Title: A narrative review on measurement properties of fixed-distance walk tests up to 40 meters for adults with knee osteoarthritis

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Abstract

Knee osteoarthritis (OA) is a serious disease and has no cure to date. Knee OA is a leading cause of functional limitation, e.g., difficulty walking. Walking speed is one method of quantifying difficulty with walking, and should be assessed in clinical practice for adults with knee OA because it has prognostic value and is modifiable. Specifically, slow walking speed is associated with increased risk of adverse health outcomes, including all-cause mortality in adults with knee OA and can be modified by engaging in physical activity or exercise. However, at present, there is little consensus on the distance and instructions used to conduct the walk test. Distance is often selected based on space availability, and instruction varies from asking the participants to walk at a comfortable pace vs. as fast as possible. Therefore, the purpose of this narrative review is to summarize the measurement properties, strengths, and limitations of a fixed-distance walk test less than 40 meters in adults with knee OA. Good measurement properties in terms of reliability and validity were observed across the different testing protocols for fixed-distance walk test, i.e., any distance ≤ 40 meters and fast- or self-paced. Therefore, clinicians and researchers can select a testing protocol that can safely and consistently be performed over time as well as provide a practice trial to acclimatize the patients to the fixed-distance walk test.

Key index terms: knee osteoarthritis, walk test, physical performance measures, physical function, assessment, measurement properties, validity, reliability, responsiveness.

Introduction

Knee osteoarthritis (OA) is a leading cause of functional limitation, e.g., difficulty walking (1-4), and affects over 250 million people worldwide (5). Walking ability serves as an important indicator of overall health in adults with knee OA, given adults who report difficulty walking have a 51% higher risk for all-cause mortality compared to those with no difficulty(6). Walking speed is one method of quantifying difficulty with walking. Slow walking speed is associated with a variety of health outcomes including all-cause mortality in well-functioning older adults (7-11) and other patient populations, including stroke and spinal cord injury (12-14). For this reason, walking speed is considered a 'functional' vital sign of overall health (10, 15). Additionally, engaging in physical activity or exercise improves walking speed and minimize the risk of developing walking difficulty (16-18), which is important for knee OA population given no cure has been found to date. Therefore, walking speed should be assessed in clinical practice for adults with knee OA because it is modifiable and has prognostic value.

There are different protocols for walk test, i.e., fixed-duration (6-minute walk test), fixed-distance (8 feet, 10-meter or 20-meter walk test) or walk test with incremental speed (shuttle walk test). In this review, we will focus only on a fixed-distance walk test less than or equal to 40 meters because it measures the ability to walk over short distances, an activity commonly restricted in adults with knee OA. Fixed-distance walk tests measure the time needed to ambulate over a specific distance. Participants are instructed to walk either at a comfortable/usual pace (self-paced walk test) or as fast as possible (fast-paced walk test). Walking speed can then be calculated by dividing the total distance by the total time taken to complete the test. Slower walking speed indicates worse physical function (11). Both self-paced and fast-paced walk tests have been used in various patient populations, including those with and without musculoskeletal pain and those with neurological diseases such as stroke (12-14).

To facilitate the use of walk test, having an understanding of its measurement properties is critical for both clinicians and researchers. From a clinical perspective, knowledge about psychometric properties will guide health care professionals to screen patients and assess their expected health, as well as describe whether patients have improved or worsened over time. For instance, it will help healthcare professionals to identify whether observed change is meaningful or considered measurement error. Comparing scores to normative values will help quantify walking impairments. From a research perspective, understanding the psychometric properties of walk tests will assist researchers in choosing the most reliable and responsive walk tests when selecting outcomes for clinical trials or observational studies.

