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Putting Guidelines Into Practice: Is Frailty Measurement at the Time of Kidney Transplant Eligibility Assessment Valid, Feasible, and Acceptable to Patients?

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Background. Clinical Practice Guidelines suggest that frailty be measured during kidney transplant eligibility assessments. Yet it is not known how frailty is best assessed in this setting or whether its assessment is acceptable to patients. We aimed to examine the construct validity and feasibility of Frailty Index (FI) assessment among patients attending a kidney transplant assessment clinic and to explore patients' perspectives on frailty and the acceptability of its routine assessment. **Methods.** A 58-item FI was calculated for 147 clinic patients. Semistructured interviews were conducted with a subgroup of 29 patients. The FI was validated against normative FI characteristics (mean, distribution, limit), age, and the Estimated Post-Transplant Survival Score. Feasibility was assessed using descriptive statistics. Qualitative data were analyzed using reflexive thematic analysis. **Results.** The mean FI was 0.23 (±0.10, normal distribution, limit 0.53). FI increased with age and Estimated Post-Transplant Survival score. The FI was completed for 62.8% of eligible patients (147/234). The median completion time was 10 min, and completion rate (with no missing data) was 100%. Four themes were identified: perceptions of frailty, acceptability, perceived benefits, and risks of frailty measurement. Patients linked frailty with age and adverse outcomes, and most did not consider themselves frail. Patients reported that the FI was quick, simple, and efficient. They felt that frailty assessment is relevant to transplant eligibility and should be used to address potentially reversible factors. **Conclusions.** The FI demonstrated construct validity and was feasible and acceptable in this clinic setting. The challenge is ensuring that routine assessments lead to better care.

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Frailty is a state of decreased physiological reserve and increased vulnerability to stressors that is associated with adverse health outcomes.[1] It is prevalent in adults with chronic kidney disease (CKD) including kidney transplant (KT) candidates. Frail KT candidates are less likely to be waitlisted or transplanted[2] and face a higher risk of waitlist mortality.[3]

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E.G., R.E.H., N.R., and R.F. designed this study. N.R. performed statistical analysis. S.W. conducted patient interviews and performed qualitative analysis. A.Y. provided senior oversight for qualitative analysis. R.H. helped develop the study protocol and assisted in data collection. A.S. and F.G. made significant contributions to data collection. S.W. drafted the article, and all co-authors edited the article before approving the final version submitted for publication. E.G., R.E.H., N.R., and S.W. had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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Frailty is also associated with post-transplantation complications including delayed graft function,[4] immunosuppression intolerance,[5] graft loss,[5] postoperative delirium,[6] increased length of stay,[7] early hospital readmission,[8] and mortality.[9]

With surgical and medical advances, older candidates and those with increasingly complex medical co-morbidities are being considered for kidney transplantation.[10] Therefore, frailty assessment has gained traction as a means to improve risk stratification, particularly in these more vulnerable groups. In the United States, KT centers that routinely measure frailty as part of their eligibility assessment have lower waitlist mortality and lower rates of graft loss.[11]

The Kidney Disease Improving Global Outcomes guidelines suggest that frailty is assessed in all potential KT candidates so both patients and clinicians are better informed of the increased perioperative risk and preoperative optimization strategies may be implemented.[12] However, there is no consensus as to how frailty is best assessed in this setting.[13] Frailty assessment tools typically align with 1 of 2 conceptual models of frailty: frailty as a biological syndrome (phenotype) or frailty as a risk state arising from an accumulation of deficits across multiple health domains. Fried's Frailty Phenotype (FFP)[14] is an operationalization of the phenotypic model of frailty. It is the most commonly used frailty tool in the KT literature[15] and the solid organ transplantation literature more widely.[16] According to the FFP, frailty is characterized by 3 or more of the following signs or symptoms: weight loss, weakness, slowness, exhaustion, and physical inactivity. The FFP is reproducible, clinically coherent with frailty being a wasting disorder with sarcopenia as a key pathophysiological feature, and predicts a wide range of adverse outcomes in the general and solid organ transplantation populations.[14,16] However, it has practical limitations (eg, grip strength and gait speed are not routinely measured in KT candidates, and weight loss poses challenges in the setting of dialysis),[17,18] and the omission of other health domains is not consistent with the solid organ transplantation community's conceptualization of frailty as a multidimensional construct.[18]

