Review

Assessment of Function Limitations in People with Chronic Kidney Disease for Implementation in Clinical Practice

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Abstract: Chronic Kidney Disease (CKD) is a global health problem and a significant contributor to mortality, morbidity and disability from non-communicable diseases (NCD). The current consensus amongst researchers in the field of renal rehabilitation and healthcare practitioners involved in the management of people with CKD, is that physical dysfunction and inactivity are severe and prevalent in all ages and CKD stages compared to normative data. The negative impact of CKD on independence is cumulative, and health interventions and policies should target prevention of deterioration of kidney function and its consequences for physical frailty, disability and ultimately, quality of life. Accurate and feasible assessment of physical function is key for supporting the clinical implementation of current clinical care management guidelines. This overview, therefore, presents the rationale and some key scientific evidence to support the recommendation of physical function measurement tools that reflect function limitations for immediate implementation in clinical practice. Measurement property characteristics of the proposed measurement tools are also summarised in order to support health and exercise professionals in selecting the right tool and in interpreting and evaluating the measured outcomes.

Keywords: sit to stand 5; gait speed; walking mobility; disability; hand-grip strength

1. Introduction

Chronic Kidney Disease (CKD) is a global health problem and a significant contributor to mortality, morbidity and disability from non-communicable diseases (NCD). Although age-standardised mortality and disability-adjusted life years have seen small increases in the last 20 years at a global level, regional disparities do exist. Higher mortality and CKD burden are reported in world regions of lower sociodemographic index, and these disparities have been mainly attributed to limited access to renal replacement therapies (RRT) and increases in the prevalence of diabetes and hypertension [1]. CKD is also considered a significant risk factor for cardiovascular disease (CVD), independent from other conventional risk factors (e.g., hypertension, diabetes, smoking, physical inactivity). The current global estimated prevalence of CKD sits at 9.1%, with the prevalence of people in CKD stage 5 and on some form of RRT standing at 0.1%, indicating that the largest proportion of people with CKD are in stages 2–4 [1]. In the UK, about 7% of the adult population above 35 years presents with CKD 3–5 [2]. Global all-age CKD prevalence has increased by 29.3% in the period of 1990–2017, which is mainly attributed to larger increases in incidence of RRT resulting from population ageing [1]. In the UK, about 67,000 people are currently on RRT, with the number of people requiring RRT increasing by about 2% every year since 2018 [3]. Furthermore, although the most prevalent cases of CKD are in stages 2–4, life years lost to disability are estimated to be the largest for CKD stage 5 and dialysis (40%) vs. 22% for CKD 2–4 [1]. This statistic indicates that the negative impact of CKD on independence may be cumulative. It makes sense, therefore, that greater emphasis of health interventions and policies is placed on targeting prevention of deterioration of kidney function and associated consequences in order to slow or reverse loss of physical independence and, ultimately, quality of life.

2. Physical Function as an Outcome of Clinical Importance in CKD

The definition of the construct of physical function and the proposed conceptual framework for its assessment in CKD has been described elsewhere [4,5]. This overview will focus on physical function indicators (derived from objective performance-based tests) measuring the ability to carry out physical tasks that reflect activities of daily living (function limitations).

An adequate level of physical function is essential for independent living. This applies to all people, but becomes even more important in people with CKD, in whom the effects of underlying disease pathophysiology, multimorbidity, accelerated biological ageing, pronounced physical inactivity and sedentary lifestyle result in severe physiological impairment (exercise tolerance), function limitations and/or disability, which negatively impact all aspects that contribute to quality of life (QoL) and, ultimately, survival [6–8].

Physical dysfunction is severe and prevalent in all ages and CKD stages compared to normative data [9,10]. Deterioration of physical function starts early in the disease process, as evidenced by very similar scores in walking mobility, lower-limb strength and self-reported physical function among groups of CKD 3–4, HD and transplanted patients [11] and may result in the rapid onset of severe physical frailty and disability, especially in the elderly CKD5 population [12,13]. Even young (42 $\pm$ 8 years) and self-reportedly high-functioning individuals on HD (physical function score on the SF-36 questionnaire: median 85, range 75–95 arbitrary units), present with deficits of 15% in gait speed, 38% in lower-limb strength and 45% in peak torque of quadriceps, in comparison to healthy and age/gender-matched counterparts [13].