Osteoarthritis Research Society International (OARSI) recommends the 40-meter fast-paced walk test to assess physical function in adults with knee OA (19). However, the distances and instructions (i.e., participants are told to walk at comfortable pace vs. as fast as possible) utilized for conducting walk tests are variable. Distance is usually selected based on the space available within the clinical and research settings. To better facilitate the use of the walk test in research and clinical practice, there is a need to understand the psychometric properties and predictive elements of walking speed measured using fixed-distance walk tests. A systematic review on walk test in knee OA was conducted in 2012 (20). Therefore, the purpose of this narrative review is to provide an up to date description of measurement properties of fixed-distance walk tests less than or equal to 40 meters in knee OA and discuss their strengths and limitations. A goal of this review is to encourage clinicians and researchers to employ walk tests given they are quick and easy test to utilize and provide insights on how to implement walk tests in the clinical/research setting based on the latest evidence. Additionally, an infographic has been created to provide a visual representation for the narrative review.

Methods

Relevant literature for articles investigating the measurement properties of walk test in adults with knee OA were identified using targeted search in PubMed and Google Scholar. Broad searches were initially performed using "walk test" and "knee osteoarthritis" alone and in combination with several different terms, including "performance-based measures", "psychometric property", "reliability", "validity", "construct validity", "predictive validity", "health outcomes", and "measurement property" . Only English-language articles indexed in PubMed or Google Scholar through August 2020 were included. Titles, abstracts, and full reports of the identified articles were screened for relevance. The articles were included in this review if they examined at least one measurement property of fixed-distance walk test less than or equal to 40 meters in adults with knee OA.

In this review, we examined the following measurement properties of walk tests of varying distances in adults with knee OA: reliability, validity, measurement error, and responsiveness.

- Reliability refers to the consistency of the walk test. Specifically, test-retest reliability examines the reproducibility of the test results across different (inter-rater) and/or same (intra-rater) examiners over multiple sessions, which can be evaluated using intraclass correlation coefficients (ICC) (21).
- Construct validity examines the relationship of the walk test to another test of physical function or purported constructs, which can be evaluated using a correlation coefficient.

Predictive validity provides information regarding the ability of the test to predict future health outcomes, including mortality (21).

- Standard error of measurement (SEM) is the amount of error that reflects the measurement error of the walk test. SEM is the dispersion around the true value for the walk test. Minimal detectable change (MDC) is the minimum amount of change, beyond measurement error, necessary to ensure that the change was not due to random variability (21).
- Responsiveness is the ability of the test to identify clinically relevant or meaningful change following an intervention, or over the time. This can be determined using test scores anchored to patient-reported or provider-reported thresholds, and interpreted using the minimum clinical important change/difference (MCID) (22).

Quality review of the literature

The methodological quality of the studies included in the review was investigated using the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) checklist (23). This appraisal was performed only for studies that investigated the following measurement properties - reliability, construct validity, measurement error and responsiveness. We acknowledged that the COSMIN checklist was originally developed to investigate the methodological quality of each measurement property for patient-reported outcome measures. However, since its inception, the checklist has been used to evaluate methodological quality for performance-based measures., including walk tests (20, 24). We used the checklist to evaluate reliability, construct validity, measurement error, and responsiveness when reported by the included studies. Each measurement property contains items related to study design and statistical methods that can be used to assess whether a study on a specific measurement property meets the standard for good methodological quality. Each item is rated as excellent, good, fair, or poor. We utilized a similar scoring approach that was taken by Dobson et al.(20) Specifically, in agreement with the COSMIN developers, the authors chose to use the "second worst score counts" method as several of the studies would be appraised as 'poor' based on small sample size. We reported the scoring as '+' for positive, '?' for indeterminate, and '-' for poor ratings. The detailed methodology for determining positive, indeterminate and poor rating for each psychometric properties of the walk tests has been published in a previous study by Dobson et al.(20) 'NR' was used if the specific measurement property was not reported or investigated in the study.

Results

An electronic broad search yielded 1012 abstracts, which were reviewed (by titles and abstracts) for relevance according to our inclusion criteria and 972 articles were subsequently excluded. Thus, leaving a total of 40 articles for full review. After full review, including manual search of reference list, 22 articles were subsequently excluded (given they used fixed-time walk tests e.g. 6-minute walk test, or other performance-based measure e.g. sit-to-stand test, or did not include knee OA population). Thus, a total of 18 articles were included in this review, where 12 articles described reliability, construct validity and/or measurement error, and 6 articles described predictive validity of fixed-distance walk test up to 40 meters in adults with or at risk of knee OA. The majority of studies included only assessed 2 or fewer of the psychometric properties (17/18, 94.4%), while Tolk et al. (25) was the only study to assess 4 properties (reliability, construct validity, measurement error and responsiveness). Gill and coauthors assessed 3 properties (reliability, construct validity and measurement error) from the same sample as well, but were reported in two separate papers (26, 27).