The Frailty Index (FI) represents the risk state (cumulative deficits) model of frailty. It is a multidimensional tool that uses a well-defined method to derive a score from a list of variables representing medical, physical, functional, cognitive, and psychosocial domains.[19] Because it does not rely on performance measures and can be constructed from different numbers and types of variables,[20] an FI score can be determined from information routinely collected in the multidisciplinary assessment of transplantation candidates[21] and/or self-reported data.[22] As a continuous measure (ranging from zero to a theoretical maximum of one), it provides information about frailty severity and enables quantification of health status in those identified as not frail on dichotomous (or trichotomous) scales.[19,23] Changes in the FI as small as 0.03 have been shown to equate to clinically significant changes in health status in older hospitalized patients,[24] and it is this sensitivity to change that makes it an ideal longitudinal measure of frailty. The construct and predictive validity of the FI in the general population is well established.[20,25,26]

Despite the conceptual and practical advantages of the FI, there has been relatively little uptake in solid organ transplantation. To date, only 2 studies have used the FI to measure frailty in KT candidates,[21,27] and as a result, there is limited evidence to validate the FI in this setting. In the study by Worthen et al,[27] FI assessments were conducted prospectively by research staff, whereas in Varughese et al's retrospective study,[21] data were extracted from the multidisciplinary transplant eligibility assessment. Neither study examined the feasibility of these approaches. Consequently, it is not known whether the belief that the FI is time consuming and, therefore, impractical in the transplant setting[18] is well-founded.

It is also unknown whether the FI and routine frailty assessment are acceptable to KT candidates. A qualitative study of patients' perceptions of KT waitlisting found that the eligibility assessment and listing process is confusing and stressful for patients.[28] The impact of age and other comorbidities on eligibility was reported to be particularly distressing. It is therefore critical to ascertain acceptability before translating guidelines into clinical practice.

This mixed-methods study aimed to examine the construct validity, feasibility, and acceptability of an FI assessment among patients attending a KT assessment clinic and to explore these patients' perspectives on frailty and the acceptability of its routine assessment.

MATERIALS AND METHODS

Study Setting and Participants

The study was conducted from June 2021 to August 2022 at the Queensland Kidney Transplant Service's Kidney Transplant Assessment Clinic in Brisbane, Australia. During their appointment, potential KT candidates attend a series of consultations with a multidisciplinary team that includes a nephrologist, a transplant surgeon, and several allied health clinicians. The assessment process takes 2–3 h.

All potential KT candidates over 18 y of age with a face-to-face appointment during the recruitment period were eligible for the study. Exclusion criteria were advanced dementia or other illness preventing meaningful engagement or being non-English speaking, with an interpreter not readily available.

Data Collection

Demographic and Clinical Data

Relevant demographic and clinical data were collected from the patients' electronic medical records. Clinical data were used to calculate an Estimated Post-Transplant Survival (EPTS) score. The EPTS is a numerical scale calculated for all adult KT candidates in the United States with the intent to allocate the highest-quality kidneys to those expected to live the longest.[29] A low EPTS score implies a better prognosis. Such longevity matching is used with the goal of increasing graft longevity, minimizing retransplant rates, and improving resource utilization. Although not yet adopted into local practice, it has been validated in Australian KT datasets.[30]

Frailty Index

The FI Short Form (FI-SF) was developed and validated by Hubbard and colleagues in their study of the CKD population.[31] Standardized methodology was used to identify 58 variables representing a wide range of health domains including medical, functional, and psychosocial aspects[31] (**Table S1, SDC**, http://links.lww.com/TXD/A581). The FI-SF was completed by a trained research nurse in this study. Data were collected from the patient and supplemented with information from the medical records as required. If present, a variable was termed a "deficit." The FI score was calculated by

dividing the number of deficits by the total number of potential deficits. For example, if a patient had 18 deficits out of a potential 58, their FI was 0.31. Although often used as a continuous variable, a FI score >0.25 is widely accepted as the score at which one is defined as "frail."[32]

Feasibility

The research nurse recorded the number of patients eligible for recruitment, the number of patients who did not consent/were not consented to, and the reasons for nonconsent. The time taken to complete the FI with each patient and the completion rate (with no missing data) were documented.