These observations support the notion that CKD is a condition of accelerated biological ageing, and its consequences appear to manifest in larger muscle groups first (lower extremity musculature and function). In a cohort of CKD 2–4 patients, significant deficits of up to 40% in measures of walking ability vs. no deficits in handgrip strength were observed in comparison to healthy controls [14,15]. Moreover, practice-based evidence from the Dialysis Outcomes and Practice Patterns Study (DOPPS) shows that about 79% of the assessed sample, presented with significant difficulties with routine daily tasks (functional disabilities), as opposed to about 30% prevalence of functional disabilities in the general population of similar age [16]. CKD is associated with multiple underlying systemic organ-system changes with widespread structural and biochemical alterations that contribute to subclinical disease early in the course of CKD, which also impact on muscle and physical function. Physical function changes, however, may not be readily detected with conventional resting diagnostic tools such as imaging or blood testing, for example, as the relationship between muscle mass and muscle function is not always linear [17]. The combined effect of these subclinical underlying changes may, however, become apparent in measures of physical function. If captured early in the disease trajectory, then the opportunities for appropriate and timely preventative interventions can be optimised [18].

Physical function impairment is the hallmark characteristic of both sarcopenia and frailty in CKD [19] and single measures of physical function limitations (e.g., gait speed, sit-to-stand performance) emerge as strong determinants of clinically important but also patient-relevant outcomes, such as frailty and falls [20,21] mortality [8], morbidity/hospitalisations and life participation [14,22]. People with CKD 3–5 and kidney transplant recipients (KTx) with better scores in measures of function limitations such as gait speed and sit-to-stand performance, experience longer event and disability-free survival and better mental health [6,7,16].

Physical function outcomes are also reflective of subclinical changes in underlying altered physiological processes (e.g., poor nutritional status, frailty and sarcopenia, which sometimes is harder to detect and accurately assess) [17,23,24] and responsive to therapeutic interventions such as exercise rehabilitation. Appropriately designed and implemented exercise-based programmes can induce clinically meaningful improvements in some physical function outcomes (VO$_2$ peak, self-reported physical function, gait speed and distance walked) [25–27].

A case already exists for the regular assessment and promotion of physically active lifestyles to enhance clinical management of the CKD patient and alleviate disability symptoms [28,29]. Accurate and feasible assessment of physical function is key to supporting the clinical implementation of care management guidance, not only to characterise prognosis and adverse clinical risk, but also to monitor progress and response to interventions towards optimised levels of physical function for a given individual. Routine monitoring of physical function and sharing this information with the people concerned can also be used to motivate patients to actively engage with physical activity (PA) to maintain/enhance physical function [18].

3. Function Limitations Measurement Instruments for Clinical Implementation

The execution of comprehensive incremental exercise testing, which includes measures of gas exchange, cardiac function, systemic blood pressure monitoring and patients' subjective responses to general and specific discomfort (via ratings of perceived exertion, angina and breathlessness scales) is considered to be the "gold standard" of integrated assessment of exercise capacity (physiological level of impairment). However, this approach is not feasible in all patients, environments and settings [4]. Physical performance tests that imitate and reflect the ability to undertake physical tasks of daily living offer a clinically feasible alternative and/or complementary method of testing incremental and upper limits of physiological exercise capacity.

All recommended measurement tools for clinical implementation should ideally satisfy minimum standards of good measurement properties (validity, reliability, responsiveness), clinical utility (interpretability), patient safety and feasibility [30]. Table 1 provides a summary of available clinimetric properties for the perusal of interested readers when trying to decide what tool to use and how to interpret results at the level of the individual. It is beyond the scope of this paper to expand on clinimetric evaluation of outcome measures, but interested readers are directed to the resources and guidance by the COSMIN Taxonomy of Measurement Properties [31].

Table 1. Summary of measurement property characteristics for proposed outcome measurement instruments, for assessing function limitations in the physical function assessment spectrum in clinical practice, for adult people with CKD.

