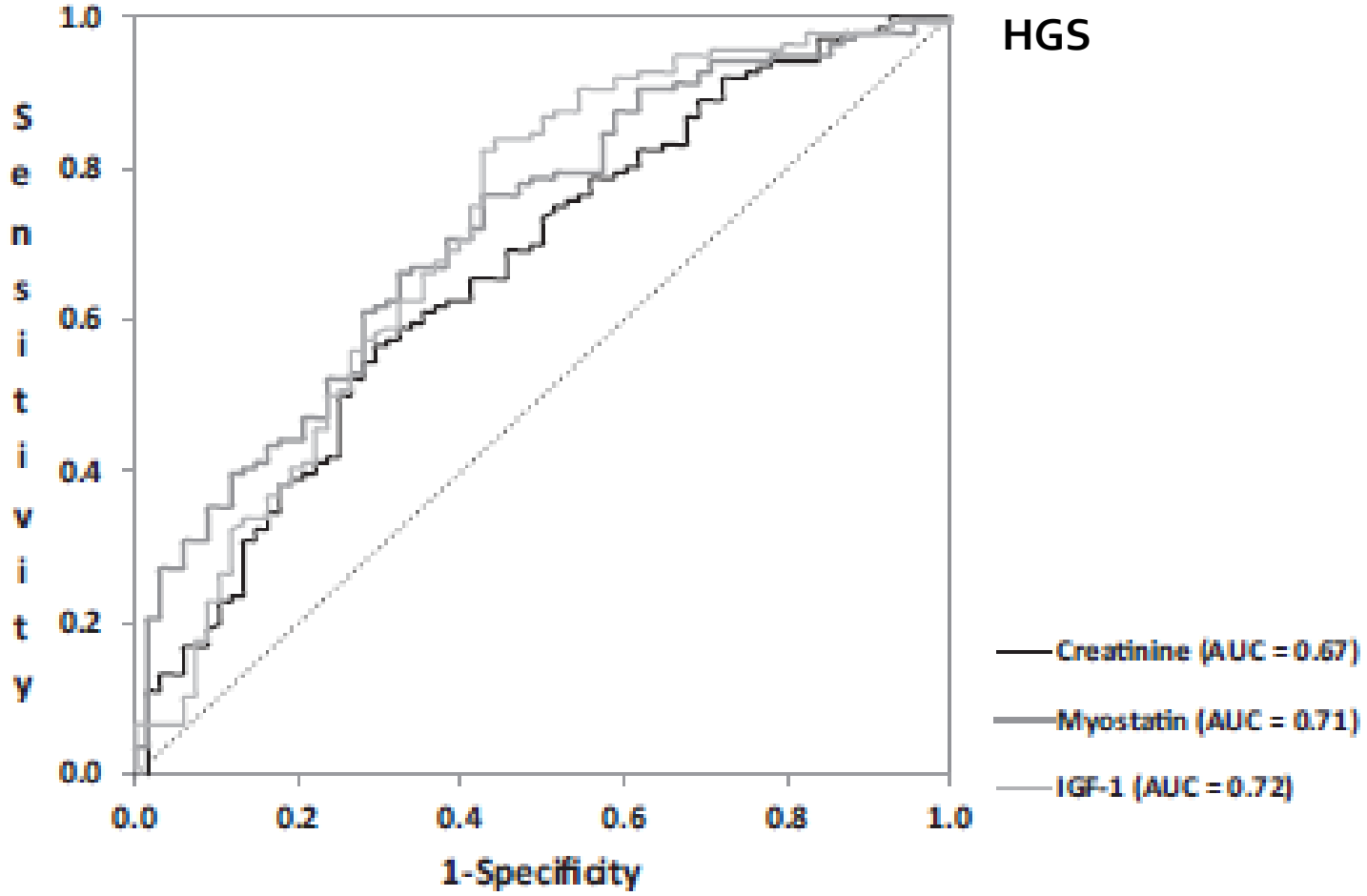


Figure 2. ROC curves for myostatin, IGF-1, and serum creatinine to detect a decreased HGS. AUC, area under the curve; HGS, handgrip strength; IGF-1, insulin-like growth factor 1; ROC, receiver operating characteristic.