Reliability

To determine the reliability of walk test, 1 study used $ICC_{1,1}$ (One-way random single measures)(26), 3 studies used $ICC_{2,1}$ (Two-way random single measures) (28-30), 1 study used $ICC_{3,1}$ (Two-way mixed single measures) (31), 3 studies used ICC (no information on type available) (25, 32, 33), and 1 study used Spearman correlation (34). Good reliability has been seen in the 50-foot, 8-meter, 13-meter, 20-meter, and 40-meter walk tests. Specifically, the test-retest and/or intra/inter rater reliability for 50-foot, 8-meter and 40-meter fast-paced walk tests were excellent, with ICC being greater than 0.9 (25, 26, 29-31). Two studies have shown good test-retest reliability for 13-meter and 20-meter self-paced walk tests, ICC >0.9 or spearman correlation between the session being greater than 0.9 (32, 34). A few studies reported improvement in test-retest reliability when the first trial was excluded from the analysis (26, 29, 34) (See Table 1). Fransen et al. (29) investigated reliability for both self-paced and fast-paced walk test in the study. In this study, one test was conducted prior to each session where participants were instructed to walk at unspecified pace. Regardless of whether it was fast-paced or self-paced, the reliability of a fixed-distance walk test less than or equal to 40 meters was excellent in adults with varying severity of knee OA (mild OA to those waiting for knee replacement surgery) (26, 28, 34). Of the 9 studies that assessed reliability, 5 studies (25, 26, 28, 31, 35), had participants who used assistive device/walking aids. However, the effects of the use of an assistive device on reliability was not fully explored.

Construct validity

Regardless of test distances, fast-paced walk tests have shown good construct validity with other known measures of physical function, i.e., 30 second chair stand test, SF-36 Physical Function scale, quadriceps strength, SF-36 Physical Component Summary scale, WOMAC function and Lower Extremity Functional Scale (27, 32, 35, 36) (Table 1). However, one study by Tolk et al. (25) found that the 40-meter faced paced walk test had limited construct validity, (spearman correlation of 40-m fast paced walk test with Knee injury and Osteoarthritis Outcome Score-Physical Function Short Form was less than 0.3). However, the same study found a moderate to strong correlation between the 40-meter fast-paced walk test and quadriceps strength (Spearman correlation >0.6) (25). The evidence for self-paced walk tests was limited. However, a study conducted by Bacon et al. (37) showed that quadriceps strength and 20-meter self-paced walk test may have non-linear relation in adults with symptomatic knee OA.

Predictive Validity

Slow walking speed can predict incident symptomatic and radiographic knee OA in community-dwelling participants. (38) Further, slow walking speed was associated with increased mortality risk (39) irrespective of the history of decline over the past one year in adults with knee OA (40) and indicates physical inability to engage in physical activity, i.e., walking fewer steps per day (41) (Table 2). However, evidence on predictive validity for fast-paced walk tests is limited.

Walking slower than 1.2 meters/second on a 20-meter self-paced walk test and walking slower than 0.5 meters/seconds on 8-foot self-paced walk test was predictive of all-cause mortality in adults with radiographic knee OA (39). The risk of developing radiographic knee OA increases by 8% for every 0.1 meters/second decline in walking speed over one year after accounting for age, knee injury, body mass index, physical activity scale for the elderly score

(42). Decline in walking speed over one year was associated with a 104% increase in risk of knee replacement in the following year compared to those without any change in walking speed (43).

