The Importance of adapting functional test instructions for older adults with neurocognitive disorders

Authors

Audrey-Ann Blais[a], Cynthia Tremblay[a], Laury Guarnaccia[a], Léane Tremblay[a], Sandrine Laflamme-Thibault[a], Sharlene Côté[c], Patrice Tremblay[c], Julie Bouchard[b,c], Rubens A. da Silva[a,b,c*]

Affiliations

[a]Programme de physiothérapie de l'Université McGill offert en extension à l'Université du Québec à Chicoutimi (UQAC), Saguenay, Québec, Canada, G7H 2B1.

[b]Département des Sciences de la Santé, Centre intersectoriel en santé durable, Laboratoire de recherche BioNR, Université du Québec à Chicoutimi (UQAC), Saguenay, Québec, Canada, G7H 2B1.

[c]Centre intégré de santé et services sociaux du Saguenay-Lac-Saint-Jean (CIUSSS SLSJ), Centre Hospitalier de La Baie, Saguenay, Québec, Canada, G7H 7K9.

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***Corresponding author**

Rubens A. da Silva, Ph.D., pht.

Département des Sciences de la Santé
Université du Québec à Chicoutimi (UQAC)
555, boul. de l'Université
Saguenay (Québec) G7H 2B1
418 545-5011, poste 6123
Email: rubens.dasilva@uqac.ca

Abstract

The assessment of the risk of falling in geriatric rehabilitation is often using standardized functional tests, which may be more complex but less representative in older adults with a neurocognitive disorder. The conceptual aim of this manuscript was thus to discuss the impact of adapted instructions on physical performance during standardized functional tests for older with neurocognitive disorders (NCD). Six topics were addressed: 1) current and global profile of falls in older, 2) fall assessment, 3) neurocognitive disorders in the older adults, 4) relationship between cognitive impairment and functional performance, 5) impact of the instructions on functional assessments in an older population, and finally 6) an overview of the future perspectives on possible adaptations for functional assessments in older adults with NCD. We believe that it is realistic and feasible to address adapted instructions to patients with NCD in clinical settings to optimize their assessment of their risk of falling.

Key Words: falls, aging, functional tests, rehabilitation, cognitive

Introduction

Assessing the risk of falling in geriatric patients is an essential part of the practice of physiotherapist. To do so, the therapists generally analyze the performance obtained in standardized functional tests, such as the BERG scale, the Sit to Stand Test or the Timed Up and Go (TUG) and associate their results with the risk of falling according to scoring grids and/or cut-off values. [1] However, assessing the risk of falling in a geriatric population often involves a cognitive component. Neurocognitive disorders (NCD), prevalent in 30% of the population aged over 80 years old, cause twice as many falls when compared to seniors with no cognitive impairment. [1-2] Furthermore, therapists must deal with deteriorating cognitive functions in the older population, even if the evaluation is mainly focused on the physical capacities of these individuals. A situation frequently observed in a clinical context of physical therapy when analyzing the results of functional tests in patients with NCD is that the clinician tends to underestimate the patient's physical capacity by interpreting a high risk of falling, whereas, the alteration of cognitive functions has considerably reduced their performance. [1] Thus, one question arises: Can adapted instructions improve the performance of individuals with NCD so their results are closer to their real physical capacity? In fact, we should better reflect on this issue and, considering more evidences so that determine new alternatives to always include these patients during functional assessments. Or, it would be interesting to test options such as the therapist's experience through verbal encouragement during the test or to use of technology such as an IPAD/cell phone with a representative video of the test and its execution to encourage the patient performance during functional assessments. In light of these factors, we discussed the following topics in this manuscript to include NCD individuals in practical execution tests for functional or rehabilitation purposes. For a global context of issue, the following topics were discussed in this conceptual manuscript :1) current and global profile of falls in older people, 2) fall assessment, 3) neurocognitive disorders in the older adults, 4) relationship between cognitive impairment and functional performance, 5) impact of the instructions or commands on functional assessments in the geriatric population, and finally 6) an overview of the future perspectives on possible adaptations for functional assessments in older adults with NCD.