		Walking Mobility	STS Transfers	HGS (Kg.m.s $^{-1}$ or Max Kg Achieved)
Why	Criterion/ structural validity	**6MWT vs. VO$_2$ peak** Regression CC: 0.62 (p = 0.008) [32] 6MWT vs. VO$_2$ peak r = 0.508 (p < 0.0001) [33] r = 0.703 [34] **Gait speed vs. Fried's frailty** AUC: 0.97 (95%CI: 0.93–1.00) [20] AUC: 0.89 (95%CI: 0.81–0.98) [21] **Gait speed vs. VO$_2$ peak** r = 0.636 [34] **TUG vs. Fried's frailty** AUC: 0.90 (95%CI: 0.80–0.99) [21]	**STS-5 vs. VO$_2$ peak** Regression CC: −0.58 (p = 0.002) [32] **STS-5 vs. isometric KEF** Spearman's Rho: (not significant) [35] **STS-5 vs. e1RM** r = 0.47, (p = 0.003) **STS-5 vs. ISWT** r = 0.74, (p < 0.001) [36] **STS-5 vs. Fried's frailty** AUC: 0.86 (95%CI: 0.75–0.96) [21] **STS-10 vs. KEF** Pearson's correlation coefficient for NDKEF%: R = 0.644 [95%CI: 0.52 to 0.74] [37] DKEF% R = 0.590 [95%CI: 0.45 to 0.70] **STS-60 vs. isometric KEF** Spearman's Rho: −0.90 (p = 0.000) [35]	**HGS vs. VO$_2$ peak** Regression CC: 0.55 (p = 0.003) [32] **HGS vs. Fried's frailty:** CC: −0.62 (95%CI: −0.73 to −0.48) AUC: 0.87 (95%CI: 0.78–0.96) [20] AUC: 0.71 (95%CI:0.59–0.83) [21] **HGS vs. malnutrition from MNA** AUC 0.766 (95%CI: 0.658–0.854) MNA <= 13.5 (sens 71.43%, spec 76.71%) [38]

Table 1. *Cont.*

		Walking Mobility	STS Transfers	HGS (Kg.m.s $^{-1}$ or Max Kg Achieved)
	Reliability	**TUG** ICC: 0.96 (95%CI: 0.92–0.98) SEM(%): 12.5 MDC$_{90-95}$: 2.90 s [39] ICC: 0.91 (95%CI: 0.78–0.86) LOA: −3.82, 2.05 MDC$_{95}$: 3.44 s [40] ICC: 0.96 (95%CI: 0.94–0.98) MDC$_{90}$: 2.9 s (95%CI: 2.2–3.7) [41] **6MWT** ICC: 0.93 (95%CI: 0.82–0.97) SEM(%): 7.6 MDC$_{95}$:77 m [42] ICC: 0.94 (95%CI: 0.89–0.97) SEM(%): 28.4 MDC$_{90}$: 66.3 m [43]	**STS-5** ICC: 0.67 (95%CI: 0.468–0.813 CV%: 8.3–15.1 SEM: 2.7 s MDC$_{95}$: 0.8–7.5 s [35,36,44] **STS-10** ICC = 0.84 [95%CI: 0.68 to 0.93] [37] ICC: 0.88 (0.78–0.94) MDC$_{90}$: 8.4 s [43] **STS-30** CV%:5.5 [45] ICC: 0.93 (95%CI: 0.58 to 0.98) MDC$_{95}$: 2.6 reps [42] **STS-60** ICC: 0.89 (95%CI: 0.80–0.94)CV%: 12.8–14.1 SEM: 1.3–3.5 reps MDC$_{90}$: 4–8.3 reps [36,39,43,44]	MDC$_{90}$: 3.4 kg [43]
	Responsiveness	**6MWT vs. VO$_2$ peak** correlation of change scores: 0.68, ($p < 0.001$) [46]	**STS-5** MCID: 3.3 s (95%CI: −0.7–7.3) STS60: 1 rep (95%CI:−4–6) [47]	
	Interpretability	**6MWT:** <350–400 m walked **Gait speed** < 0.85–0.6 m/s **3mTUAG** > 10 s associated with significantly higher risk of death, disability, physical frailty [15,20,21,48–50]	**STS-5** and early admission to hospital post KTx (not significant) [51] STS-5 1 point reduction produced 1.28-fold higher risk of death (95%CI: 1.02–1.60) [52] STS-5 > 15s significantly discriminates frail from non-frail individuals [21] **STS-30** 35% decreased risk of CV events 16% decreased risk of all-cause hospitalisation [53]	**HGS** and early admission to hospital post KTx (not significant) [51] **HGS predicts mortality** [54,55] better than measures of muscle mass and other measures of sarcopenia [49,56,57] **and hospitalisations** [9,57] HGS and fractures (not significant [58]
Who		In all adult people with CKD in any stage	In all adult people with CKD in any stage	In all adult people with CKD in any stage
Impact/Value			Cut off points for sarcopenia classification [59]	Cut-off points for frailty phenotype [23] Cut off points for sarcopenia [59] Normative data from UK population exists [60]
	Expertise		No specialist training required but standardised assessment protocol needs to be followed [5]	No specialist training required but standardised assessment protocol needs to be followed [61]
	Equipment		Standard height chair (height of 42–46 cm) and stopwatch	Hand-held dynamometer at cost
	Purpose		Physical function outcome (and possibly screening)	Screening and physical function outcome