Semistructured Interviews

A semistructured interview guide was developed to elicit patients' views on frailty and frailty assessment, informed by the researchers' own expertise in frailty research (**Figure S1, SDC,** http://links.lww.com/TXD/A581). Interviews were conducted at least 1 wk after FI-SF completion. Interviews were conducted in order of readiness and patient availability. It was predetermined that at least 20 interviews would be required to reach thematic saturation.[33] The interview guide was modified following the first 3 interviews to assist patients' understanding of differences between FI-SF and other clinic assessments. Interviews were estimated to last approximately 10 mins, but timing was not restricted if patients wished to talk longer.

All interviews were conducted via telephone by a single researcher (S.W., Geriatrician independent of the transplant assessment process). Interviews were transcribed using transcription software (Otter.ai). Transcripts were not returned to patients for review or correction. Approval was granted by the hospital Human Research Ethics Committee (2021/HE000989).

Data Analysis

Evidence to support the construct validity of the FI includes its statistical distribution and relationship with age in healthy versus unwell populations, as well as its submaximal limit.[20,34,35] Consequently, the distribution, mean (with standard deviation), and 99th percentile of the FI were determined to ensure it conformed with known norms. That is, it was hypothesized that on visual inspection, the distribution of FI would be a normal distribution in this clinical population, and the 99th percentile would be <0.7. The relationship between the FI and chronological age was determined using linear regression analyses (adjusted for sex). In keeping with the frailty literature,[35] it was hypothesized that the FI would increase modestly with chronological age in this clinical population.

The FI has also been validated against prognostic scales, such as CKD stage.[31] The EPTS score was identified as a relevant prognostic measure in this population. The relationship between the FI and EPTS score was determined using linear regression analyses (adjusted for sex and age). Because high EPTS scores correspond with worse prognosis, it was hypothesized that the FI would increase with EPTS score.

Residuals from linear regression analyses were assessed for all assumptions (with visual inspection of plots and statistical tests), including normality, linearity, homoscedasticity, and the presence of influential outliers. No issues of significance were identified. Regression analyses using age and EPTS as categorical variables were also conducted.

Agreement between the FI and another frailty tool (such as the FFP or Short Physical Performance Battery, which are commonly used and already validated in the transplant literature), was not tested because it has been established in the general population as well as the transplantation population that frailty tools derived from different models identify different groups of patients as frail and the correlation between the tools is poor.[27,36-38]

Feasibility was assessed using descriptive statistics. An independent *t*-test and Wilcoxon ranked sum were used to compare the means and medians of continuous variables between interviewed and noninterviewed groups. The chi-square test or Fisher's exact test were used to compare categorical variables depending on size.

Interviews were analyzed using Braun and Clarke's reflexive thematic analysis method,[39] in line with the researchers' interpretative/constructivist worldview. Analysis was undertaken concurrently with data collection and conducted as described (**Table S3, SDC**, http://links.lww.com/TXD/A581).

For all statistical analyses, a *P*-value <0.05 was considered significant. Statistical analysis was conducted using Stata (StataCorp 2021, version 17).

RESULTS

Patient Recruitment and Characteristics

Of 234 eligible patients, 147 (62.8%) were recruited to the study (Figure 1). Forty-five patients also consented to participate in the interview. A total of 29 interviews were conducted, at which time the researcher felt adequate data had been generated to reach thematic saturation.

Patient demographics and clinical characteristics are presented in Table 1. The mean age of patients was 52 y, and 58.5% were male. Almost all patients had Stage 5 CKD (97%), and the majority were on dialysis (86%).

FI Validity

The FI was normally distributed (**Figure S2, SDC**, http://links.lww.com/TXD/A581) with a mean of 0.23 (median 0.21), standard deviation of 0.10, and 99th percentile of 0.53. Fifty-eight participants (39.5%) were frail (FI > 0.25). The distribution of deficits is presented in Table S1 (**SDC**, http://links.lww.com/TXD/A581). Adjusting for sex, each additional year of chronological age was associated with a higher FI (β = 0.001, 95% confidence interval, 0.00-0.002; $P = 0.048$; **Figure S3, SDC**, http://links.lww.com/TXD/A581). A regression analysis showing the ANOVA of FI by age group (adjusted for sex) found a statistically significant difference between groups ($F(6,140) = 2.33$, $P = 0.04$) (**Table S2, SDC**, http://links.lww.com/TXD/A581). Adjusting for age and sex, each additional percent of EPTS was associated with a higher FI (β = 0.002, 95% confidence interval, 0.00-0.003; $P < 0.001$; **Figure S4, SDC**, http://links.lww.com/TXD/A581). A regression analysis showing the ANOVA of FI by EPTS group (adjusted for age and sex) found a statistically significant difference between groups ($F(6,140) = 4.05$, $P < 0.001$) (**Table S2, SDC**, http://links.lww.com/TXD/A581).