1. Falls in the geriatric population: A current profile

The World Health Organization (WHO) defines a fall as an "event which results in a person coming to rest inadvertently on the ground or floor or other lower level". [2, 3] Thus, falling may be a frequent event for most of the population. However, the occurrence of a fall in an older adult will have a higher impact, including functional and activity limitations, increase in chronic diseases, poor quality of life and well-being, loss of autonomy, social withdrawal and even future falls that lead to more serious consequences as fear of falling and restriction for voluntary activities. [4] The prevalence of falls among seniors can reach up to 2.4 million falls in the USA and 37.3 million falls worldwide, per year. This means 1 person will suffer a fall every 15 seconds, only in USA. [5, 6] Additional statistics show that a person dies every 29 minutes in the USA and there are over 424,000 deaths each year, worldwide, that are directly related to falls among seniors. [2, 7-9] Furthermore, in Canada, about 1/3 of the population of individuals aged over 65 fall every year and at least 25% of these individuals require emergency treatment for fall-related injuries. This represents more than 368,000 falls and 189,000 hospitalisations, only in Quebec. Finally, in Canada, a single fall event costs $30,000 on average in healthcare services and hospitalizations. Considering these numbers, the magnitude of the economic impact of falls on healthcare services is important, not only in Canada, but also worldwide, and consequently explains the interest in research on this subject. In recent years, research has focused mainly on the risk factors of falls among seniors. [10] The falls risks are often subdivided into several categories such as socio-demographics (age, female, use of a walking aid), health problems (urinary incontinence, Parkinson's Disease, stroke, dizziness, foot pathology), motor capacities (decrease in muscle strength, alteration of walking pattern and balance disorders), sensorial deficits (alteration of vision or somatosensory system deficit), cognitive and psychological factors (fear of falling, cognitive deficits, history of depression) and drugs (quantity of medication, psychotropic or cardiovascular system drugs). [1, 11] This demonstrates the importance of evaluation, as well as rehabilitation programs for these physical and psychological factors among older adults to prevent and reduce the incidence of falls.

2. Fall assessment

Physiotherapists are one of the healthcare professionals in charge of assessing balance and risk of falls in older adults. To do this, several tools commonly called ‘‘functional tests’’ have been developed over the years to determine and/or predict an individual’s risk of falling. Some of these tests, as well as their metrological properties, are listed in ***Table 1.*** As it can be seen, these tests have shown to be valid in some way for measuring the risk of falls, and to have good test-retest and inter-rater reliability, which is why they are tools of choice for physiotherapists to predict the risk of falls in older people. However, the inability to determine the precise cause of an individual’s balance problem or risk of falling is evident in all these tests. Indeed, maintaining balance requires the involvement and motor control processing from the three sensory systems (sensorimotor, visual, and vestibular). Consequently, these tests assess also specific muscle groups recruited for postural corrections and adjustments such as hip, trunk, knee, and ankle muscle groups often used for balance reactions in older adults. [12, 13] In addition, the results of functional tests are often reported with the use of advanced technological tools such as the force platform and/or surface electromyography (EMG) which will respectively measure more precisely postural balance through the displacement of the pressure center and muscle activation during tasks such as maintaining balance or walking. [14-17] These technological analysis systems can quantify and objectify the precise contribution of each sensory system and muscle group during a balance task. [12, 16] These measures can further directly and accurately diagnose a sensory-motor problem associated with a balance disorder, hence their usefulness in clinical settings to evaluate or predict a risk of falling. Depending on the cognitive impairments diagnosed by these technological devices, it would be beneficial to adapt the functional tests for each individual and therefore, adapt and to provide effective and personalized rehabilitation plan. [18, 19]

A second shortcoming applies to all the functional tests listed in ***Table 1***, namely the exclusion of the cognitive component. In fact, none of the functional tests mentioned above, except for the FES-I questionnaire, [20] are designed to consider the participants’ possible cognitive impairment. An option is the modifying some of these tests by adding a cognitive load (or dual-tasking) can increase their ability to detect a fall (example in Timed up and go: TUG or in MiniBEST using dual-tasking component), [15] which evaluates the cognitive function in some way.

