The C5-75 Program: Meeting the Need for Efficient, Pragmatic Frailty Screening and Management in Primary Care

Linda Lee,[1,2,3] Aaron Jones,[4] Andrew Costa,[5] Loretta M. Hillier,[6] Tejal Patel,[2,7] James Milligan,[1,2,3] John Pefanis,[1,2] Lora Giangregorio,[3,8] George A. Heckman,[3,9] and Ruchi Parikh[2]

RÉSUMÉ

La recherche de cas de maladies chroniques complexes chez les personnes âgées de 75 ans et plus (évaluation C5-75) est une approche systématique visant la détection de la fragilité par l'évaluation de la vitesse de marche et de la force de préhension, ainsi que le dépistage d'affections comorbides. La présente étude a permis d'identifier les caractéristiques de ce programme de dépistage qui étaient les plus fortement associées à la fragilité en vue d'optimiser son dépistage. Les analyses ont inclus 1 948 évaluations C5-75 réalisées entre 2013 et 2018. Les facteurs les plus fortement associés à la fragilité étaient un âge supérieur à 85 ans, une faible activité physique et le fait d'avoir subi plus de deux chutes au cours des six derniers mois. Le fait de retrancher les patients de moins de 85 ans qui avaient rapporté une activité physique régulière et moins de deux chutes a exclu 39,1 % de la cohorte, tout en maintenant une sensibilité de 95,2 % et une valeur prédictive négative de 99,4 % pour la fragilité. Ces résultats permettront d'optimiser le dépistage de la fragilité, de faciliter sa mise en œuvre et de cibler les conditions coexistantes qui peuvent contribuer ou être influencées par la fragilité.

ABSTRACT

Case-Finding for Complex Chronic Conditions in Seniors 75+ (C5-75) is a systematic approach to identify frailty using gait speed and hand-grip strength and to screen for co-morbid conditions. We identified the C5-75 features offering the highest yield for identifying frailty and to streamline the screening program. Analyses included 1,948 C5-75 assessments completed from 2013 to 2018. Age 85 or older, less than regular physical activity, and more than two falls in the previous six months had the strongest associations with frailty. Exempting patients under 85 who reported regular physical activity and less than two falls excluded 39.1 per cent of the cohort while maintaining a sensitivity of 95.2 per cent and a negative predictive value of 99.4 per cent for frailty. These findings provide insight into optimizing screening for frailty, making it more feasible to implement and to identify co-existing conditions that may contribute to or be affected by frailty.

[1] Department of Family Medicine, McMaster University
[2] Centre for Family Medicine Family Health Team
[3] Schlegel-University of Waterloo Research Institute for Aging
[4] Department of Health Research Methods, Evidence, and Impact; McMaster University
[5] Departments of Clinical Epidemiology & Biostatistics, and Medicine; McMaster University
[6] GERAS Centre for Aging Research, Hamilton Health Sciences
[7] School of Pharmacy, University of Waterloo Centre for Family Medicine Family Health Team
[8] Department of Kinesiology, University of Waterloo
[9] Faculty of Applied Health Sciences, School of Public Health and Health Systems, University of Waterloo

*This study was supported by the Canadian Frailty Network Catalyst Grant.

Sponsor's Role: Canadian Frailty Network provided financial support for the implementation and evaluation of the C5-75 program.

Manuscript received: / manuscrit reçu : 18/12/2019

Manuscript accepted: / manuscrit accepté : 05/04/2020

Mots-clés : vieillissement, fragilité, dépistage, soins de première ligne, recherche de cas, comorbidité

Keywords: aging, frailty, screening, primary care, case-finding, co-morbid conditions

La correspondance et les demandes de tirés-à-part doivent être adressées à : / Correspondence and requests for offprints should be sent to:
Linda Lee, M.D.
Centre for Family Medicine Family Health Team
10 B Victoria Street
South Kitchener, ON N2G 1C5
(lee.linda.lw@gmail.com)

Introduction

Frailty has been defined as a state of increased vulnerability from age-associated decline in physiologic reserve and function resulting in reduced ability to cope with everyday or acute stressors (Bergman et al., 2007; Xue, 2011). It can be conceptualized as the convergence of geriatric and medical conditions, which, along with other factors such as socio-economic circumstances, can lead to greater propensity for health destabilization (Lee, Heckman, & Molnar, 2015). Frailty places older adults at greater risk for adverse outcomes such as recurrent falls, fractures, and disability as well as increased health service utilization and mortality (Fried, Ferrucci, Darer, Williamson, & Anderson, 2004; Martin & Brighton, 2008; McNallan et al., 2013; Shamliyan, Talley, Ramakrishnan, & Kane, 2013; Tom et al., 2013). It affects an estimated 10 to 14 per cent of community-dwelling persons aged 65 years and older, and prevalence increases with age and with certain complex chronic conditions (Collard, Boter, Schoevers, & Oude Voshaar, 2012; Shamliyan et al., 2013). Frailty may affect more than half of older persons with heart failure or chronic obstructive pulmonary disease (Jha et al., 2015; McNallan et al., 2013), and nearly one third of persons with Alzheimer disease (Kojima, Liljas, Iliffe, & Walters, 2017; Robertson, Savva, & Kenny, 2013).

Given the aging population, Canada's critical shortage of geriatricians, and a health care system challenged to meet the needs of persons living with frailty, it is increasingly recognized that primary care must accept a greater role in the management of frail older adults. As frailty and disability are dynamic and multidimensional involving physiologic, psychological, social, and environmental factors (De Lepeleire, Iliffe, Mann, & Degryse, 2009), primary care physicians are in a unique position to consider the effect of multimorbidity in the context of the person's individual circumstances and to tailor treatment recommendations to realistically attainable health care goals (Starfield, 2011). Moreover, primary care can increase equitable access to care and appropriate services, and reduce care costs with early community-based interventions that have the potential to prevent crises that lead to hospitalization (Starfield, Shi, & Macinko, 2005).

Early recognition of frailty and its contributing conditions has been challenging because its manifestations can be subtle and slowly progressive, and thus dismissed as normal aging. Identification of frailty can ensure that treatment decisions consider the potential for worsened outcomes in the context of frailty, resulting in better-informed decision-making that is consistent with the individuals' wishes and values. Recognition of co-existing conditions that are associated with frailty can optimize management, potentially avoiding health destabilization and related health care costs (Lee et al., 2015). Several conceptualizations of frailty and multiple frailty scales have been proposed; however, there is a lack of consensus on how best to assess frailty in primary care practice (Abellan van Kan et al., 2010; Rodriguez-Manas et al., 2013). Although the Fried frailty phenotype measure has been extensively tested for its validity and is widely used in research (Bouillon et al., 2013; de Vries et al., 2011; Fried et al., 2001), these measures may be too impractical or time-consuming to implement in busy clinical practice. The Centre for Family Medicine (CFFM) Family Health Team, in Kitchener, Ontario, Canada, created the CFFM Case-finding for Complex Chronic Conditions in Seniors 75+ (C5-75) program to meet the need for a feasible, efficient way to identify and address frailty within primary care.