One-year mortality

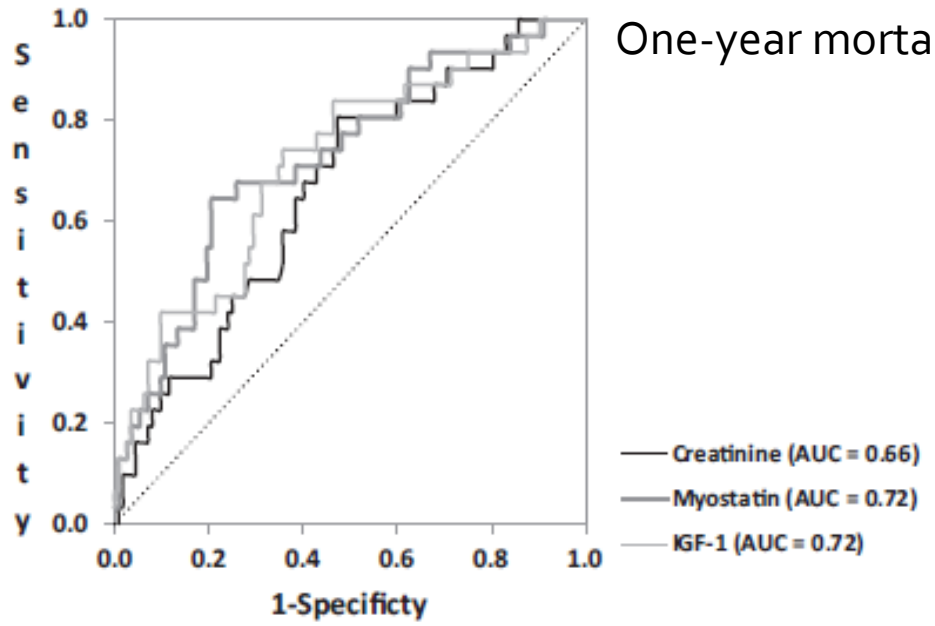


Figure 3. ROC curves for myostatin, IGF-1, and serum creatinine to predict mortality at 1 year (unadjusted). AUC, area under the curve; IGF-1, insulin-like growth factor 1; ROC, receiver operating characteristic.

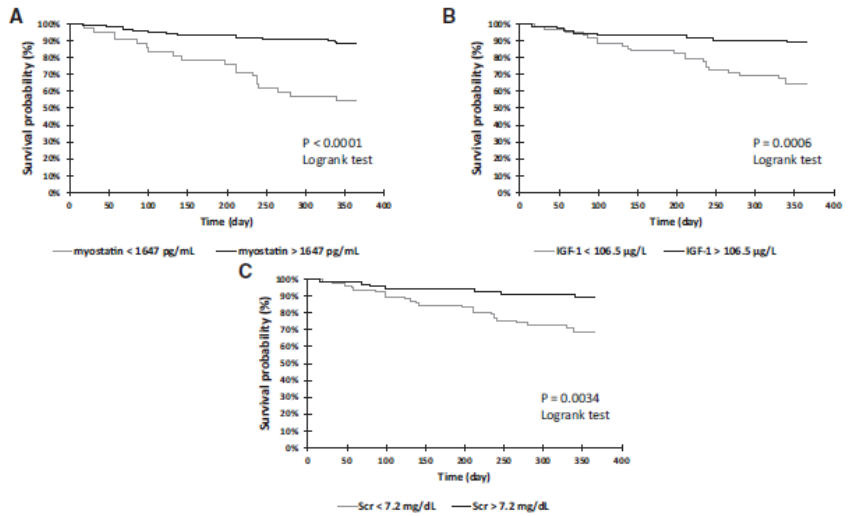


Figure 4. Survival curves within 1 year for myostatin (A), IGF-1 (B), and serum creatinine (C) (unadjusted). IGF-1, insulin-like growth factor 1.

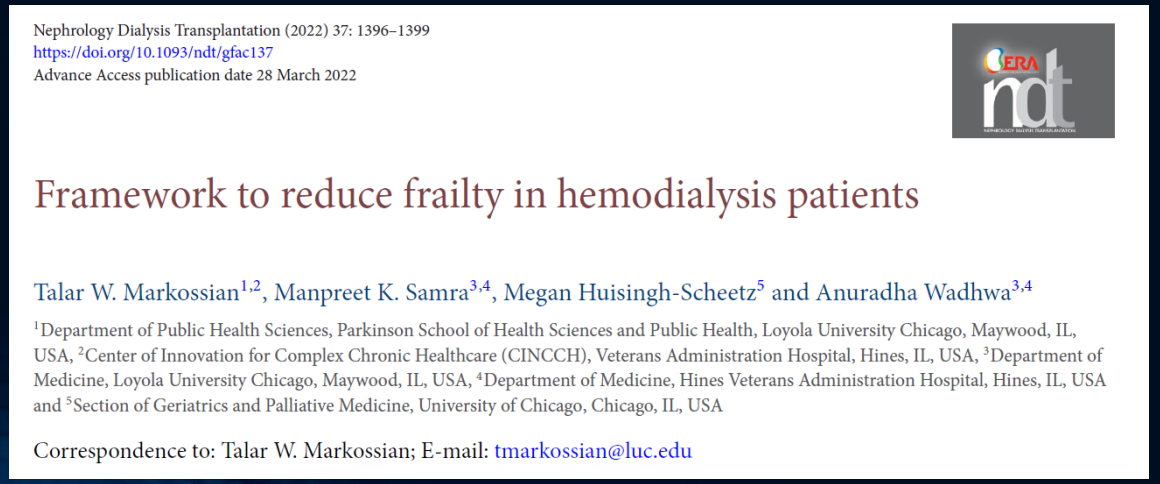
Table 5. Association Between Plasmatic Concentrations of Myostatin and IGF-1 and One-Year Survival: Cox Proportional Hazards Models (n = 143)