Unfortunately, this situation creates an inconsistency between clinical and research contexts. Indeed, the complex nature of NCD would be a major source of bias for studies that would prefer to exclude it (because excluding this aspect would not adequately represent the geriatric population). However, for their part, clinicians must frequently deal with their patients' cognitive impairment. Thus, currently in clinic, professionals use these tests with NCD population to assess their risk of fall, but this assessment can certainly be influenced by their participants' cognitive factors. It is therefore possible for them to observe, from a clinical perspective, a significant bias regarding the understanding of the test in older individuals with NCD, leading to functional test results that are often not representative of their true abilities. Consequently, instructions adapted for individuals with NCD during functional tasks would allow inclusion of these patients while keeping the test valid. This would also allow clinicians to obtain a result more representative of their patients' function.

3. Neurocognitive disorders

Neurocognitive disorders (NCD) are defined as a significant cognitive decline, progressive and irreversible, in a person's prior abilities for one or more cognitive functions.[21] The predominant clinical signs are memory and learning problems, but may be compounded by several other forms of cognitive deterioration, making the clinical picture unique to each patient. There are two categories of NCDs: minor (MCI), a decline in cognitive function beyond the normal age-related decline, without significant functional impairment, [22] and major, which represents all the stages of dementia, categorized by cognitive impairment and associated with functional impairment or, in other words, loss of independence. [21] The most common causes of NCD include advanced age, cerebrovascular disease, and neurodegenerative pathologies (Alzheimer's Disease, Lewy body Disease, stroke, etc.). [21, 23, 24] Genetic factors [23] and depression [25] can also predispose to a neurocognitive disorder. According to the WHO, the global prevalence of cognitive disorders was 47.5 million in 2015, but projections for 2050, taking into account the aging population, will reach 135 million cases, worldwide. [26] Indeed, global projections are numerous, and so are the consequences of neuro-cognitive disorder. It can be difficult for these people to have the ability to complete a testament or to manage their finances, to have an appropriate judgment to consult a doctor for their health issues, to recognized and understand the nature and function of objects that surround them, to

understand the essence of an instruction given to them and to carry out their daily tasks independently. [26] Therefore, if an affected person has disabilities related to comprehension, memory, or recognition of objects, it is highly likely that the result of a functional test assessing their balance or locomotion will be adversely affected. In addition, Alzheimer's Disease and other dementias can affect 10-12% of the population aged 65 and over. [27]

A recognized and validated way to screen for NCDs is the use of clinical tools such as the Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA). [28-30] The use of the MMSE, which is reported to have greater specificity than MoCA, is recommended to screen individuals with major NCD, [30] while MoCA is recommended to detect mild cognitive impairment (MCI), given is greater sensitivity. [28] In fact, several studies recommend using MMSE first during an assessment to classify individual disabilities, and then, if the patient scores normal (≥ 24), MoCA should be used to screen for mild disorders (88% sensitivity and 98% specificity for a cut-off of 17). [32] To detect a NCD in patients with Parkinson's Disease, the recommended tool is MoCA rather than MMSE. [29] MoCA shows good sensitivity (81%) and specificity (77%) considering a cut-off point of 22 to distinguish patients with healthy cognitive status from those with MCI or Alzheimer's Disease. [32] These tools should be used before performing functional tests to screen NCD and thus determine whether adaptation of standardized instructions is required to obtain a valid patient's performance result during a physiotherapy assessment. However, until now, in the literature, there is no cut-off point to identify from which level of cognitive impairment functional tests with customized instructions would be more appropriate to use and valid.

4. Relationship between neurocognitive disorder and functional capacity

According to scientific literature, there is a direct link between cognitive function and an individual's functional status. Indeed, a higher cognitive capacity is associated with a higher level of functional independence. [33] Several studies define functional disability by the number of impairments in activities of daily living (ADL) and instrumental activities of daily living (IADL). [34] ADL are essential survival tasks such as walking, eating and personal care (e.g. hygiene, toileting, bathing and dressing), [35] while IADL are more complex tasks that are necessary for independent living at home and in the community (e.g. meal preparation, use of the telephone, housework, outside shopping, transportation, use of stairs, etc.). [34] A study by Dodge et al. (2005) found that

cognitive impairment had a greater impact on ADL than on IADL. As those activities are in other words essential survival tasks, this means, at a certain level, that the survival of a person with NCD would be disrupted. Indeed, this level of impact will influence the level of severity (mild, moderate, or severe) of a major NCD. [23] Specifically, NCD is responsible for 11 to 19% of the skill loss in IADL and 18 to 36% of the skill loss in ADL. On the other hand, this study evaluated the cognitive impairment of the population without detailing the area of cognition responsible for these functional losses.