The C5-75 Program

The C5-75 program is based on a chronic care model, a widely used framework for chronic disease management, which stratifies patients according to degree of risk and tailors interventions accordingly (Wagner, Austin, & von Korft, 1996). C5-75 aims to identify older adults who are frail and potentially at highest risk of poor outcomes and to initiate interventions to reduce the risk of health destabilization. The goal of C5-75 is to address frailty pro-actively in routine family practice to improve primary health care for older adults living with frailty, helping them to maintain health and well-being with the best quality of life for as long as possible. C5-75 incorporates a two-level algorithmic approach using validated tools. *Level 1* annual screening consists of screening for frailty using a standardized assessment of gait speed and hand grip as well as low physical

https://doi.org/10.1017/S0714980820000161 Published online by Cambridge University Press

activity, chronic obstructive pulmonary disease, and falls. *Level 2* screening systematically screens for common geriatric conditions associated with frailty, poor health outcomes, and risk for destabilization. The C5-75 screening protocol is presented in Table 1.

Although the Fried frailty phenotype measure has been extensively tested for its validity (Bouillon et al., 2013; Di Baru et al., 2014; Saum et al., 2012) and is widely used in frailty research (Bouillon et al., 2013; Clegg, Rogers, & Young, 2015; de Vries et al., 2011; Pialoux, Goyard, & Lesourd, 2012), administration of these frailty measures is time-consuming and impractical within the context of clinical practice. Alternatively, single-trait measures of frailty such as gait speed alone may be more feasible to implement in practice; however, there is concern they may produce too many false positives (Clegg et al., 2015; Lee et al., 2017).

In a previous study, we demonstrated that although single-trait measures of gait speed or hand grip strength alone were sensitive and specific proxies (sensitivity and specificity of 87.5%, 94.6% for gait speed; 100%, 90.5% for grip strength) for the Fried frailty phenotype, use of gait speed with grip strength was accurate, precise, specific, and more sensitive (sensitivity and specificity of 87.5%, 99.2%) than other possible combinations and were feasible to implement in primary care (Lee et al., 2017). In this study, we found that the positive predictive value for single traits in predicting the Fried frailty phenotype ranged from 13 per cent to 53 per cent and increased to 88 per cent for the dual measure of gait speed and grip strength (Lee et al., 2017). Measuring grip strength along with gait speed can increase screening predictive value without adding significant time, training, or costs (Bohannon, Bear-Lehman, Desrosiers, Massy-Westropp, & Mathiowetz, 2007; Karpman & Benzo, 2014). Thus, we used the dual measure of gait speed and hand-grip strength as a proxy for the Fried frailty phenotype; this approach is a practical and efficient means of screening for frailty within primary care.

Those who screen positive for frailty in Level 1 or who have heart failure or a history of falls are then scheduled for Level 2 screening. Featuring standardized measures known to have good psychometric properties, Level 2 consists of screening for (a) nutrition, (b) fracture risk (Papaioannou et al., 2010), (c) urinary incontinence (Bettez et al., 2012; Thuroff et al., 2011; Uebersax, Wyman, Shumaker, McClish, & Fantl, 1995), (d) depression (Kroenke & Spitzer, 2002; Kroenke, Spitzer, & Williams, 2003), (e) anxiety (Skapinakis, 2007; Spitzer, Kroenke, Williams, & Lowe, 2006), (f) social isolation (Lubben et al., 2006), (g) caregiver burden if applicable (Bachner & O'Rourke, 2007; Bedard et al., 2001), (h) cognitive impairment (Borson, Scanlan, Chen, & Ganguli, 2003), (i) falls risk (American Geriatric Society & British Geriatric Society, 2011), and (j) risk for destabilization (Elliott, Gregg, & Stolee, 2016) (see Table 1).

Screening results are documented in the patient's electronic medical record (EMR) and family physicians are notified when frailty or new conditions are identified. Evidence-informed interventions are then recommended, as applicable, for the management of these conditions, including referrals to other care providers (Lee et al., 2018a). A team-based interprofessional approach enables physicians to identify and manage high-risk persons within primary care, addressing the challenges related to limited resources and limited physician time with the structure of a typically busy family practice. By bringing together the patient's family physician, interprofessional health care providers, specialist physicians (if necessary), and community resources, health care providers are integrated within the primary care practice to meet patient and caregiver needs. More detailed information about the development and implementation of C5-75 and recommended interventions is available elsewhere (Lee et al., 2018a).

The two-level screening process was developed to establish a feasible and efficient approach to screening for frailty in the context of a busy primary care setting. Completed by a nurse prior to regularly scheduled routine medical appointments, Level 1 screening takes approximately seven minutes to complete. Given the realities of busy family practice with hectic workflow and time and resource limitations, Level 2 screening is completed in a separate, dedicated appointment as conducted by nursing, pharmacy, and if applicable, social workers. It takes approximately 30 minutes to complete. We selected the screening tools and interventions implemented in the C5-75 program on the basis of current research evidence, best-practice guidelines, and expert opinion; we developed and trialled the screening protocol using an iterative process, consistent with Plan, Do, Study Act (PDSA) cycles (Gillam & Siriwardena, 2013), of balancing potential benefits to patients with acceptability and feasibility within a busy clinical practice context (Lee et al., 2018a).

In a previous study of 965 patients who completed the C5-75 Level 1 screening, we identified 7 per cent as frail on the basis of their gait speed and grip strength; Level 2 screening (n = 640) identified patients with cognitive impairment (22%), depression (7%), social isolation (20%), and urinary incontinence (39%) (Lee et al., 2018a). An examination of 499 screenings for chronic obstructive pulmonary disease (COPD) resulted in 11 patients being referred for spirometry, after which four were newly diagnosed with COPD (Lee et al., 2016). We have also demonstrated the

https://doi.org/10.1017/S0714980820000161 Published online by Cambridge University Press

Table 1: Case-finding for Complex Chronic Conditions in Seniors 75+ (C5-75) screening tools

Level 1 Screening

Frailty	Exercise[c]	Heart Failure	Chronic Obstructive Pulmonary Disease[d]	Falls[e]
(i) 4 m gait speed[a] (ii) hand-grip strength[b] *For new assessments:* If frail (gait speed < 0.67m/second): (i) Refer for Level 2 screening. (ii) Refer for medication review. *For repeat assessments:* If frail (gait speed < 0.67m/second) and if gait speed is < .02m/second compared to last year: (i) Refer for Level 2 screening. (ii) Refer for medication review.	Which of the following describes you best? (i) I am physically active. I do 30 min. or more of moderate intensity physical activities, 5 or more days per week. (ii) I am physically active occasionally, or during some seasons much more than others. (iii) I am not physically active beyond moving around or walking during activities of daily living. If (ii) or (iii): Provide Prescription for physical activity with information about community exercise programs.	For all persons with known heart failure: (i) Refer for Level 2 screening. (ii) Refer for medication review.	Do you currently smoke cigarettes or have you ever smoked cigarettes? If "yes", ask: (i) Do you cough regularly? (Y/N) (ii) Do you cough up phlegm regularly? (Y/N) (iii) Do even simple chores make you short of breath? (Y/N) (iv) Do you wheeze when you exert yourself or at night? (Y/N) (v) Do you get frequent colds that persist longer than those of other people you know? (Y/N) If "yes" to any, refer for spirometry if this has not been completed within the past year.	I'd like to know about any falls you have had, whether or not you've had an injury. A fall means a slip or trip in which you lost your balance and landed on the floor or ground or lower level. (i) In the past 6 months, have you had two or more falls or near-falls? (Y/N) (ii) In the past 6 months, have you had a fall with injury requiring medical attention? (Y/N) If "yes" to either question: (i) Refer for Level 2 screening. (ii) Refer for medication review.