Measurement error

SEM and/or MDC with a 90% confidence interval (MDC_{90}) were reported for both self-paced and fast-paced walk tests in adults with knee OA. Table 3 shows the values for the SEM and MDC_{90} for walk tests that were found in adults with knee OA. Specifically, the SEM and MDC_{90} for the 40-meter self-paced walk test was 0.14 meters/second and 0.32 meters/second respectively in adults with end stage hip and knee OA (28). SEM and MDC_{90} for the 10-m fast-paced walk test was 0.10 meters/second and 0.28 meters/second, respectively, in adults with hip or knee OA or following joint replacement (30).

Responsiveness

Tolk et al. (25) reported that 40-meter fast-paced walk test was responsive given at least 75% of hypothesis on correlation between the change scores in walk test and anchor question were confirmed. However, we did not find the evidence for responsiveness for self-paced walk test in adults with knee OA.

Appraisal of methodological quality of studies included in this review

We used the COSMIN checklist (20) to evaluate the methodological quality of the included studies and determined that all studies met either an indeterminate or positive rating if the property was assessed. Table 4 displays the rating for each specific property reported by the studies. Twelve individual studies were appraised for methodological quality for following measurement properties: reliability, construct validity, measurement error and responsiveness only. For reliability, we rated 8 studies as positive (66.7%), 1 as indeterminate (8.3%), and 3 could not be rated as they did not include the appropriate metric (25%). For construct validity, 4 studies were appraised as positive (36.4%), 1 study was appraised as indeterminate (9.1%), while the remaining 7 studies did not report on construct validity (54.5%). For measurement error, 6 studies were rated as positive (50.0%), and 6 studies did not receive a rating (50.0%). Only 1 study, which was rated positive (100%) assessed responsiveness in adults with knee OA.

Discussion

In this narrative review, we found that there were inconsistencies in the testing protocol for fixed-distance walk tests up to 40 meters. Regardless of variability in distance and instructions used to conduct the test, they were reliable in knee OA population. Fast-paced walk tests have good construct validity and were responsive while self-paced walk tests have good predictive validity. Specifically, slow walking speed (measured using self-paced fixed-distance walk test) was associated with an increased risk of mortality in knee OA and increased the risk of developing radiographic and symptomatic knee OA. Thus, good measurement properties, in terms of reliability and validity were observed across the different testing protocols. Hence, clinicians and researchers can likely select a testing protocol that can safely and consistently be performed in a clinical or research setting, and be assured that it will likely perform well. We have summarized methods, interpretation, pros/cons, and application of fixed-distance walk tests in the infographic.

We found the reliability of the walk test was good in adults with varying severity of knee OA (26, 28, 34) regardless of the distance and instructions used to conduct the test. However, the reliability may be affected by the number of trials. For both self-paced and fast-paced walk tests, reliability improved when the first trial was removed (26, 29, 34). The first trial may serve as a practice trial and may facilitate the adults with knee OA to get acclimated to test, which may explain the improvement in the reliability. Therefore, it is recommended to administer practice trials in clinical and research settings to obtain reliable values for both self-paced and fast-paced walk test.

Walk tests are relatively easy for clinicians and researchers to administer and can be conducted in most clinical/research settings. The equipment needed includes a marked walkway, stopwatch, and tape measure. Further, scoring on most tests allows the use of assistive devices by patients if needed. However, it is important to note that the protocol used to conduct the walk test and information regarding the scoring needs to be documented and kept consistent for repeated measurements. The respondent and administrative burden is minimal, given that tests can be completed in less than 5 minutes, and no specialized training is needed to conduct the test. Further, they can be administered and adapted to any language. Normative comfortable walking speed values based on age range from 20 to 79 years are published (44). A recent study showed reference values (by sex, age, Kellgren–Lawrence grade, or body mass index) for walking speed measured using the 20-m walk test (45). Given walk tests are a performance-based measure, they are not subjected to the same limitations as using patient-reported physical function measures, such as recall bias (46). Though the evidence on the MCID for the walk test is not established in knee OA population, previous studies in older adults have shown that the self-paced walk test has the ability to detect clinically meaningful change. Specifically, Kwon et al. (47) found the change of 0.08 m/s on the 4-m self-paced walk test as clinically meaningful change in sedentary adults aged 70 to 89 years old.