A 2008 American study has demonstrated that early functional changes related to MCI may be associated with a poor verbal learning performance. [36] This means that people with few verbal learning skills, such as practicing reading and writing, may be more prone to changes in their cognitive functions and therefore, in a long term, cognitive decline. To add to this, a 2010 study directed by David A. Gold [37] determined that indeed, people with multiple domains MCI are more touched on IADL than people with only one domain MCI. Having that said, the more domains involved in cognitive impairment, the more disabilities will appear in person's daily life. Moreover, according to the same author, mild IADL changes can predict a future cognitive decline [36], hence the importance to quickly diagnose NCD and adapt tasks for patients' safety.

A recent study by Bruderer-Hofstetter et al.[34] presents a model of factors affecting IADL in a population with MCI. Among the cognitive factors, it is noted that those representing the greatest proportion of variation in IADL performance are executive functions (37%), attention (33%), and memory (23%). [35] Along the same lines, several studies suggest that it is more precisely the executive function that plays a predominant role in the realization of ADL and IADL. [33, 34] These functions include several skills, such as planning, cognitive flexibility, and inhibition of automatic behaviors. Thus, these are all processes that contribute to the control of goal-directed actions. [38] They are therefore essential for the achievement of ADL and IADL, specifically in terms of mobility. Indeed, cognition plays a major role when it comes to simultaneously walking and performing another task such as talking to someone. Cognition is also necessary to inhibit response to external distractions, such as environmental noise. [37,38,39] In addition, the safety of a person with impaired cognitive functions who crosses a crowded street may be compromised because of the multiple external distractions. In this example, a fall may occur as well as an accident between the pedestrian and a car, which can create more serious consequences.

Moreover, some studies have shown a decrease in walking speed, an increase in the occurrence of falls, and a decrease in performance for mobility tasks in older adults with impaired executive cognitive function. [37,38,39] One of these studies suggests that mobility assessment should be perform with people with, or at risk for developing a cognitive disorder, because it is known that altered mobility performance comes before the behavioral manifestations of MCI. [39] Thus, it could also be interesting to assess mobility of people with MCI, or more generally NCD, with functional tests by giving standardized verbal instructions, but this would be to determine the presence of a risk for developing cognitive impairment. However, the primary goal is to obtain representative results of functional performance and not to determine whether a person is at risk of developing NCD or not.

With respect to functional mobility, a study by Kalsait et al.[39] was conducted in a group of 60 to 85 year-old people with cognitive impairment identified with a MoCA score of <26/30 to determine the correlation between cognitive impairment, functional mobility and the risk of falling. The results show that a decrease in the MoCA score is associated with an increase in TUG test completion time (poor performance), meaning that a decrease in cognitive status will lead to decreased functional mobility. [39] Another study showed the same results, in addition to specifying that the participants with MCI with amnestic impairment had a better performance than those with MCI without memory impairment (non-amnestic) or with multiple domains impairment. [40] However, the authors of this study claimed that participants with a non-amnestic MCI manifested a poorer health status and presented more chronic conditions, leading to the poorest performances. [40] In the end, it remains unclear if patients with memory impairment would have honest performances with other functional tests assessing mobility, for example, a test with longer verbal instructions.

5. Impact of instructions on functional assessments in the geriatric population

The instructions and their understanding have a significant impact on functional performance. Currently, tests that measure functional ability and risk of falling in older individuals have a standardized administration, for

both tasks and instructions. Consequently, a standardized command cannot be personalized to an individual with special needs in comprehension. For patients with NCD who may have memory and attention problems, it is possible that the standardized instructions are too complex and difficult to understand. [41, 42] It might therefore be interesting to validate whether other types of instructions could promote understanding of the test, and thus allow therapists to obtain a performance that is more representative of the actual abilities of their patients with NCD. Indeed, although standardized instructions are complete and list the tasks to be done while being the same for all participants, this still has some disadvantages. Mainly, they are long instructions with too much information that is given to the patient all at once. This frequently leads to misunderstandings for participants with memory or attention problems who may forget the instructions once they are ready to execute the test.