Level 2 Screening

Nutrition	Fracture Risk	Urinary Incontinence	Depression, Anxiety, Social Isolation	Caregiver Burden (if applicable)
1. Measure height 2. Measure weight 3. Ask: Have you lost weight in the past 6 months without trying to lose weight? (Y/N) If "yes", refer to dietitian.	If on medications for osteoporosis:[f] remind family physician to review appropriateness of therapy and monitoring. If not on medications for osteoporosis: (i) Order X-ray T-L spine if:[g] • rib–pelvis distance ≤ 2 fingerbreadths, or • Wall-Occiput distance > 5 cm, or • measured height decrease of ≥ 2 cm over 3 years, or decrease of > 6 cm from patient's tallest recalled height (ii) If ≥ 3 years since last Bone Mineral Density, order test. (iii) Ensure ≥ 800 IU Vitamin D.	Ask: Do you leak urine or wet yourself?[h] If "yes," ask: Does it bother you enough that you'd like to have this looked into further? (Y/N) If "yes":[i] (Frank & Szlanta, 2010) (i) Send urine for urinalysis and culture. (ii) Provide handout on avoidance of caffeine, alcohol, and excessive drinking of fluids. (iii) Order post-void residual pelvic ultrasound. (iv) Refer to incontinence program.	1. Administer PHQ-2; If score ≥ 3, request completion of PHQ-9.[j] If PHQ-9 score ≥ 10, MD is notified. 2. Administer GAD-2; If score ≥ 3, request completion of GAD-7.[k] If GAD-7 score ≥ 10, notify family physician. 3. Administer LSNS-6[l]; If score < 12, refer for social work assessment.	1. If caregiver is present, administer 4-item Zarit scale[m] (if caregiver is not present, obtain verbal consent to contact by phone). If score ≥ 8, request caregiver to complete 22-item Zarit scale. If score ≥ 17, notify family physician and recommend referral to social worker.

Continued

Table 1: Continued

Cognitive Impairment	Falls Risk	Assessment Urgency Algorithm (AUA)
If not seen in Memory Clinic within 1 year, administer Mini-Cog.[n] If positive score, notify family physician and recommend referral to the Memory Clinic.[o]	1. Obtain orthostatic vitals 2. Ensure optometrist or ophthalmologist assessment within past year 3. Check cane/walker height 4. Gait quality assessment 5. Ask: (i) Do you ever feel unsteady on your feet or that you might lose your balance? (Y/N) (ii) Are you worried about falling? (Y/N) If "yes" to either question, refer to Mobility Clinic.[p] (Lee, Milligan, Hillier, & McMillan, 2013)	Administer AUA[q] and record score. If score = 6, notify family physician and recommend referral to geriatric medicine.

[a] Gait speed instructions: "Walk at your usual speed, as if you are walking down the street to go to the store. Walk all the way past the other end before you stop".
[b] Hand grip measured twice on each side: "I would like to test your grip strength on both hands, as this can be an indicator of general strength. Squeeze as tightly as you can for 3 s".
[c] Physical activity screening (Topolski et al., 2006)
[d] Chronic obstructive pulmonary disease (COPD) screening (O'Donnell et al., 2008)
[e] Falls preventions (American Geriatric Society & British Geriatric Society, 2011)
[f] Medications for osteoporosis: risedronate; alendronate; denosumab; zolendronic acid; raloxifene; teriparatide
[g] Fracture prevention (Papaioannou et al., 2010)
[h] Urinary incontinence screening (Bettez et al., 2012; Thuroff et al., 2011)
[i] Management of urinary incontinence (Frank & Szlanta, 2010)
[i] PHQ-2/PHQ-9: Patient Health Questionnaire (2- and 9-question versions) (Kroenke et al., 2003; Kroenke & Spitzer, 2002).
[k] GAD-3/GAD-7: General Anxiety Disorder (3 and 7 item versions) (Spitzer et al., 2006).
[l] LSNS: Lubben Social Network Scale (Lubben et al., 2006)
[m] Zarit Caregiver Burden Scale (Bedard et al., 2001)
[n] Cognitive impairment screening (Borson et al., 2003)
[o] Assessment and management of memory concerns (Lee et al., 2010)
[p] Assessment and management of mobility issues (Lee et al., 2013)
[q] Assessment Urgency Algorithm (Elliott et al., 2016)

feasibility and acceptability of this program within our family practice setting as well as in a less-resourced group of 14 family practices in collaboration with a community pharmacy Lee et al., 2018b). Although described as a valuable way to pro-actively identify frailty and health issues, integrating C5-75 into busy family practice can be challenging from both a time and resource perspective, even at Level 1, which is quite brief (Lee et al., 2019).

After having implemented the C5-75 program for five years, we were interested in increasing the efficiency of the C5-75 workflow by targeting the program to those who are most likely to be frail. The purpose of this study was to identify which C5-75 screening criteria best identify those who are frail. With this information, we streamlined the screening process. A second objective was to report the prevalence of frailty as assessed by the new screening process.

Methods

Study Design

We conducted a retrospective medical record review for all consecutive patients assessed in the C5-75 program between April 1, 2014, and December 12, 2018. This study was approved by the Hamilton Integrated Research Ethics Board, McMasterUniversity.

Setting and Participants

Participants were patients who completed the C5-75 screening within the CFFM Family Health Team, which consists of interprofessional health care providers (physicians, nurses, social workers, and pharmacists) serving 28,420 patients, 1,518 of whom were aged 75 years and older, across 19 urban and rural family physician practices.

C5-75 Screening Process

Prior to regularly scheduled routine medical appointments, all patients 75 years and older completed the C5-75 assessment, as administered by specially trained nurses. Patients were excluded from screening if they were acutely ill; participation was voluntary. Frailty was measured using gait speed (Abellan van Kan et al., 2009), calculated as the number of seconds to walk four metres at a usual pace (the fastest of two trials is recorded), and hand grip strength (Syddall, Cooper, Martin, Briggs, & Aihie, 2003), calculated as the higher score of two 3-second trials, with each hand, using a handheld dynamometer (Jaymar Hydraulic Dynamometer Model #281-12-0600, J.A. Preston Corp, Clifton, NJ). Frailty was defined as four-meter gait speed of greater than 6 seconds (Abellan van Kan et al., 2009). Hand grip weakness was defined as a score within the lowest 20 per cent of the population, and stratified by gender (Lee et al., 2017; Leong et al., 2015). We validated this dual-trait frailty measure in previous research to be an accurate, precise, sensitive, and specific proxy for the Fried frailty phenotype (Lee et al., 2017).