Strengths and Limitations

The major strengths of walk tests are that they are valid, have good test-retest reliability in adults with knee OA, and have good predictive validity for health outcomes in older adults. This test has shown to predict health outcomes, including the ability to be physically active and mortality in adults with knee OA. Further, it is easy to administer and interpret, requires little equipment and/or training, and is thus inexpensive. However, there are several limitations. First, there is little consensus regarding the distance to be used for the test and whether participants were instructed to turn around while testing. This, in turn, can impact the acceleration and deceleration phases needed to complete the walk test. Prior studies caution using walking speed values interchangeably for short- versus standard-distance walk tests, i.e, 4-meter vs. 20-mter or 10-meter (48-50). Thus, we caution generalizing the evidence regarding walking speed measured using different test distances and instruction. Second, prior studies have shown that age, race, psychological factors (e.g. depression), and disease severity are associated with slower walking speed (51-54). Therefore, patient-specific factors should be accounted for when interpreting walking speed values. Third, there are limited construct validity studies for self-paced walk tests, however, the predictive validity of the self-paced walk test is strong. On the contrary, construct validity studies for the fast-paced walk test are extensive, but there is limited evidence on predictive validity in the knee OA population. Therefore, further research is needed to investigate the psychometrics for both self-paced and fast-paced walk tests. Lastly, the focus of this review was on a fixed-distance walk test less than 40 meters. Therefore, future research or review on measurement properties on fixed-duration walk test (e.g. 6-minute walk test) or fixed-distance walk test greater 40 meters in knee OA population is needed.

Summary

Regardless of test distances, walk tests are recommended to objectively assess walking difficulty in adults with varying degrees of knee OA (mild to end-stage knee OA) for clinical and research purposes. However, there is a need to highlight the distance used to measure walking speed as well as whether the walk test was conducted at a comfortable or fast pace in research studies so the thresholds indicative of poor health outcomes can be applied appropriately. Health care providers should stick with the testing protocol (best suited as per the space availability) and use it over time to ensure reliability and the ability to interpret change. Further, when possible, a practice trial may be considered to acclimatize the patients to the fixed-distance walk test.

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Table 1: Reliability and validity of walk test in adults with knee osteoarthritis

Study	**Sample size**	**Patient population**	**Test Distance**	**Instruction**	**Number of trials**	**Use of assistant devices**	**Test-retest or intra/inter rater reliability: ICC or spearman correlation [95%CI]**	**Comparator for construct validity**	**Construct validity: Correlation r[95%CI]**
Motyl et al, (34)	15	Mild to moderate OA	20-meter	*walk tests were conducted at a self-selected pace	2 trials/session[ɣɣ] 2 sessions/visit 2 visits 8 to 20 days apart.	Participants who used assistive devices were not included in the study	****Within day:** Day 1 Session 1 – 0.94 [0.83, 0.98] Day 1 Session 2 – 0.90 [0.72, 0.97] Day 2 Session 3 – 0.97 [0.91, 0.99] ****Between day:** Session 1 and 3 – 0.78 (0.45, 0.92) Session 2 and 3 – 0.95 (0.85, 0.98)		
Gill et al, (26, 27)	82	People awaiting hip/knee replacement surgery	50-foot	'go as fast as you can safely walk'.	4 trials[ɣɣ]	Used of walking aid was allowed but effects on measurement properties not available	0.97 [0.90, 0.98]***	30-CST SF-36 PF SF-36 PCS WOMAC function	-0.64 [-0.75, -0.49] -0.39 [-0.56, -0.19] -0.38 [-0.55, -0.17] 0.42 [0.23, 0.58]
Kennedy et al, (28)	21	End stage hip and knee OA	40-meter	"walk as quickly as you can without overexerting yourself."	3 assessments	Used of walking aid was allowed but effects on measurement properties not available	0.91 [0.81, 0.97]		