Feasibility

Forty-two participants (17.9%) were not able to be approached for FI assessment due to logistical reasons (eg, research nurse being on leave, clinic appointment

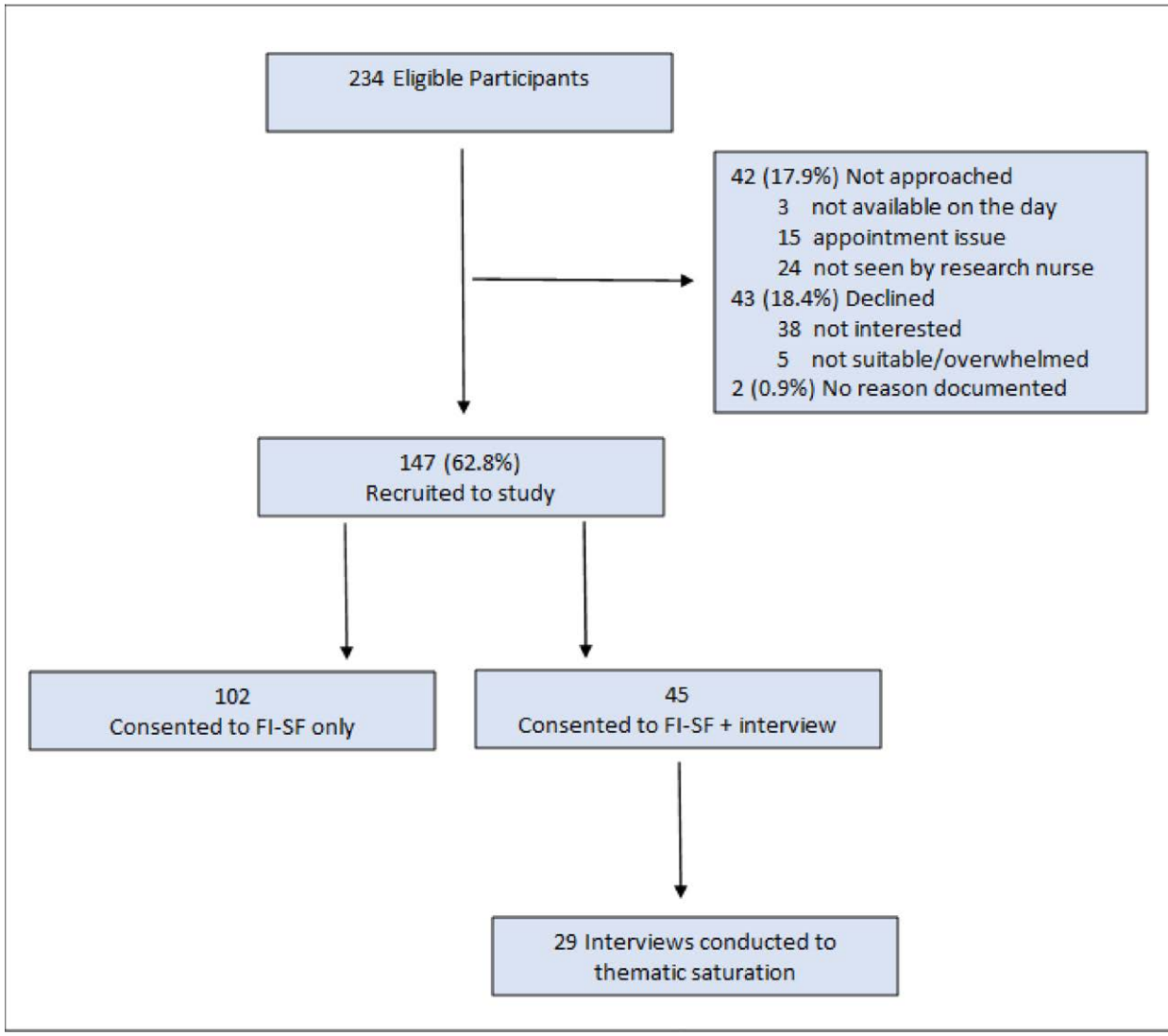

FIGURE 1. Participant selection. FI-SF, Frailty Index Short Form.

being changed due to COVID-19 pandemic conditions; Figure 1). The median FI completion time was 10 min (IQR = 10–12), and the completion rate (with no missing data) was 100%.