Table 1. *Cont.*

		Walking Mobility	STS Transfers	HGS (Kg.m.s $^{-1}$ or Max Kg Achieved)
Feasibility	Safety/suitability		No adverse events reported in supervised set ups / Not suitable for people who cannot stand independently / No floor or ceiling effects	No adverse events reported in supervised set ups / Suitable for non-mobile individuals / No floor or ceiling effects
	Comprehensibility and setting		No language barriers and time efficient as it can be completed in <5 min / Any location in clinical or research environment	No language barriers and time efficient as it can be completed in <5 min / Any location in clinical or research environment

6MWT—6 min walk test; AUC—area under the curve; CC—correlation coefficient; CV%—MDC converted to % variation score; HGS—hand grip strength ICC—intra-class correlation; ISWT—incremental shuttle walking test; KEF—knee-extension force; MDC—minimal detectable change, defined as SEM with 90–95% confidence intervals; MCID—minimum clinically important difference; MNA—mini nutritional assessment; NDKEF—non-dominant knee-extension force; RM—repetition maximum; STS—sit-to-stand; SEM—standard error of measurement defined as test–retest variability in measurement score with 68% confidence intervals; TUG—3 m timed up-and-go test; VO$_2$ peak—peak oxygen uptake. Validity indices reflect the extent to which the measurement tool reflects the construct it is supposed to measure. If validity is poor, then the tool is not a good substitute for the construct of interest. Reliability indices reflect the amount of variation (error) associated with a measurement tool, and therefore change scores need to exceed these indices in order to count as true changes. Interpretability indices reflect the clinical or practical importance of scores or change of scores, and this information can be used to support appropriate risk stratification and monitoring of progress at patient level.

3.1. Function Limitations—Which Measurement Instruments?

Batteries of physical performance tests such as the Short Physical Performance Battery (SPPB) have been reported in the CKD literature as a prognostic tool in survival studies in kidney transplant recipients [62], but also as an outcome in exercise-based interventions [63]. The SPPB is composed of objectively tested performance components of standing balance, five chair rises and gait speed, that are aggregated to produce a scoring range from 0 (worst) to 12 (best). The SPPB has also been suggested as one of the tools to assess physical performance to confirm the presence of sarcopenia [59]. Physical frailty, predominantly assessed using Fried's phenotype [23], has also emerged in the last decade as an indicator of function limitations, disability and other adverse clinical outcomes [6,13,19]. Although Fried's phenotype is a relatively expedient assessment, it requires a combination of both objectively measured physical function (handgrip strength and gait speed) and patient-reported outcomes (fatigue and physical activity). There is also a considerable amount of variation and accuracy in the estimation of prevalence and responsiveness of this index to various interventions in the CKD population [17], mainly due to the different approaches used to measure the constituent components of physical frailty [48]. Therefore, many clinicians still find these procedures for assessing physical-function-related outcomes more time consuming and impractical for universal clinical implementation. Moreover, given that changes in the total scores and classifications produced by these indices are driven mostly by changes in single-constituent components (e.g., gait speed and/or STS performance), ref. [63] and that single tests are usually simpler, more time efficient and carry superior prognostic value [62], it makes sense to propose the following stand-alone tests and outcomes for routine use in clinical practice, but also for research purposes.

3.2. Walking Mobility

Several investigators have evaluated walking ability via measures of distance walked during a fixed time period (e.g., 6 min walk test) and time and gait speed over a set distance (e.g., Timed-Up and Go test over 3 m or gait speed over 4 m). Maintaining walking ability is important for active living and life participation, considering that walking is the most accessible form of PA and mobility. In a systematic review of falls in CKD, Lopez-Soto (2015) [64], identified that the majority of reported falls occurred during ambulation and rising from a seated and/or lying position. Thus, assessing and improving walking and

body transfer abilities may be important for immediate patient benefit in the short term. Table 1 summarises measurement properties of the most commonly reported walking tests in the CKD literature.