Fransen et al, (29)	41	Adults with knee OA	8-meter	1st five trials: "walk at a pace that you consider to be normal" Next five trials: "walk at a pace that you consider to be fast"	5 trials at normal pace and next 5 trials at fast pace. ϒϒ 45-60 seconds pause between each trial.	None of the participants were using a walking aid for indoor ambulation	For 1st five trials: 0.93 [0.88, 0.96]*** For next five trials: 0.93 [0.90, 0.96]***		
Stratford et al, (35)	93	Patients awaiting total hip or knee arthroplasty	20-meter	"walk as quickly as you can without overexerting yourself."	Not available	The use of walking aids was permitted but effects on measurement properties not available		Lower Extremity Functional Scale	0.44 [0.26,0.59]
Marks, (32)	15	Knee OA	13-meter	"walk with ordinary shoes at their normal comfortable walking pace"	2 trials/session 2 minutes rest pause between trial 2 session 1 week apart	0 participants used walking aids.	Within day: 0.98**** Between day: 0.80****	Lequesne Index of Severity for Knee OA	0.65
Dobson et al, (30)	51	Hip or knee OA, or following joint replacement	40-meter	"walk as quickly but as safely as possible, without running"	1 trial/session 2 sessions 1-week apart	Participants ambulated independently in the community (i.e., no walking aids)	Within-rater reliability 0.92 [0.82, 0.96]		
Dobson et al, (30)	51	Hip or knee OA, or following joint replacement	10-meter	"walking as quickly as possible, without running"	1 trial/session 2 sessions 1-week apart	Participants ambulated independently in the community	Within-rater reliability 0.88 [0.80, 0.93]		

						(i.e., no walking aids)			
Tolk et al, (25)	N= 30 for reliability N=85 for validity	Knee OA patients indicated for total knee arthroplasty	4 x 10-meter	"walk as quickly but as safely as possible, without running"	For reliability assessment: 2 trials 20 minutes apart	2 participants used walking aids during the test	0.93 [0.85, 0.96]	KOOS-PS OKS Quadriceps strength	-0.25 0.32 0.64
Villadsen et al, (33)	20	Severe hip or knee OA	20-meter	1st two trials: "walk with their usual pace" Next two trials: "walk at the maximal pace in which they felt secure"	2 trials at usual pace and next 2 trials at fast pace	No information available	1st two trials: 0.93 For next two trials: 0.98		
Holm et al, (33)	40	radiographic and/or symptomatic Knee OA	40-meter	"walk as fast as possible without compromising safety"	1 trial/session 2 sessions 3 days apart	3 participants use cane while performing the walk test.	Between 2 session: 0.98 [0.96, 0.99]		
Luc-Harkey et al, (36)	76	symptomatic and radiographic tibiofemoral OA	20-meter	"walk as quickly as possible from one set of cones to the other and to continue walking through the finish line	3 trials	Participants who used assistive devices were not included in the study		Quadriceps strength (involved limb) bilateral quadriceps strength	0.54$^{\gamma}$ 0.32$^{\gamma}$

				before stopping”						

*“if participant began to walk at a pace that was obviously not their normal self-selected walking speed as determined by the assessor (e.g., running or jogging), the test was immediately stopped”
**the effect estimates were computed using Spearman correlation. Specifically, for within session reliability
***reliability improved when 1st trial removed
****95%CI was not reported, however, the study reported standard error. The standard errors were 0.46 for within day and 1.10 for between day.
30-CST = 30 second chair stand test; SF-36 PF = SF-36 Physical Function scale; SF-36 PCS = SF-36 Physical Component Summary scale; KOOS-PS = Knee injury and Osteoarthritis Outcome Score - Physical Function Short Form; OKS = Oxford Knee Score,
ICC[95%CI] = Intraclass correlation [95% Confidence interval]. 95%CI are reported in table if they were reported in the evidence
r[95%CI] = correlation coefficient [95% Confidence interval]. 95%CI are reported in table if they were reported in the evidence
ɣ represents beta co-efficient obtained from the regression model, when walking speed was dependent variable and comparator was independent variable.
ɣɣ Practice trial recommended

Table 2: Predictive validity of self-paced walk test in community-dwelling older adults and adults with knee osteoarthritis