Semistructured Interviews

Characteristics were similar across interviewed and noninterviewed groups apart from a higher proportion of White/Caucasian patients in the interviewed (93%) versus noninterviewed (75%) groups (P = 0.037) (**Table S4, SDC**, http://links.lww.com/TXD/A581).

In the qualitative interviews, 4 overarching themes were identified, outlined next with exemplar quotes in Table 2, along with the participant's corresponding FI score.

Theme 1: Perceptions of Frailty

The term "frailty" was mostly viewed as being synonymous with old age (quote 1), with some patients questioning their suitability to participate in this study. Patients frequently associated frailty with falls and functional dependence. Some identified that frailty was not always visible and could affect younger people who were unwell.

Patients identified a potential link between frailty and adverse transplant outcomes (quote 2). One patient suggested that frailty may impact a person's fitness for certain dialysis modalities. However, not all patients believed severe frailty would be a barrier to transplantation, with some patients thinking that a more severe frailty status would increase their likelihood of receiving a transplant (quote 3). Most patients did not believe they were frail and expressed their views on the utility and benefit of frailty assessment in relation to those whom they believed to be older and more vulnerable than themselves (quote 4).

Theme 2: Characteristics of Frailty Assessment Influencing its Acceptability

Incorporation of frailty assessments into a preexisting process was a key acceptability factor, avoiding issues such as travel and adjusting work, childcare responsibilities, and dialysis schedules. Alternative processes, such as self-completion of the FI-SF before attending clinic or doing a computerized version, were suggested (quote 5). Patients liked that the assessment could be completed quickly and fitted in well between their specialist appointments on the day (quote 6).

TABLE 1.
Patient characteristics

	Total (N = 147)
Mean age in years (SD)	52.0 (13.0)
Male sex	86 (58.5%)
Mean BMI (SD)	27.9 (4.6)
Ethnicity—Caucasian	116 (78.9%)
Walking aid	
Does not use	138 (93.9%)
Uses walking aid	9 (6.1%)
Falls (last 6 mo)	
0–1	146 (99.3%)
2 or more	1 (0.7%)
Smoking status	
No response	4 (2.7%)
Never	70 (47.6%)
Former	72 (49.0%)
Current	1 (0.7%)
Number of different medications in 24 h	
1–4	28 (19.1%)
5–9	85 (57.8%)
10–14	32 (21.8%)
15–19	2 (1.4%)
Medical history	
<10 medical problems	127 (86.4%)
≥10 medical problems	20 (13.6%)
Kidney disease severity	
Stage 4	5 (3.4%)
Stage 5	142 (96.6%)
Is patient receiving dialysis?	
No	21 (14.3%)
Yes	126 (85.7%)
Type of dialysis (N = 126)	
Peritoneal dialysis	40 (27.2%)
Hemodialysis	86 (58.5%)
Median (IQR) days on dialysis (N = 126)	372 (182-923)
Has the participant had a previous transplant?	
No	123 (83.7%)
Yes	24 (16.3%)
Mean Frailty Index (SD)	0.23 (0.10)
Frailty (n)	
Not frail	89 (60.5%)
Frail	58 (39.5%)

BMI, body mass index; IQR, interquartile range.

Some reported that it was a good distraction from what was otherwise a stressful day.

Patients reported that the FI questionnaire was relevant and easy to answer. Patients did not find questions confronting or difficult, recognizing that they were an essential part of any clinical assessment (quote 7). One patient was concerned that the content of the FI-SF was not sensitive enough to pick up on less severe signs of frailty. They expressed that they had perceived that frailty assessment would be more complex than what was carried out (quote 8).

Theme 3: Perceived Benefits of Frailty Measurement in Transplant Assessment

Patients identified that frailty assessment was a good measure of one's current health status. They believed it was a useful adjunct to clinician assessment (quote 9). The results of frailty measurement were believed to provide potential candidates with more realistic expectations regarding their transplant and recovery, allowing them to approach their transplant better informed and to address potentially reversible causes of frailty (quote 10). Some felt frailty assessment gave them an opportunity for self-reflection on how their health status had changed over the course of their disease journey.