Gait speed stands out as the most consistent and discriminatory outcome for a number of health-related outcomes [6]. Nixon et al., (2020) [20], identified gait speed as the best single screening outcome for physical frailty in a cohort of 90 participants in CKD4–5. Gait speed had an area under the curve (AUC) value of 0.97 [95%CI 0.93–1.00] with sensitivity and specificity of 0.84 and 0.96, respectively, against the Fried's frailty phenotype. Similarly, gait speed was associated with excellent diagnostic accuracy for physical frailty in young (<65 years) people on HD with an AUC of 0.98 (95%CI 0.96–1.00) and in older (>65 years) patients (AUC: 0.79; 95%CI: 0.64–0.94). Notably, there was a significant difference in the AUC between the age groups, indicating that gait speed performs better as a frailty screening tool in the younger HD subgroup [21]. A cut-off point of <0.85 m/s for physical frailty screening was derived based on the best balance between sensitivity (79%) and specificity (93%) achieved against the Fried's frailty phenotype [21]. Moreover, a study including 800 people on HD suggested that gait speed may be more sensitive in discriminating function limitations in women than handgrip strength, or other measures of sarcopenia, as the prevalence of slowness amongst women (48.3%) was twice as common than in men (28.7%) [49]. From the same study, gait speed also significantly improved the accuracy of predicting death over 2 years, with 1SD of faster gait speed being associated with a significant (36%) reduction in death (HR: 0.64; 95%CI: 0.48–0.84). Gait speed <0.6 m/s as opposed to >0.6 m/s was associated with a HR of death of 2.17 (95%CI: 1.19–3.98) over a period of 12 months, in a cohort of about 700 people on HD of 65 years of age [50]. From the same study, people who could not complete a walk of 4.57 m were almost seven times more likely to die over a year (HR: 6.93; 95%CI: 4.01–11.96). The risk of hospitalisation over a year was similar, but still significant between subgroups with gait speed <0.8 m/s and <0.6 m/s (OR; 2.04; 95%CI: 1.19 to 3.49), but difficulties with activities of daily living (ADL) were more prevalent in the subgroup with gait speed <0.6 m/s. Each 0.1 m/s decrement in gait speed was associated with a 17% increased risk of death in the same group of HD patients over a period of 2 years [50] and with 26% increased risk of death in CKD 2–4 over a 3-year period [15].

Distance walked over 6 min (6MWT) of >350 m has also been associated with almost a three times higher risk of death over 3 years in pre-dialysis patients, in models controlling for multiple confounders [15]. Torino et al., (2014) reported that a 20 m increase in the 6MWT was associated with an 11% reduced risk of all-cause death, 7% of all fatal and non-fatal cardiovascular events and 4% of all-cause hospitalisations in 182 patients on HD [65]. Similar observations regarding the clinical interpretability of the timed up-and-go performance (TUG) have been reported in the literature, with 1 s slower TUG being associated with 8% increased risk of death [15], and scores > 10 s (or unable to complete) being associated with a seven-fold increased likelihood of ADL disability in elderly CKD5 patients [66]. More recently, Zanotto et al. (2021) reported that the 3 m TUG score was an excellent screening tool for physical frailty (AUC: 0.90; 95%CI: 0.80–0.99). A score >10.8 s was associated with sensitivity and specificity of 0.89 and 0.85, respectively, against Fried's Frailty phenotype in a cohort of 76 people on HD, and this test performed equally well as a screening tool in younger and older subgroups [21].

Gait speed and dynamic mobility are highly relevant for ADLs and strong predictors of patient relevant outcomes and might also outperform other measures of sarcopenia and muscle strength for discriminating function limitations between men and women on HD [49]. However, they may require some preparatory work (set up and marking of distances) and access to sufficient and safe walking indoor surfaces and spaces. In addition, assessment of walking mobility would be feasible only in ambulatory people (Table 1).