Patients were also screened for level of self-reported physical activity (Topolski et al., 2006), history of falls (American Geriatric Society & British Geriatric Society, 2011), and COPD for those with a smoking history (O'Donnell et al., 2008) (Table 1). Patients identified as frail, as well as those who had heart failure and a history of falls (two or more in six months, or any falls requiring medical attention in six months) were scheduled for Level 2 screening and were referred to a pharmacist for medication review to identify medication-related problems and ensure medication optimization.

Data Collection and Analyses

Descriptive Statistics and Yield Calculations. Data collected from medical records included patient age, gender, and all assessment results. We conducted statistical analyses using R v3.5.2 (R Core Team, 2013). Descriptive statistics

Table 2: Level 1 and 2 sample characteristics

Level 1 Characteristics	*n* = 1,948
Demographics	
Age, yr (median Q1,Q3)	80 (76,84)
Gender, female, n (%)	1,045 (54)
Frailty Measures	
4m Gait Speed, seconds (median Q1,Q3)	4.1 (3.5, 4.9)
Hand grip strength, kg/m^2 (median Q1,Q3)	22 (18, 31)
Frail by gait speed,[a] n (%)	
Yes	209 (11)
No	1,697 (87)
Missing	42 (2)
Low grip strength,[b] *n* (%)	
Yes	349 (18)
No	1,583 (81)
Missing	16 (1)
Dual-trait frail,[c] *n* (%)	
Yes	84 (4)
No	1,810 (93)
Missing	54 (3)
Level 2 Characteristics	***n* = 195**
Age, yr (median Q1,Q3)	83
Gender, female, *n* (%)	111 (58)

Q1 = 1st quartile; Q3 = 3rd quartile
[a] 4m gait speed < 6 seconds
[b] Hand grip strength < 14 for females, or < 24 for males
[c] Both fail by gait speed and low grip strength

https://doi.org/10.1017/S0714980820000161 Published online by Cambridge University Press

(frequencies, means, standard deviations) were generated for age, gender, frailty measures, and positive screening results (categorical items). We defined dual-trait frailty as gait speed < 0.67m/second in addition to a grip strength of less than 14 kg/m^2 for females or 24 kg/m^2 for males. We defined item yield as the proportion of assessments in which an item was answered positively, unless that figure was greater than 50 per cent in which case the yield was one minus the positive proportion. This reflected the concept that an item that is consistently answered the same way (positive or negative) tends to contain less information than an item with greater balance between positive and negative responses. We calculated yield for the categorical items on the Level 1 and Level 2 assessments. For items with more than two possible responses, to calculate yield we used the most prevalent response against the other responses.

Associations with Frailty. For statistical analysis, we randomly split the data set into a training set containing 70 per cent of the cases and a validation set containing the remaining 30 per cent. We examined the associations between Level 1 assessment items and frailty defined by dual trait or gait speed alone, as measured on the same assessment within the training data set. We used multivariable logistic regression with generalized estimating equations and robust covariance estimation to account for correlation between multiple assessments belonging to the same patient. Missing data were treated with multiple imputation (van Buuren, 2007).

Optimization. In order to optimize the C5-75 assessment process, assessment items considered to have little value were identified for removal. Decisions regarding item removal were determined by team discussions considering item yield, strength of association with frailty, and the clinical importance of the item as judged by the group.

Criteria Development. We examined items retained on the C5-75 Level 1 assessment that had significant associations with frailty to determine whether criteria could be developed to exclude patients with a very low likelihood of frailty from gait speed and hand-grip measuring. Various criteria combining Level 1 items were examined and evaluated for their sensitivity, negative predictive value, and size using the validation data set. We determined a priori that an exemption protocol would need to achieve at least 90 per cent, preferably 95 per cent, sensitivity for dual-trait frailty.

Results

A total of 1,948 Level 1 assessments were completed by 1,123 patients; 507 patients had at least two Level 1 assessments completed over time. There were 195 Level 2 assessments completed by 159 patients; 23 patients had at least two Level 2 assessments. Patients contributing to Level 1 assessments to the study had a median age of 80, and 54 per cent were female (Table 2). There were 209 patients (11%) considered to be frail by gait speed, 349 patients (18%) had low grip strength, and 84 patients (4%) met the criteria for dual-trait frailty.

Item Yields

Levels 1 and 2 screening results are presented in Supplementary Table S1. Yields for the Level 1 assessment items ranged from 1.2 per cent to 48.1 per cent. The lowest yielding items were colds persist longer (1.2%) and wheeze during exertion (3.6%); the highest yielding item was regular physical activity (48.1%) and history of smoking (43.8%). Yields for the Level 2 assessment items ranged from 0.5 per cent to 27.8 per cent (Supplementary Figure S1). The lowest yielding items were weight loss greater than 5 lbs. (4.2%), self-reported fracture in previous year (6.0%), and a positive screen for generalized anxiety disorder (9.3%). The highest yielding items were self-reported urinary incontinence (36.3%), more than one fall in past year (27.8%), and a positive screen for cognitive impairment (25.6%).

Associations with Frailty

Older age in years (OR: 1.21, 95% CI, 1.13, 1.30), more than two falls in six months (OR: 3.36, 95% CI 1.18, 9.57), exercise only with daily living activities (OR: 8.54, 95% CI 2.74, 26.65), and only occasional exercise (OR: 2.94, 95% CI 1.11, 7.73) were factors significantly associated with dual-trait frailty (Table 3). Associations with gait-only frailty were similar: older age in years (OR: 1.14, 95% CI 1.09, 1.20), more than two falls in six months (OR: 4.35, 95% CI 2.00, 9.46), exercise only with daily living activities (OR: 9.66, 95% CI 5.09, 11.83), and only occasional exercise (OR: 3.34, 95% CI 1.83, 6.14).