Patients thought that frailty assessment would help predict post-transplant complications in the perioperative setting. They felt clinicians could make better treatment decisions and deliver more person-centered care if they knew their patient's frailty status (quotes 11 and 12).

Theme 4: Perceived Risks of Frailty Measurement in Transplant Assessment

Patients did not identify any risks associated with the FI-SF used in this study. However, older and some younger patients voiced apprehension about frailty assessments potentially influencing transplant eligibility (quote 13) and concern that they may be denied treatment based on factors that were nonmodifiable (quote 14). Some patients were indifferent to how frailty measurements were utilized and more readily accepting that a very frail person may not be suitable for transplant (quote 15).

It was also identified that a one-off frailty assessment may not accurately reflect a patient's health status, especially if conducted at a time of a potentially reversible illness. Therefore, to establish one's "true frailty status," patients considered that repeat assessments were required (quote 16).

DISCUSSION

In this mixed-methods study, we found evidence in support of the construct validity of the FI in the potential KT candidate population, and we ascertained that prospective FI assessment is feasible in the clinic setting and acceptable to patients. However, there was evidence of discordance between FI scores and self-estimated frailty in some patients and concerns about the potential impact of frailty assessment on transplant eligibility. These findings have important implications for the incorporation of routine frailty assessment into clinical practice.

Through their analysis of population data, Mitnitski and Rockwood (who developed the FI) demonstrated that the FI has mathematical properties consistent with a complex system comprised of redundant parts. They ascertained that as a population ages and/or becomes more impaired (ie, accumulates deficits), the FI distribution changes from a skewed distribution typical of systems with redundancy to a more symmetrical (normal) distribution typical of systems without redundancy.[20] They also identified that there is a limit to the FI of approximately 0.7[34] and that while the FI increases with age at rate of about 3% per year in healthy populations, the rate reduces to zero in frailer populations.[35] Both of these findings were consistent with the notion that, at some point, maximal deficit accumulation is reached and redundancy is exhausted. Altogether, these characteristics validated the FI as a measure of frailty when it is conceptualized as a risk state arising from an accumulation of deficits. Consequently, the normal distribution of the FI, the 99th percentile of 0.53, and the small increment in the FI with chronological age reported in this study are all evidence of the FI's construct validity in this population. Increments in the FI with the EPTS score also support its construct validity. Overall, the FI results are as

TABLE 2.

Exemplar quotes from patient interviews corresponding to each theme

Theme	Quotes
1. Perceptions of frailty	1. *"It probably shocked me a little bit, at my age, that that word was used. But I think that we need to be just more understanding what the word frailty means and not necessarily old."* P032 (57M, FI 0.36)
	2. *"If you're already very frail, you might, the transplant might muck you around even more and recovery time might be a bit longer"* P017 (47M, FI 0.19)
	3. *"If that was determined, more frailty would get you further towards getting a new kidney, on the deceased donor list or something like that, then I suppose that would be a good thing"* P014 (33M, FI 0.21)
	4. *"N o actually, there's no downside to it. I think it is a good idea. It's probably stopped a lot of people being operated on that shouldn't be operated on if you ask me…. If I were to need an operation I would deserve an operation, but I'm currently a fit person and I am in good health and I would get over these operations quick and the operations are successful."* P028 (71M, FI 0.27)
2. Characteristics of frailty assessment influencing its acceptability	5. *"But if there is support and if, say, they do it on their own free time and that saves the government, the hospitals, the research department money, that they could use on something else."* P012 (63F, FI 0.38)
	6. *"It was all very quick and easy so was no great problem. And then afterwards, we didn't miss any appointment or anyone calling for us or anything like that."* P022 (61M, FI 0.18)
	7. *"And personally, I've been dealing with this for over 30 y, so I find nothing confronting now. Umm there's no question I haven't been asked somewhere through the journey."* P025 (45M, FI 0.21)
	8. *"Oh, well it was, it was really very easy. I didn't have any concerns about the questions being asked. I actually thought it would be more extensive than it was."* P029 (68F, FI 0.34)
3. Perceived benefits of frailty measurement in transplant assessment	9. *"I think it's a good thing that the patient has the frailty test to ensure their good health or help the doctor to come to a better assessment of the patient."* P054 (64M, FI 0.38)
	10. *"I think it's a good idea, because then if people have a higher index, they can get advice about, if possible, to become lower on the frailty index, so that they can improve in different areas of their health."* P015 (61F, FI 0.21)
	11. *"It's probably a good way of catching conditions early on and sort of treating them before they're out of hand…….I think there's probably certain conditions where or certain, certain, I guess, treatments where if you're, if you're frailer than somebody else they might be more or less suitable."* P039 (44M, FI 0.19)
	12. *"It's probably going to help the doctors and possibly even the nursing staff understand a bit more about that patient so they're not just treating everybody, you know, exactly the same, and having expectations the same for everybody."* P026 (46F, FI 0.17)
4. Perceived risks of frailty measurement in transplant assessment	13. *"I wouldn't like to see people denied treatment on the basis of their frailty without there being some sort of process whereby there was some sort of programme to improve function."* P029 (68F, FI 0.34)
	14. *"Knowing and not trying to improve is different to knowing and not being able to improve. That's where I feel I'm a bit conscious in my answer, because if I knew I was feeling frail, in, in one aspect of my healthcare, I would want to improve it, but there may be other people who are unable to."* P015 (61F, FI 0.21)
	15. *"Um I don't think, if they're frail they are probably not up to having things done on them are they really?"* P028 (71M, FI 0.27)
	16. *"So, I'm not sure how that would be if you can become fitter, then that score would have to change with that."* P037 (47M, FI 0.19)

