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Increasing use of cognitive measures in the operational definition of frailty—A systematic review

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ABSTRACT

Ageing is associated both with frailty and cognitive decline. The quest for a unifying approach has led to a new concept: cognitive frailty. This systematic review explores the contribution of cognitive assessment in frailty operationalization.

PubMed, Web of Knowledge and PsycINFO were searched until December 2016 using the keywords *aged; frail elderly*; *aged, 80 and over*; *frailty*; *diagnosis*; *risk assessment* and *classification*, yielding 2863 hits. Seventy-nine articles were included, describing 94 frailty instruments. Two instruments were not sufficiently specified and excluded. 46% of the identified frailty instruments included cognition. Of these, 85% were published after 2010, with a significant difference for publication date ($X^2 = 8.45$, $p < .05$), indicating increasing awareness of the contribution of cognitive deficits to functional decline. This review identified 7 methods of cognitive assessment: dementia as co-morbidity; objective cognitive-screening instruments; self-reported; specific signs and symptoms; delirium/clouding of consciousness; non-specific cognitive terms and mixed assessments.

Although cognitive assessment has been increasingly integrated in recently published frailty instruments, this has been heterogeneously operationalized. Once the domains most strongly linked to functional decline will have been identified and operationalized, this will be the groundwork for the identification of reversible components, and for the development of preventive interventional strategies.

1. Introduction

Worldwide the proportion of the oldest old (80 years and over) is growing faster than that of any other age group. Moreover, their proportion is expected to triple between 2015 and 2050. This demographic tendency has medical, social, economic and political implications, which need to be addressed as soon as possible in order to prevent future imperilments (United Nations, 2015). In this context, research on physical frailty has become a popular topic in recent years. The concept of physical frailty refers to a dynamic, age-related condition characterized by a decline beyond a certain threshold in the reserve capacity of multiple inter-related physiological systems leading to decreased resistance to stressors and an increased risk for adverse health outcomes such as diminished mobility, falls, functional decline, institutionalization, hospitalization and death (Fried et al., 2001; Fulop et al., 2010; Gobbens et al., 2010a). Furthermore, with an increasingly aged population, cognitive decline and its costly personal and societal consequences are also a cause for concern. As people age, a decline is noted in their executive functions, speed of information processing, reasoning, and certain aspects of memory, which threatens their independent functioning (Deary et al., 2009). Since advancing age is associated with both physical frailty and cognitive decline their co-existence in an individual might be related to a common underlying ageing-related process (Morley, 2015) which amongst others targets the central

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nervous, metabolic, endocrine and cardiovascular systems in addition to inflammation.

From a scientific, clinical, public health and economical points of view, the first step in frailty management is its identification. To date, there is a myriad of conceptual definitions and operationalization of frailty (Azzopardi et al., 2016). However, there are two leading yet contrasting models of frailty operationalization. The first model, the Fried's Frailty Phenotype, perceives frailty as a geriatric syndrome consisting of signs and symptoms pertaining exclusively to the physical domain. It is based on 5 criteria, i.e. unintentional weight loss, self-reported exhaustion, slowness (walking speed), muscle strength (hand grip strength) and physical activity. The absence of such criteria indicates robustness, the pre-frail (subclinical) state is defined by the presence of 1 or 2 criteria and ultimately frailty is determined by the presence of 3 or more criteria. Furthermore, according to the founder of this model, multimorbidity–the co-existence of 2 or more chronic conditions–is a potential risk factor for the development of pre-frailty and frailty due to common underlying pathophysiology (Fried et al., 2001) as well as due to enhanced decline in the reserve capacity of multiple physiological systems (Ruan et al., 2015). Akin to frailty, the prevalence of multimorbidity rises markedly with advancing age from 62.4% in the 65–74 years age group to 76.2% in the over 85 years age group (Rocca et al., 2014). In a study involving senior adults aged 70 years and older, the prevalence of frailty was higher in older men with cardiovascular disease and diabetes (Bartley et al., 2016). Furthermore, in frail older adults, the prevalence of multimorbidity increases dramatically over time (Chamberlain et al., 2016). This highlights the importance of managing underlying conditions, particularly cardiovascular disease, as well as preventing the development of further co-morbidities when considering interventions to delay the onset of frailty.

The second leading model of frailty operationalization is the Rockwood frailty index, a mathematical model characterized by an accumulation of health deficits across multiple domains including medical, functional, and psychosocial aspects (Rockwood et al., 2005). As long as the health deficits include variables associated with the health status, cover a spectrum of bio-physiological systems, have prevalence increasing with age and do not saturate easily, then, it is the number of deficits rather than their nature which counts. The frailty status is determined by calculating the ratio of health deficits present to the total potential health deficits such that the total score is a continuum between 0 and 1 and a score of 0.2 is suggestive of approaching the frail state (Searle et al., 2008).