Screening Criteria

We developed exemption protocol criteria using various combinations of age, falls history, and self-reported activity levels. Two criteria met the 95 per cent sensitivity threshold for both dual-trait frailty and gait-only frailty. A protocol that would exempt patients under 80 years of age who reported regular physical activity exempted 25.7 per cent of patients in our sample. These criteria had a sensitivity of 98 per cent and negative predictive value of 99.6 per cent for dual-trait frailty and a sensitivity of 97.7 per cent and negative predictive value of 99 per cent for gait frailty (Table 4). A second potential exemption protocol would exempt patients under 85 years old who reported regular physical activity and fewer than two falls in the past six months; this

https://doi.org/10.1017/S0714980820000161 Published online by Cambridge University Press

Table 3: Odds ratio (OR) and 95% confidence intervals (CI) from multivariable logistic regression of dual-trait frailty and gait speed frailty

Variable	Dual Trait Frailty			Gait Speed Frailty		
	OR	95% CI	*p*	OR	95% CI	*p*
Age (years)	1.21	(1.13, 1.30)	< 0.001	1.14	(1.09, 1.20)	< 0.001
Gender (Male)	1.07	(0.52, 2.21)	0.72	0.90	(0.57, 1.42)	0.64
Any COPD symptom	0.76	(0.21, 2.76)	0.55	0.71	(0.27, 1.93)	0.51
History of smoking	0.98	(0.31, 3.06)	0.78	1.06	(0.53, 2.13)	0.88
History of heart failure	0.78	(0.33, 1.85)	0.47	0.73	(0.37, 1.39)	0.34
More than 2 falls in 6 months	3.36	(1.18, 9.57)	0.02	4.35	(2.00, 9.46)	< 0.001
Activity level						
Only daily living vs. Regular physical activity	8.54	(2.74, 26.65)	< 0.001	9.66	(5.09, 11.83)	< 0.001
Occasional vs. Regular physical activity	2.94	(1.11, 7.73)	< 0.001	3.34	(1.83, 6.14)	< 0.001

Table 4: Prevalence of frailty and diagnostic accuracy measures of exemption criteria for dual-trait frailty and gait frailty on validation sample

Screening Criteria	% Of Sample Excluded	% Frail Among Included	% Frail Among Excluded	Sensitivity	Specificity	PPV	NPV
Dual Trait Frailty							
80 years+	47.8%	7.3%	1.3%	94.9%	48.7%	7.3%	98.7%
85 years+	78.6%	12.9%	2.2%	61.3%	80.5%	12.9%	97.8%
2+ falls in last six months	94.9%	16.2%	3.9%	17.8%	95.7%	16.2%	96.1%
Less than regular physical activity	48.0%	7.2%	1.4%	63.7%	76.3%	7.2%	98.6%
Only daily living activities	85.0%	4.3%	4.6%	34.9%	63.2%	4.3%	95.4%
80 years+ or 2+ falls in last six months	46.3%	7.2%	1.2%	87.5%	47.4%	7.2%	98.8%
80 years+ or less than regular physical activity	25.7%	5.9%	0.4%	98.0%	26.1%	5.9%	99.6%
2+ falls or less than regular physical activity	48.3%	7.3%	1.2%	87.5%	47.6%	7.3%	98.8%
80 years+ or only daily living activities or 2+ falls	41.4%	7.2%	0.8%	94.9%	34.4%	7.2%	99.2%
85 years+ or less than regular physical activity or 2+ falls	39.1%	7.0%	0.6%	95.2%	40.3%	7.0%	99.4%
Gait Frailty							
80 years+	47.8%	15.8%	5.8%	75.3%	50.3%	15.8%	94.2%
85 years+	78.6%	24.7%	7.2%	48.8%	81.5%	24.7%	92.8%
2+ falls in last six months	94.9%	39.4%	9.6%	17.6%	96.6%	39.4%	90.4%
Less than regular physical activity	48.0%	18.3%	3.3%	85.6%	52.3%	18.3%	96.7%
Only daily living activities	85.0%	12.6%	10.1%	42.8%	63.0%	12.6%	89.9%
80 years+ or 2+ falls in last six months	46.3%	16.4%	4.8%	80.1%	49.1%	16.4%	95.2%
80 years+ or less than regular physical activity	25.7%	14.5%	1.0%	97.7%	28.4%	14.5%	99.0%
2+ falls or less than regular physical activity	48.3%	18.2%	3.0%	87.3%	51.1%	18.2%	97.0%
80 years+ or only daily living activities or 2+ falls	41.4%	7.1%	0.6%	94.1%	43.0%	7.1%	99.4%
85 years+ or less than regular physical activity or 2+ falls	39.1%	17.5%	1.1%	96.0%	43.6%	17.5%	98.9%

PPV = Positive predictive value; NPV = Negative predictive value

exempted 39.1 per cent of patients in our sample with a sensitivity of 95.2 per cent and negative predictive value of 99.4 per cent for dual-trait frailty, and a sensitivity of 96 per cent and negative predictive value of 98.9 per cent for gait frailty (Table 4). None of the criteria examined achieved 90 per cent sensitivity for low grip strength (Supplementary Table S2).

Discussion

This study revealed that age (85 years and older), less than regular physical activity, and more than two falls in the past six months had the strongest associations with frailty. These findings support the increasing recognition of the association between physical activity and frailty, both in terms of low physical activity being

https://doi.org/10.1017/S0714980820000161 Published online by Cambridge University Press

a risk factor for frailty, and increasing evidence to support the effectiveness of physical activity interventions for frail older adults (Kehler et al., 2018; Negm et al., 2017; Rogers et al., 2017). The identification of screening items most strongly associated with frailty provides insight into how to more optimally and efficiently identify frailty in primary care to achieve maximum positive yield with minimum resource use. Revisions to the screening process (Figure1) focused on streamlining Level 1; we retained physical activity and falls items on the basis of their associations with frailty and removed screening for COPD; we also retained history of heart failure as a criterion for Level 2 screening for its clinical relevance. COPD screening was replaced with screening for dyspnea in Level 2 to identify poorly managed cardiorespiratory conditions (Fletcher, 1960); focusing on this in Level 2 may have increased its yield as the focus here was on screening among frail adults. We replaced nutrition screening in Level 2 with a new tool to screen for malnutrition (Morrison, Laur, & Keller, 2019). Lastly, we eliminated shortened versions of the depression (Kroenke et al., 2003) and anxiety (Skapinakis, 2007) screening tools to reduce assessment burden of having to administer both the shorter and longer versions of the tools.

By retaining the highest yield/most clinically important elements and eliminating the rest, we can make this program more feasible and generalizable to other primary care practice sites, which will likely impact longer-term sustainability. Feasibility is particularly relevant for Level 1 screening where there is a need to keep negative impact on patient flow in a busy practice setting to a minimum; this is less relevant for Level 2, which is completed in a separate office visit. As increasing age is strongly associated with frailty, it may not be necessary to screen all persons under age 85 for primary care for frailty; using hand-grip strength and gait speed on just those over age 85 or those over age 75 who report two or more falls in the past six months or report exercising only with activities of daily living (6% of patients) will capture almost the same number of frail persons as would be achieved by screening all patients aged 75 years and older. By targeting more comprehensive Level 2 interventions for only those most in need – that is, those who are frail – those complex conditions which can worsen frailty or be worsened by frailty can be identified and managed pro-actively to prevent destabilization of health.