Other types of instructions, such as video or verbal instructions with key words and encouragement, would therefore be possible alternatives for therapists, without changing the test administration. [42] Video instructions would have the advantage of being clear, representative of the task and could facilitate understanding and promote attention for people with NCD. [41, 43] However, not all therapists working with older adults have access to a technological device that allows videotaped instructions to be viewed, and it may take longer in the participant's appointment, since videotaped instructions are an add-on, although these could be used on a cell phone. Moreover, many people of this age group have vision problems. [10, 44]

Finally, personalized verbal instructions would thus make it possible to target specific key words (e.g., 'stand up', 'turn around', 'sit down'), to encourage (e.g. 'go') and to repeat throughout the test, which would allow a performance that is more representative of the participant's true functional level. This type of instruction would prevent forgetfulness and provide a reminder of the tasks to be completed during the test, to use intact cognitive functions of people with NCD. However, some details may be omitted by the physiotherapist because not all words will be spoken with the same intonation, and the level of encouragement will not be exactly the same for everyone, so this type of instruction may vary from one participant to another. Understanding and interpreting verbal instructions has been shown to require multiple brains structures and connections, which can be damaged depending on neuro-cognitive impairment in older people. Thus, understanding a standardized verbal instruction without encouragement and without repeating can become a challenge for affected people. Indeed, this skill is

processed by Wernicke's area, located in the left temporal lobe, while the word connotation and prosody, [46] such as intonation, volume and emotional tone, are analyzed and processed by the right hemisphere, in the contralateral region to Broca's and Wernicke's areas. [45, 47] During standardized functional tests, standardized instructions plus a demonstration by a therapist are included in the pre-test steps. This demonstration can help the participant to better understand the test but can also represent an obstacle to his comprehension, according to the preserved cognitive functions. If the occipital lobe, where visual information is processed (object's physical appearance, spatial localisation, recognition), is affected, the elder may have an erroneous result while performing a functional test. He would therefore be a good candidate to receive personalized instructions, adapted to his intact cognitive functions, allowing him to carry out the test with a real performance score. [43] Finally, it is therefore possible to see that each brain areas are necessary in visual information processing and that they provide specific information that is useful in the performance of a complex physical task. All these complex cerebral processes could confuse the patient by decreasing understanding and test performance.

Another interesting aspect is that despite the high prevalence of NCD in population, only a few studies have investigated alternative methods of transmitting or adapting the instructions of a functional test used in physiotherapy, for example. A recent study conducted a mobility test, the TUG, with elderly people without NCD, with mild NCD and with Alzheimer's disease, by adapting the verbal instructions. The authors verbally gave key words throughout test execution like "get up", "walk" and "turn" (when the participants reached the cone positioned three meters from the chair) and "sit down" when they returned to the chair. Their objective was to identify differences in mobility in people with and without cognitive impairment. The results of this study show that the rate of movement of people with Alzheimer's disease was higher than people without or with mild NCD. However, the authors did not evaluate the conventional TUG test with the standardized instructions, so it is impossible to verify whether there would be an improvement in performance in the same group [42]. In conclusion, further studies are needed to determine the benefits of adapted and/or video instructions during functional tests in an older population with different levels of NCD. This could have significant impact on rehabilitation programs in geriatric specialized care.

6. Perspectives for Physiotherapy Clinicians and Research

As described in this manuscript, literature offers numerous functional tests demonstrating good metrological qualities to assess the risk of falling. However, these tests must be performed in a standardized manner with specific instructions, but these are not adapted to patients with cognitive impairments. This can therefore lead to a significant gap between the patient's performance on the standardized test and his or her actual functional capacity. As a result, the standardized test results could suggest a therapeutic ceiling, whereas this is mainly caused by NCD (table 1). In future research, it would be relevant to compare the effect of different types of instructions on performance during functional tests in a population with NCD. In addition, there is a need for future research to study the effect of adding a measuring instrument to assess tasks that requires both balance and cognitive functions, which can cause falls. Considering the information presented in this work, we believe that it is realistic and feasible to address adapted instructions to patients with NCD in clinical settings, and therefore, that physiotherapists should modify their instructions according to their patients' cognitive deficiencies to optimize their assessment of their risk of falling. The goal is to better target the impairment and needs of patients with NCD, to offer them the most effective and personalized treatment plan for their condition as well as a better quality of life.

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