FI, Frailty Index

expected for this relatively young population with a severe disease.

The results are also consistent with Varughese et al's[21] finding of a modest increase in the FI with age and a maximal FI of 0.60. Worthen et al[27] did not examine the relationship between FI and age in their study, but they reported a maximal FI of 0.70 and an FI distribution approaching normal. Our frailty prevalence rate of 39.5% is higher than that reported in the majority of the KT literature.[15] While populations may differ slightly between transplant centers, between-study differences in the approach to frailty measurement are likely to be the key contributing factor. Worthen et al[27] showed that the frailty prevalence rate was 38% using the FI and 16% using the FFP in their sample of KT candidates. The same pattern has been reported in large meta-analyses of older community dwellers[40] and studies of lung transplantation candidates.[37] The larger estimates generated by the FI, which are attributable to the multidimensional nature of the tool, highlight the possibility that the burden of frailty in KT candidates has been underestimated due to the predominance of phenotypic frailty tools in research to date. While Varughese et al[21] did not report a prevalence rate, they reported a mean FI value of 0.27 (compared with 0.24 in our study and 0.23 in Worthen et al's[27] study). The higher value may reflect their inclusion of multiorgan transplant candidates (eg, kidney pancreas transplants) who may be frailer compared with those with single organ failure. Overall, the frailty prevalence and mean FI values reported by these studies demonstrate that this population is frailer than the "normal" population. In Australia, the mean FI of community dwellers requiring geriatric assessment and support (mean age = 81 y) was found to be 0.24.[41]

In terms of feasibility, the FI-SF required minimal assessor training, was quick to administer, easy for patients to understand, and had complete data for all variables. Logistical issues prevented the research nurse from approaching some eligible patients; strategies to increase assessment rates in clinical practice require consideration. For example, in the United Kingdom, an FI is automatically generated from routinely collected electronic medical record data for older adults attending general practice.[42] A similar automated approach may be feasible in the KT setting as candidates undergo extensive eligibility assessments that collect data relating to multiple health domains. As identified by patients in this study, a self-reported FI may streamline frailty assessment in the outpatient setting. This is a focus of ongoing enquiries by our group. Compared with the FI, the FFP (and other performance-based tools) may not be as feasible in the KT setting. In a study by Adlam et al,[43] some KT candidates could not participate in the study as they

could not be assessed using the FFP secondary to immobility. Data were missing for study participants due to participants being unable to use the equipment and being unable to recall their weight from 1 y prior. Miscalibration of equipment, the long administration time required for the FFP (estimated to be 25 min per participant), staff time constraints, and limited training were also identified as key issues.