This study confirms screening differences based on whether frailty is determined based on gait speed alone or dual traits (gait speed and hand grip). Other researchers have also noted that different ways of screening for frailty yields different subsets of frail patients; one method is not necessarily "better" than the other but, rather, they are complementary methods (Cesari, Gambassi, van Kan, & Vellas, 2014). Our findings confirm this emerging concept that gait speed alone will identify a slightly different population of frail persons than those identified by gait speed and hand-grip strength. Depending on resources available, physicians in primary care settings may elect to define frailty on the basis of gait speed alone; however, in doing so they will need to be aware that they may be identifying persons with differing prevalence of certain co-morbidities and may also be generating more false positives (Lee et al., 2017). The findings from this study provide additional support for our previous study finding that dual-trait frailty (hand-grip strength and gait speed) is preferable to single-trait measures alone (Lee et al., 2017) if the aim is to efficiently identify within primary care practice those older adults who are frail and have associated but unrecognized conditions which co-exist and may worsen frailty or be worsened by frailty.

Focusing on Level 1 items for primary care allows for the stratification of patients based on the risk of poor outcomes and tailoring intensity of intervention accordingly. Consistent with a chronic disease care model (Scott, 2008), all patients aged 75 years and older would receive a simple, quick, high-yield systematic screening process that is feasible at the primary care level to detect frailty; those deemed frail (and at higher risk of poor outcomes) would receive a more intense case finding for conditions associated with frailty. The rationale for this type of screening in primary care is the opportunity to optimize the management of these often unrecognized, co-morbid conditions before they destabilize. This upstream approach aims to prevent acute care utilization associated with destabilized conditions such as falls, medication mismanagement due to unrecognized dementia, fracture due to poorly managed osteoporosis, or unrecognized caregiver stress.

Key strengths of this program, which differentiate it from other frailty tools, are that it is (a) quick, practical, objective, and measurable; (b) created by primary care practitioners for busy primary care practice and validated in a family practice population; (c) systematically implemented into regular primary care office visits using typical office staff and is not dependent on physician time for screening; (d) not dependent on accurate updated EMR records on each patient, which is sometimes challenging when diagnoses are not recorded or no longer current and medication lists may be outdated; (e) not dependent on knowledge of functional abilities, which may be inaccurate when based on self-report and may require corroborated history for verification, nor is it dependent on a comprehensive geriatric assessment in order to determine level of frailty; and (f) it is based on the Fried frailty phenotype concept of frailty, which

https://doi.org/10.1017/S0714980820000161 Published online by Cambridge University Press

is one of the most commonly used standards of frailty in the published literature (Bouillon et al., 2013; de Vries et al., 2011).

Limitations and Future Research

Completion of C5-75 screening is limited to those who have scheduled primary care appointments and excludes those who are housebound and might be the frailest of patients. As such, this selection bias may underestimate the prevalence of frailty in this practice setting. Screening for falls in this study is based on self-report, which may underestimate the true prevalence of falls (Ganz, Higashi, & Rubenstein, 2005; Mackenzie, Byles, & D'Este, 2006; Peel, 2000). However, the objective of the screening program is not to accurately estimate the prevalence of falls, but rather to identify patients at high risk for frailty. So, while the number of falls might be underreported, our study demonstrates a strong association between the self-report of two or more falls in six months and frailty, which justifies its use in the screening protocol.

Although this study was implemented in a multidisciplinary primary care setting, with human resources and processes in common with other primary care–based programs for older adults (Counsell et al., 2007), more research is needed on the feasibility and impacts of implementation of C5-75 within varying practice models. We are currently examining the relationship between the trajectory of frailty and co-morbid conditions and interventions provided. Pilot testing of the revised screening protocol – with consideration for feasibility, acceptability to health care providers and patients, and efficiency – will further support improvements to this program. Of particular interest will be evaluative studies of the impact of C5-75 in enabling primary care to better identify and manage older adults living with frailty and streamlining referrals to geriatric medicine specialists, similar to other programs that build capacity in primary care for the management of complex geriatric conditions and improve efficiency of use of limited available specialist resources (Lee et al., 2010; Lee et al., 2018c).

Within the Level 1 screening protocol, we considered an individual's ever having had a diagnosis of heart failure as being an indication for referral to Level 2 screening. The idea was that anyone who has ever had heart failure may benefit from medication optimization and proactive identification as well as management of possible co-existing conditions, such as cognitive impairment and falls risk, to reduce risk of health destabilization. In considering heart failure, we did not use criteria for staging cut-offs, but it is possible that considering stage of heart failure may further increase efficiency of this inclusion criteria. This is an area for future exploration as we analyse data to determine the yield of referring all persons ever diagnosed with heart failure.

Conclusions

The findings from this study generated a more optimized, two-step screening process which uses annual hand grip and gait speed screening for frailty for patients aged 85 years and older, as well as for those aged 75 years and older who reported two or more falls in the past six months or who reported exercising only with activities of daily living. This screening process will identify approximately the same number of frail persons as would be identified by screening every person aged 75 and older. This approach will make it more feasible to routinely screen for frailty in primary care setting to optimize primary health care for older adults living with frailty, as well as to support informed treatment and care decisions in the context of frailty.

Supplementary Materials

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S0714980820000161.

References

Abellan van Kan, G., Rolland, Y., Andrieu, S., Bauer, J., Beauchet, O., Bonnefoy, M., … Vellas, B. (2009). Gait speed at usual pace as a predictor of adverse outcomes in community-dwelling older people an International Academy on Nutrition and Aging (IANA) Task Force. *Journal of Nutrition, Health and Aging*, *13*(10), 881–889.

Abellan van Kan, G., Rolland, Y., Houles, M., Gillette-Guyonnet, S., Soto, M., & Vellas, B. (2010). The assessment of frailty in older adults. *Clinics in Geriatric Medicine*, *26*(2), 275–286.

American Geriatric Society & British Geriatric Society. (2011). Summary of the Updated American Geriatrics Society/British Geriatrics Society clinical practice guideline for prevention of falls in older persons. *Journal of the American Geriatric Society*, *59*(1), 148–157.

Bachner, Y. G., & O'Rourke, N. (2007). Reliability generalization of responses by care providers to the Zarit Burden Interview. *Aging & Mental Health*, *11*(6), 678–685.

Bedard, M., Molloy, D. W., Squire, L., Dubois, S., Lever, J. A., & O'Donnell, M. (2001). The Zarit Burden Interview: A new short version and screening version. *The Gerontologist*, *41*(5), 652–657.

Bergman, H., Ferrucci, L., Guralnik, J., Hogan, D. B., Hummel, S., Karunananthan, S., … Wolfson, C. (2007). Frailty: An emerging research and clinical paradigm—Issues and controversies. *Journal of Gerontology Series A: Biological Sciences & Medical Sciences*, *62*(7), 731–737.

Bettez, M., Tu, L. M., Carlson, K., Corcos, J., Gajewski, J., Jolivet, M., & Bailly, G. (2012). 2012 update: Guidelines for adult urinary incontinence collaborative consensus document for the Canadian Urological Association. *Canadian Urological Association Journal*, *6*(5), 354–363.

Bohannon, R. W., Bear-Lehman, J., Desrosiers, J., Massy-Westropp, N., & Mathiowetz, V. (2007). Average grip strength: A meta-analysis of data obtained with a Jamar dynamometer from individuals 75 years or more of age. *Journal of Geriatric Physical Therapy*, *30*(1), 28–30.