3.3. Body Posture Transfers

Sit-to-Stand (STS) performance tests involve rising unassisted from a standard height chair (42–46 cm) and sitting back on the chair, as fast as possible. Sit-to-Stand body transfers are commonly used as outcomes in exercise-based interventions in the CKD population, and several variations of the test exist, such as STS-5 and STS-10, which reflect the fastest time (in seconds) people can complete 5 or 10 STS cycles. These tests have been interpreted as proxy indicators of muscle power [5,67]. Sit-to-Stand-5-derived muscle power has been shown to significantly discriminate varied abilities in performing ADLs and walking, and even outperformed a muscle-mass index in a group of 100 individuals in pre-dialysis CKD [68]. STS-30 and STS-60, on the other hand, have been used as indicators of muscular endurance and fatiguability, as they require patients to perform as many STSs as they can in 30 and 60 s respectively [5]. The clinical value of the STS performance is supported by observations that for every 1 mL/min/1.73 m^2 drop in GFR, the odds were 1.5 times higher that the patient would not be able to rise unassisted from a chair once (STS1), and when the diagnosis was diabetes, the odds ranged from 1.7 to 21 times higher [69]. In a more recent study in 162 CKD 2–5 patients, lower STS30 was significantly associated with a 35% reduced risk of major adverse cardiovascular events (HR: 0.65; 95%CI: 0.47–0.89) and 16% reduced risk of all-cause hospitalisation (HR: 0.84; 95%CI: 0.74–0.95) over a period of 29 months [53]. Zanotto et al. (2021), also reported excellent diagnostic accuracy of STS-5 against Fried's frailty phenotype in 76 people on HD (AUC: 0.86; 95%CI: 0.75–0.96). A cut off point of >15.6 s was associated with sensitivity of 87% and specificity of 77% and performed equally well in younger and older patients [21]. The responsiveness characteristics of the STS-5 test were reported in a group of 26 individuals with CKD2–4, following a 12-week exercise intervention [47]. Change in QoL, as assessed using the SF36 questionnaire, was used as the criterion against which STS5 change scores were validated. Out of five physical function outcomes tested (STS-60, shuttle walk test, VO$_2$ peak, one repetition max), STS-5 change was the only outcome that significantly discriminated between those who reported better QoL vs. same or worse QoL following the exercise programme (refer to Table 1 for measurement properties characteristics).

3.4. Handgrip Strength (HGS)

In the last decade, we have seen a significant volume of evidence on the predictive value of HGS as an indicator of muscle function and mortality and morbidity outcomes in the CKD population [24,70]. Indicatively, Isoyama et al., (2014) reported that HGS only, remained a significant predictor of death over a period of 29 months (HR: 1.79; 95%CI: 1.09 to 2.94) vs. muscle mass (HR: 1.17; 95%CI: 0.73 to 1.87), in a cohort of 330 people on HD [56]. Furthermore, HGS seemed to identify a higher proportion of people at risk of death, particularly during the early months of the follow-up period, as opposed to the number of people identified as at risk based on measures of muscle mass alone or by sarcopenia classification [49,56]. Similarly, in a cohort of 128 KTx recipients (49 ± 15 year) who were followed for up to 64 months, only decreased HGS remained significantly associated with higher risk of combined mortality and hospitalisations and it even outperformed indices of muscle mass, sarcopenia and sarcopenic obesity in fully adjusted models [57]. However, a recent report by Zanotto et al. (2021), which included data from 76 people on HD, suggested that HGS might not be the best screening tool for frailty in comparison with other tools such as STS-5 and TUG, as it had the lowest AUC: 0.71 (95%CI: 0.59–0.83) and specificity (46%) characteristics [21]. As mentioned earlier, HGS alone may underestimate the prevalence of function limitations in women on HD [49], the predictive power of HGS for survival in women [71] and the extent of lower-limb weakness in all genders [15]. Nevertheless, assessment of HGS is highly common practice for evaluating frailty and sarcopenia in a wide range of population groups with established cut-off criteria [23,59], and existing UK normative data for comparison purposes [60]. Reliability characteristics of the HGS assessment are scarce in the CKD population, but given the highly desirable feasibility

features of this assessment tool (Table 1), it could be a tool appropriate for universal implementation in clinical practice.

4. Summary and Conclusions

Adequate physical function is essential for life-participation activities and perceived satisfaction with overall quality of life. Maintenance of functional independence and prevention of disability is a priority target in all clinical practice guidelines for the management of people in all stages of CKD, and accurate and feasible assessment of physical function, is key to supporting the effective implementation of these guidelines. The most commonly reported tests in the CKD literature, which objectively assess function limitations at the level of the individual, are walking tests to determine gait speed and dynamic walking mobility, sit-to-strand transfers and isometric hand grip strength. All three of these measurement tools can be easily implemented in routine clinical practice and in research settings alike for monitoring and evaluation of physical health. Based on the currently available knowledge, all three of these measurement tools are independent and strong determinants of a range of adverse health outcomes such as falls, frailty, hospitalisations and mortality. Interpretation and evaluation of test results is supported by research evidenced clinical anchors and other clinimetric characteristics, as summarised in Table 1.

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