	Univariate Analysis	
Included variables	HR [95% CI]	*P* Value
Univariate model		
Age	1.041 [1.012-1.071]*	.0052
Gender	—	NS
Albumin	1.09 [1.02-1.16]*	.0069
Prealbumin†	2.72 [1.84-4.03]*	<.0001
CRP	1.006 [1.002-1.011]*	.0033
Hemodiafiltration	4.61 [1.40-15.2]*	.0119
Serum creatinine*	1.27 [1.07-1.52]	.0073
Myostatin‡	1.81 [1.26-2.58]*	.012
IGF-1§	1.15 [1.06-1.25]*	.0008
Multivariable models		
Model 1		
Age	-	NS
Gender	-	NS
Myostatin	1.49 [1.03-2.15]	.0356
IGF-1	1.11 [1.01-1.21]	.025
Model 2		
Age	-	NS
Gender	-	NS
Albumin	-	NS
CRP	-	NS
Hemodiafiltration	-	NS
Serum creatinine	-	NS
Myostatin	1.49 [1.03-2.15]	.0356
IGF-1	1.11 [1.01-1.21]	.0250
Model 3		
Age	-	NS
Gender	-	NS
Albumin	-	NS
Prealbumin†	2.72 [1.84-4.03]	<.0001
CRP	-	NS
Hemodiafiltration	-	NS
Serum creatinine	-	NS
Myostatin	-	NS
IGF-1	-	NS

CI, confidence interval; CRP, C-reactive protein; HR, Hazard Ratio; IGF-1, insulin-like growth factor 1; NS, not significant.
*HR for a serum creatinine decrease of 1 mg/dL.
†HR for a prealbumin decrease of 0.1 g/L.
‡HR for a myostatin decrease of 1000 pg/mL.
§HR for a IGF-1 decrease of 10 µg/L.

Conclusions: TO DO LIST and PERSPECTIVES

- The prevalence of frailty in hemodialysis patients is very high
- Standardization of the definition (and of the measurements)
- Role of biomarkers to detect frailty?
- Role of frailty in the decision to start dialysis?
- Role of frailty in the assessment of eligibility for renal transplantation?
- To be interventional



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Framework to reduce frailty in hemodialysis patients

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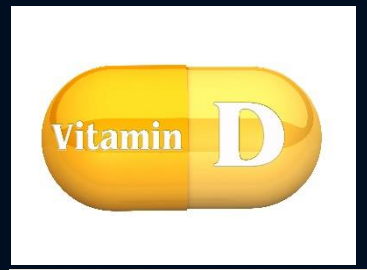
Special Article

Frailty Consensus: A Call to Action

John E. Morley MB, BCh [a,*], Bruno Vellas MD [b,c], G. Abellan van Kan MD [b,c], Stefan D. Anker MD, PhD [d,e], Juergen M. Bauer MD, PhD [f], Roberto Bernabei MD [g], Matteo Cesari MD, PhD [b,c], W.C. Chumlea PhD [h], Wolfram Doehner MD, PhD [d,i], Jonathan Evans MD [j], Linda P. Fried MD, MPH [k], Jack M. Guralnik MD, PhD [l], Paul R. Katz MD, CMD [m], Theodore K. Malmstrom PhD [a,n], Roger J. McCarter PhD [o], Luis M. Gutierrez Robledo MD, PhD [p], Ken Rockwood MD [q], Stephan von Haehling MD, PhD [r], Maurits F. Vandewoude MD, PhD [s], Jeremy Walston MD [t]

- Exercise (resistance and aerobic)
- Caloric and protein support
- Vitamin D
- Reduction of polypharmacy



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CLINICAL PRACTICE GUIDELINE FOR NUTRITION IN CHRONIC KIDNEY DISEASE: 2019 UPDATE

Intradialytic exercises

Blood Purification

Review – Advances in CKD 2022

Blood Purif
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Exercise in Dialysis: Ready for Prime Time?

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- Many small studies with moderate benefits (but no hard endpoints)…but most patients were probably not frail
- Three RCTs (6- till 12-months of intervention) …but disappointing results…
- One RCT (6-months) showed benefits on left ventricular mass (MRI)
- Remains underused (less than 10% of dialysis centers propose this activity), need for kinesiologists and physiotherapists (nephrologists do not feel comfortable with prescription although majority of them think it is useful)…and so, funding…
- Dialysis is source of fatigue in itself , risk of cramps, hypotension
- High % of drop-out

Jupiler

Questions?
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