Borson, S., Scanlan, J. M., Chen, P., & Ganguli, M. (2003). The Mini-Cog as a screen for dementia: Validation in a population-based sample. *Journal of the American Geriatric Society*, *51*(10), 1451–1454.

Bouillon, K., Kivimaki, M., Hamer, M., Sabia, S., Fransson, E. I., Singh-Manoux, A., … Batty, G. D. (2013). Measures of frailty in population-based studies: An overview. *BMC Geriatrics*, *13*(1), 64.

Cesari, M., Gambassi, G., van Kan, G. A., & Vellas, B. (2014). The frailty phenotype and the frailty index: Different instruments for different purposes. *Age and Ageing*, *43* (1), 10–12.

Clegg, A., Rogers, L., & Young, J. (2015). Diagnostic test accuracy of simple instruments for identifying frailty in community-dwelling older people: A systematic review. *Age and Ageing*, *44*(1), 148–152.

Collard, R. M., Boter, H., Schoevers, R. A., & Oude Voshaar, R. C. (2012). Prevalence of frailty in community-dwelling older persons: A systematic review. *Journal of the American Geriatric Society*, *60*(8), 1487–1492.

R Core Team. (2013). *R: A language and evironment for statistical computing*. Vienna, AUT: R Foundation for Statistical Computing. https://www.r-project.org/

Counsell, S. R., Callahan, C. M., Clark, D. O., Tu, W., Buttar, A. B., Stump, T. E., & Ricketts, G. D. (2007). Geriatric care management for low-income seniors: A randomized controlled trial. *Journal of the American Medical Association*, *298*(22), 2623–2633.

De Lepeleire, L. J., Iliffe, S., Mann, E., & Degryse, J. M. (2009). Frailty: An emerging concept for general practice. *British of Journal in General Practice*, *59*(562), e177–e182.

de Vries, N. M., Staal, J. B., van Ravensberg, C. D., Hobbelen, J. S., Olde Rikkert, M. G., & Nijhuis-van der Sanden, M. W. (2011). Outcome instruments to measure frailty: A systematic review. *Ageing Research Reviews*, *10*(1), 104–114.

Di Baru, M., Profili, F., Bandinelli, S., Salvioni, A., Mossello, E., Corridori, C., … Francesconi, P. (2014). Screening for frailty in older adults using a postal questionnaire: Rationale, methods, and instruments validation of the INTER-FRAIL study. *Journal of the American Geriatric Society*, *62*(10), 1933–1937.

Elliott, J., Gregg, S., & Stolee, P. (2016). *Implementing & evaluating the Assessment Urgency Algorithm in primary care and an emergency department*. http://regionalhealthprogramsww.com/Files/AUA%20Assess%20and%20Restore%20Year%202_Final%20Report%20April%202016.pdf

Fletcher, C. M. (1960). Standardized questionaries on respiratory symptoms. *British Medical Journal*, *2*(5213), 1665.

Frank, C., & Szlanta, A. (2010). Office management of urinary incontinence among older patients. *Canadian Family Physician*, *56*(11), 1115–1120.

Fried, L. P., Ferrucci, L., Darer, J., Williamson, J. D., & Anderson, G. (2004). Untangling the concepts of disability, frailty, and comorbidity: Implications for improved targeting and care. *Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *59*(3), 255–263.

Fried, L. P., Tangen, C. M., Walston, J., Newman, A. B., Hirsch, C., & Gottdiener, J. Cardiovascular Health Study Collaborative Research Group (2001). Frailty in older adults: Evidence for a phenotype. *Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *56*(3), M146–M156.

Ganz, D. A., Higashi, T., & Rubenstein, L. Z. (2005). Monitoring falls in cohort studies of community-dwelling older people: Effect of the recall interval. *Journal of the American Geriatrics Society*, *53*(12), 2190–2194.

Gillam, S., & Siriwardena, A. N. (2013). Frameworks for improvement: Clinical audit, the plan-do-study-act cycle and significant event audit. *Quality in Primary Care*, *21*(2), 123–130.

Jha, S. R., Ha, H. S., Hickman, L. D., Hannu, M., Davidson, P. M., Macdonald, P. S., & Newton, P. J. (2015). Frailty in advanced heart failure: A systematic review. *Heart Failure Reviews*, *20*(5), 553–560.

Karpman, C., & Benzo, R. (2014). Gait speed as a measure of functional status in COPD patients. *International Journal of Chronic Obstructive Pulmonary Disease*, *9*, 1315–1320.

Kehler, D. S., Hay, J. L., Stammers, A. N., Hamm, N. C., Kimber, D. E., Schultz, A. S. H., … Duhamel, T. A. (2018). A systematic review of the association between sedentary behaviors with frailty. *Experimental Gerontology*, *114*, 1–12.

Kojima, G., Liljas, A., Iliffe, S., & Walters, K. (2017). Prevalence of frailty in mild to moderate Alzheimer's disease: A systematic review and meta-analysis. *Current Alzheimer Research*, *14*(12), 1256–1263.

Kroenke, K., & Spitzer, R. L. (2002). The PHQ-9: A new depression diagnostic and severity measure. *Psychiatric Annals*, *32*(9), 509–521.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2003). The Patient Health Questionnaire-2: Validity of a two-item depression screener. *Medical Care*, *41*(11), 1284–1292.

Lee, L., Heckman, G., & Molnar, F. J. (2015). Frailty: Identifying elderly patients at high risk of poor outcomes. *Canadian Family Physician*, *61*(3), 227–231.

Lee, L., Hillier, L. M., McKinnon, W. J., Gregg, S., Fathi, K., Sturdy Smith, C., & Smith, M. (2018c). Effect of Primary Care-Based Memory Clinics on Referrals to and Wait-Time for Specialized Geriatric Services. *Journal of the American Geriatric Society*, *66*(3), 631–632.

Lee, L., Locklin, J., Skimson, K., & Patel, T. (2018b). Frailty Screening in Primary Care: A Pilot Study Involving Collaboration Between Community Pharmacy and Family Practice. *Canadian Geriatrics Journal*, *21*(3), 250.

Lee, L., Lu, S., Hillier, L. M., Bedirian, W., Skimson, K., & Milligan, J. (2019). Patient and Healthcare Professional Perspectives on "C5-75": A Primary Care Program to Identify and Support Older Adults Living with Frailty. *Canadian Geriatrics Journal*, *23*(3), 124.

Lee, L., Patel, T., Costa, A., Bryce, E., Hillier, L. M., Slonim, K., … Molnar, F. (2017). Screening for frailty in primary care: Accuracy of gait speed and hand-grip strength. *Canadian Family Physician*, *63*(1), e51–e57.

Lee, L., Patel, T., Hillier, L. M., Locklin, J., Milligan, J., Pefanis, J., & Boscart, V. (2018a). Frailty screening and case-finding for complex chronic conditions in older adults in primary care. *Geriatrics*, *3*(3), 39.