This study was the first to explore KT candidates' perspectives on frailty and the acceptability of its routine assessment. Most associated frailty with older age, and many described their health status as optimal despite objectively high FI scores. This discordance is not unexpected. In a study of frail hemodialysis patients, only 4.9% of frail patients identified themselves as frail.[44] Objective assessment using the FI can facilitate conversations with patients and clinicians about frailty and potential post-transplant outcomes, particularly as many KT candidates appear ill-prepared for the adverse effects of immunotherapy, ongoing functional limitations, and significant follow-up required post-transplantation.[45] A benefit of the FI over other frailty measures is that it provides information about the health status and associated risks of *all* patients, not just frail patients.

During interviews, most patients expressed their views on the benefits of frailty assessment (in relation to transplant eligibility) with regards to patients frailer than themselves. Patients expressed concern that they may be denied a transplant based on a one-off frailty assessment without any opportunity to improve their health status. Indeed, frailty is dynamic and can change during the course of one's transplant journey,[46] highlighting the importance of using a validated measure such as the FI that can be repeated over time. We, the patients in our study, and Kidney Disease Improving Global Outcomes clinicians agree that frailty assessment should trigger tailored interventions for potentially reversible factors.[12] Prehabilitation aims to enhance preoperative functional capacity to improve tolerance for upcoming surgical interventions and improve postoperative outcomes.[47] A small pilot study of center-based physical therapy for KT candidates resulted in improved physical activity and in those who proceeded to transplant, reduced length of stay.[48] A clinical trial evaluating a mutimodal prehabilitation program including physical, nutritional, and psychological interventions on KT candidates is currently underway.[49] A Comprehensive Geriatric Assessment by a geriatrician is another potential approach to optimizing the health status of frail candidates before transplantation.[50] Overall, while patients expressed a range of ideas about the potential impact of frailty on transplant eligibility, they almost universally agreed that it is relevant and important to the assessment process.

Potential KT candidates lead busy lives despite their chronic disease, and specialist transplant centers often cover wide geographical areas, necessitating significant travel commitments for certain candidates. In our study, the incorporation of frailty assessment into a routine clinic appointment was a key factor in its acceptability. Our findings are consistent with a study of frailty screening among community-dwelling older adults in General Practice, which reported that frailty instruments that are quick, require minimal equipment, and have minimal space are more acceptable to both patients and administering nurses.[51]

This study has some limitations. Given its cross-sectional nature, validation of the FI was limited to examining construct validity. There is, however, increasing evidence for the predictive validity of the FI in KT candidates in relation to a range of adverse outcomes.[21,27] While the EPTS has not been used to validate the FI in the literature to date, the EPTS and FI are clinically coherent as markers of prognosis, and the relationship between the 2 measures supports but does not confirm construct validity of the FI. The study was conducted at 1 site, and the FI assessments were performed by a single assessor; additional information regarding feasibility may be gleaned by including more than 1 site and assessor. Semistructured interviews explored the views of prospective candidates from a wide geographical area, of varying ages and frailty status, and interviews were conducted by a single researcher, which allowed for more nuanced coding and deeper reflexive insight into the views expressed by transplant candidates. However, the majority of patients were Caucasian and of an English-speaking background. This potentially limits the generalizability of findings and excludes culturally and linguistically diverse populations who may need additional support in completing the FI-SF and/or have differing views on frailty assessment.

CONCLUSIONS

While there are only a small number of studies that have utilized the FI to measure frailty in KT and solid organ transplantation more widely, we propose that the FI is the ideal tool. The FI is congruent with the conceptualization of frailty as a multidimensional construct; its granularity affords a greater understanding of population and individual risk and changes in health status over time than categorical measures; and it is more accessible as it does not rely on performance-based measures and can be derived from self-report and routinely collected data. There are extensive validation data from the general frailty literature and a growing evidence base in transplantation. The current study found evidence in support of the FI's construct validity and feasibility in the KT setting. Routine quantification of frailty using the FI may be substantially more feasible than phenotypic measures such as the FFP.

This study was the first to examine the acceptability of routine frailty assessment and the FI in transplantation, and we found that patients identify the relevance and importance of frailty assessment to key stakeholders, including themselves. Discordance between objective frailty scores and subjective, self-assessed frailty status highlights the importance of using validated frailty tools and counseling patients regarding their risk of significant perioperative and post-transplant complications. The next challenge is to ensure that routine frailty assessment leads to better care. Patients and clinicians alike want the assessment of frailty to be accompanied by actions to reduce frailty. Research examining the impact of prehabilitation on frail potential KT candidates is what is needed to change current guidelines from "suggesting" to "recommending" the routine assessment of frailty.

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