Study	Sample size	Patient population	Walk test	Outcomes
Purser et al, (38)	1858	community-dwelling adults	8-foot	Walking 0.1 m/s slower was associated with a greater incidence of radiographic and symptomatic knee OA
Master et al, (39)	4215	Adults with radiographic knee OA	20-meter	Walking 0.2 m/s slower was associated with an increased mortality risk
Master et al, (39)	1244	Adults with radiographic knee OA	8-foot	Walking 0.2 m/s slower was associated with an increased mortality risk
Master et al, (40)	4229	Adults with or at risk of knee OA	20-meter	Walking slower than 1.2 m/s was associated with an increased mortality risk, irrespective of decline over the past year
Master et al, (41)	1925	Adults with or at risk of knee OA	20-meter	Walking 0.1 m/s slower indicates inability to walking at least 6000 steps per day
Herzog et al, (42)	1460	Adults without radiographic knee OA	20-meter	Every 0.1 m/s decline in walking speed over one year increases the risk of developing radiographic knee OA
Harkey et al, (43)	4264	Adults with or at risk of knee OA	20-meter	One-year decline in walking speed was associated with an increased risk of future incident knee replacement.

Table 3: Standard error of measurement (SEM), ability to detect change and clinically meaningful change of walk test in adults with knee osteoarthritis

Study	**Sample size**	**Patient population**	**Walk test**	**SEM**	**MDC_{90}**
Kennedy et al, (28)	21	End stage hip and knee OA	40-meter *SPWT	0.14m/s	0.32 m/s
Dobson et al, (30)	51	Hip or knee OA or following joint replacement	10-meter **FPWT	0.10 m/s	0.28 m/s
Dobson et al, (30)	51	Hip or knee OA or following joint replacement	40-meter **FPWT	0.07 m/s	0.19 m/s
Gill et al, (26)	82	People awaiting hip/knee replacement surgery	50-foot **FPWT	1.32 seconds	3.08 seconds
Tolk et al, (25)	30	Knee OA patients indicated for total knee arthroplasty	4 x 10-meter **FPWT	0.10 m/s	
Villadsen et al, (33)	20	Severe hip or knee OA	20-meter *SPWT		1.7 seconds
Villadsen et al, (33)	20	Severe hip or knee OA	20-meter **FPWT		0.9 seconds
Holm et al, (31)	40	Radiographic and/or symptomatic knee OA	40-meter **FPWT	0.2 m/s	

MDC_{90} = Minimal Detectable Change at 90% confidence interval
m/s = meters/second
*SPWT = self-paced walk test
**FPWT = fast-paced walk test
OA = osteoarthritis

Table 4: Appraisal of the methodological quality of the included studies using COSMIN checklist

Articles	Sample size	Walk test	Reliability	Construct validity	Measurement error	Responsiveness
Motyl et al, (34)	15	20-meter *SPWT	?	NR	NR	NR
Gill et al, (26, 27)	82	50-foot **FPWT	+	+	+	NR
Kennedy et al, (28)	21	40-meter **FPWT	+	NR	+	NR
Fransen et al, (29)	41	8-meter *SPWT 8-meter **FPWT	+	NR	NR	NR
Stratford et al, (35)	93	20-meter **FPWT	NR	+	NR	NR
Marks, (32)	15	13-meter *SPWT	+	+	NR	NR
Dobson et al, (30)	51	40-meter **FPWT 10-meter **FPWT	+	NR	+	NR
Tolk et al, (25)	N= 30 for reliability and measurement error N=85 for validity N=70 for responsiveness	4 x 10-meter **FPWT	+	?	+	+
Villadsen et al, (33)	20	20-meter *SPWT 20-meter **FPWT	+	NR	+	NR
Holm et al, (31)	40	40-meter **FPWT	+	NR	+	NR
Luc-Harkey et al, (36)	76	20-meter **FPWT	NR	+	NR	NR

+ : positive rating; ? : indeterminate rating; - : Negative rating; NR : Not reported.
*SPWT = self-paced walk test
**FPWT = fast-paced walk test