Lee, L., Patel, T., Hillier, L. M., & Milligan, J. (2016). Office-based Case-Finding for Chronic Obstructive Pulmonary Disease in Older Adults in Primary Care. *Canadian Respiratory Journal*, *2016*.

Leong, D. P., Teo, K. K., Rangarajan, S., Lopez-Jaramillo, P., Avezum, A., Jr., Orlandini, A., … Prospective Urban Rural Epidemiology (PURE) Study investigators. (2015). Prognostic value of grip strength: Findings from the Prospective Urban Rural Epidemiology (PURE) study. *Lancet*, *38*(9990), 266–273.

Lubben, J., Blozik, E., Gillmann, G., Iliffe, S., von Renteln Kruse, W., Beck, J. C., & Stuck, A. E. (2006). Performance of an abbreviated version of the Lubben Social Network Scale among three European community-dwelling older adult population. *The Gerontologist*, *46*(4), 503–513.

Mackenzie, L., Byles, J., & D'Este, C. (2006). Validation of self-reported fall events in intervention studies. *Clinical Rehabilitation*, *20*(4), 331–339.

Martin, F. C., & Brighton, P. (2008). Frailty: Different tools for different purposes? *Age and Ageing*, *37*(2), 129–131.

McNallan, S. M., Singh, M., Chamberlain, A. M., Kane, R. L., Dunlay, S. M., Redfield, M. M., … Roger, V. L. (2013). Frailty and healthcare utilization among patients with heart failure in the community. *The Journal of the American College of Cardiology Heart Failure*, *1*(2), 135–141.

Morrison, J. M., Laur, C. V., & Keller, H. H. (2019). Screen III: Working towards a condensed screening tool to detect nutrition risk in community-dwelling older adults using CLSA data. *European Journal of Clinical Nutrition*, *73*(9), 1260–1269.

Negm, A. M., Kennedy, C. C., Thabane, L., Veroniki, A. A., Adachi, J. D., Richardson, J., … Papaioannou, A. (2017). Management of frailty: A protocol of a network meta-analysis of randomized controlled trials. *Systematic Review*, *6*(1), 130.

O'Donnell, D. E., Hernandez, P., Kaplan, A., Aaron, S., Bourbeau, J., Marciniuk, D., … Voduc, N. (2008). Canadian Thoracic Society recommendations for management of chronic obstructive pulmonary disease—2008 update—highlights for primary care. *Canadian Respiratory Journal*, *15*(Suppl A), 1A–8A.

Papaioannou, A., Morin, S., Cheung, A. M., Atkinson, S., Brown, J. P., Feldman, S., … Scientific Advisory Council of Osteoporosis Canada. (2010). 2010 clinical practice guidelines for the diagnosis and management of osteoporosis in Canada: Summary. *Canadian Medical Association Journal, 182*(17), 1864–1873.

Peel, N. (2000). Validating recall of falls by older people. *Accident Analysis and Prevention*, *32*(3), 371–372.

Pialoux, T., Goyard, J., & Lesourd, B. (2012). Screening tools for frailty in primary health care: A systematic review. *Geriatrics & Gerontology Internation*, *12*(2), 189–197.

Robertson, D. A., Savva, G. M., & Kenny, R. A. (2013). Frailty and cognitive impairment—A review of the evidence and causal mechanisms. *Ageing Research Reviews*, *12*(4), 840–851.

Rodriguez-Manas, L., Feart, C., Mann, G., Viña, J., Chatterji, S., Chodzko-Zajko, W., … FOD-CC group. (2013). Searching for an operational definition of frailty: A Delphi method based consensus statement. The frailty operative definition-consensus conference project. *Journals of Gerontology Series A: Biological Sciences & Medical Sciences*, *68*(1), 62–67.

Rogers, N. T., Marshall, A., Roberts, C. H., Demakakos, P., Steptoe, A., & Scholes, S. (2017). Physical activity and trajectories of frailty among older adults: Evidence from the English Longitudinal Study of Ageing. *PLoS One*, *12* (2), e0170878.

Saum, K. U., Muller, H., Stegmaier, C., Hauer, K., Raum, E., & Brenner, H. (2012). Development and evaluation of a modification of the Fried frailty criteria using population-independent cutpoints. *Journal of the American Geriatric Society*, *60*(11), 2110–2115.

Scott, I. (2008). Chronic disease management: A primer for physicians. *Internal Medicine Journal*, *38*(6), 427–437.

Shamliyan, T., Talley, K. M. C., Ramakrishnan, R., & Kane, R. L. (2013). Association of frailty with survival: A systematic literature review. *Ageing Research Reviews*, *12* (2), 719–736.

Skapinakis, P. (2007). The 2-item Generalized Anxiety Disorder scale had high sensitivity and specificity for detecting GAD in primary care. *Evidenced Based Medicine*, *12*(5), 149.

Spitzer, R. L., Kroenke, K., Williams, J. B., & Lowe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, *166*(10), 1092–1097.

Starfield, B. (2011). Is patient-centered care the same as person-focused care? *The Permanente Journal*, *15*(2), 63–69.

Starfield, B., Shi, L., & Macinko, J. (2005). Contribution of primary care to health systems and health. *The Milbank Quarterly*, *83*(3), 457–502.

Syddall, H., Cooper, C., Martin, F., Briggs, R., & Aihie, S. A. (2003). Is grip strength a useful single marker of frailty? *Age and Ageing*, *32*(6), 650–656.

Thuroff, J. W., Abrams, P., Andersson, K. E., Artibani, W., Chapple, C. R., Drake, M. J., *et al.* (2011). EAU guidelines on urinary incontinence. *European Urology*, *59*(3), 387–400.

Tom, S. E., Adachi, J. D., Anderson, F. A., Jr., Boonen, S., Chapurlat, R. D., Compston, J. E., … LaCroix, A. Z. (2013). Frailty and fracture, disability, and falls: A multiple country study from the global longitudinal study of osteoporosis in women. *Journal of the American Geriatric Society*, *61*(3), 327–334.

Topolski, T. D., LoGerfo, J., Patrick, D. L., Williams, B., Walwick, J., & Patrick, M. B. (2006). The rapid assessment of physical activity (RAPA) among older adults. *Preventing Chronic Disease*, *3*(4), 1–8.

Uebersax, J. S., Wyman, J. F., Shumaker, S. A., McClish, D. K., & Fantl, J. A. (1995). Short forms to assess life quality and symptom distress for urinary incontinence in women: The Incontinence Impact Questionnaire and the Urogenital Distress Inventory. Continence Program for Women Research Group. *Neurourology Urodynamics*, *14*(2), 131–139.

van Buuren, S. (2007). Multiple imputation of discrete and continuous data by fully conditional specification. *Statistical Methods in Medical Research*, *16*(3), 219–242.

Wagner, E. H., Austin, B. T., & von Korft, M. (1996). Organizing care for patients with chronic illness. *The Millbank Quarterly*, *74*(4), 511–544.

Xue, Q. L. (2011). The frailty syndrome: Definition and natural history. *Clinics in Geriatric Medicine*, *27*(1), 1–15.