Focusing solely on the physical aspects of frailty has negative implications as holistic care may be jeopardized (Gobbens et al., 2010a). In the quest for a resolution of the consequences of this issue, a group of experts consensually developed an integral operational definition of frailty which in addition to physical aspects–such as strength, balance, endurance, mobility and physical activity-also includes nutrition and cognition (Gobbens et al., 2010b). Moreover, in a systematic review published in 2011, the authors corroborate that cognition is one of the most important elements in the identification of frailty (Sternberg et al., 2011). As shown below, the relationship between cognitive impairments and physical frailty has been evaluated in studies of criterion validity (concurrent and predictive). In a relatively recently published review, the authors analyzed the association between physical frailty and cognitive impairment in both cross-sectional and longitudinal studies (Robertson et al., 2014). In the French Three-City Study involving community-dwelling participants aged 65 years and older, the authors demonstrated that using Fried's frailty criteria (Fried et al., 2001), the percentage of individuals identified with cognitive impairment (defined by the lowest quartile on the Mini Mental State Examination and Isaacs Set Test) was 22% in frail subjects, compared to 12% and 10% in pre-frail and robust individuals respectively. Furthermore, in the same study it was shown that subjects with coexisting cognitive impairment and physical frailty were at an increased risk for the development of adverse health outcomes, implying that cognitive impairment improves the predictive validity of Fried's Frailty Phenotype (Avila-Funes et al., 2009). In the Brazilian FIBRA study it was shown that subjects identified as frail using Fried's model performed worse on the MMSE and the authors suggested the inclusion of cognitive assessment into frailty operationalization (Macuco et al., 2012). This association has also been demonstrated using Rockwood's cumulative health deficit model: frail participants where less subject to stabilization or improvement of cognitive deficits (assessed using the modified MMSE score). Cognitive improvement was observed in 23.9% of non-frail individuals compared to 13.4% in frail individuals (Mitnitski et al., 2011). In a cross-sectional study focusing on older females in Korea, it was reported that subjects with slower walking speed and weakened hand grip strength had lower scores on the Korean version of the Montreal Cognitive Assessment test (Kang et al., 2016). In addition, several longitudinal studies have shown the predictive effect of physical frailty measures on cognitive decline or incident dementia and vice versa (Auyeung et al., 2011; Boyle et al., 2010; Clouston et al., 2013; Robertson et al., 2014; Samper-Ternent et al., 2008; Shim et al., 2011). In addition, the findings from a systematic review analyzing the psychometric properties of the measurements of cognitive frailty (published from 2013 onwards) reflect that an association exists between physical frailty and cognitive decline but currently a valid and reliable operational definition of cognitive frailty is lacking (Sargent and Brown, 2017). In contrast, a study analyzing the relationship among seven frailty domains (methodology replicated in three different studies involving elderly populations for consistency), showed that the cognitive domain might not belong to this multi-dimensional frailty concept. Alternatively it could be that in these studies global cognitive impairment was assessed rather than specific cognitive domains such as executive function and processing speed necessary for frailty identification (Sourial et al., 2010).

The emerging concept of cognitive frailty has gone through various stages in recent years. In 2013, an international consensus group (International Academy on Nutrition and Aging and the International Association of Gerontology and Geriatrics) suggested an initial definition for the evolving concept of cognitive frailty. It is an umbrella term for the co-occurrence of physical frailty and mild cognitive impairment (defined by a score equal to 0.5 on the clinical dementia rating (CDR)) in the absence of Alzheimer dementia (AD) or other dementias. Cognitive frailty, in parallel with physical frailty has the potential to be reversible (Kelaiditi et al., 2013). Although this concept may allow for the study of aggregate risk, the drawback is that it may hamper the investigation of potentially distinct sources of impairment. More recently this definition has been further elaborated. In 2014, pre-physical frailty was added as a criterion to the definition of cognitive frailty (Dartigues and Amieva, 2014). In addition, in 2015, other authors stated that there are two subtypes of cognitive frailty (Ruan et al., 2015), namely the *reversible* and the *potentially reversible* subtypes. The *reversible* type refers to subjective cognitive decline (SCD) whereby older adults have altered subjective cognitive function but normal performance on cognitive tests. These individuals have a CDR score of < 0.5 (Jessen et al., 2014). The *potentially reversible* type refers to the classical mild cognitive impairment (MCI) stage with a CDR score of 0.5. Pre-physical frailty and subjective cognitive decline being reversible play a significant role in the prevention of frailty. This is a strong argument for the inclusion of cognitive assessment in frailty instruments. Furthermore, in a recent paper the authors highlighted the importance of the chronological development of physical frailty followed by cognitive decline to distinguish the entity of cognitive frailty from other cognitive deteriorations independent of physical dysfunction (Canevelli and Cesari, 2015).

The purpose of this systematic review is to compile an itinerary of the role of cognitive dysfunction in the operationalization of frailty and then to analyze the way in which cognition is evaluated in the related instruments. This is to determine if there has been a shift in recent years in the weight of cognitive measures in frailty operationalization. Although recently several systematic reviews have explored the