

## **Additional file 1: detailed description of the assessment procedures and all measurement instruments and their sub-scales**

All study assessments were performed in the patient's hospital room and on the ward. Whenever a participant had difficulty understanding the instructions of any assessment, the examiner was allowed to demonstrate individual items or tasks, use verbal persuasion, physical cueing and physical assistance, but only if this was allowed according to the official instrument instructions. Breaks were allowed between assessments. A hand-held digital stopwatch was used for all temporal outcomes. Walking distances were recorded with a digital measuring wheel.

Patients were scored at their highest level of safe function, using their usual walking aid. The same device was used for all assessments in a single session. Similar items in different assessments were only performed once to reduce participant's burden, e.g. standing with both feet together is required in the DEMMI and the Performance Oriented Mobility Assessment (POMA). For participants requiring some kind of physical assistance during ambulation (Functional Ambulation Categories score  $\leq 2$ ), the walking tests were scored as "unable" (timed up and go test, gait speed, 2 minute walk test) or "0 points" (POMA gait subscale), respectively.

We used a broad set of clinically established comparator instruments that show sufficient validity and reliability on older people. However, the measurement properties of most comparator instruments in older people with cognitive impairment are unclear since they have never, or only insufficiently been analysed.

The **Hierarchical Assessment of Balance and Mobility (HABAM)** is a clinical bedside and interval level mobility assessment that quantifies functional abilities in the sub-categories balance, transfers and ambulation. Higher scores indicate higher ability (0 to 26 points). There are no reports of the HABAM's psychometrics in older people with cognitive impairment, but multiple studies indicate sufficient reliability, content and construct validity in various populations of older people.[1–3]

The **Performance Oriented Mobility Assessment (POMA)** is a well-established clinician-rated measure of older people's mobility and fall risk [4]. The maximum ordinal score of 28 points indicates better mobility. The POMA has sufficient reliability [5, 6] and predictive validity [5] in older people with moderate to severe dementia, but significant feasibility problems have also been reported for this population [5].

The clinician-completed **Functional Ambulation Categories (FAC)** distinguishes 6 levels of walking ability subjected to the amount of assistance required over a walking distance of 10 meters [7]. Lower scores, where physical assistance is needed, indicate poorer mobility than higher scores, where the patient is able to ambulate independently. The FAC has never been analysed in people

with dementia but adequate predictive validity as well as excellent concurrent validity and reliability have been reported for patients with stroke [8].

The **2-minute walk test (2minWT)** can be used to quantify walking endurance and functional-exercise capacity [9]. By measuring similar constructs, the 2minWT seems to be better tolerated by geriatric inpatients than the 6 minute walk test [10]. Subjects were asked to walk as far as possible within two minutes on the hospital corridor. Only one trial was performed to avoid fatigue effects. The psychometric properties in people with Alzheimer's dementia have not been established for the 2minWT but for the 6 minute walk test, which seems quite comparable and shows sufficient reproducibility [11–13].

The **Short Physical Performance Battery (SPPB)** is a measure of mobility and physical functioning. It includes three objective tests of lower body functions: a hierarchical test of standing balance, a four meter walk test (4mWT) and five times chair rise test (5xCRT) [14]. The SPPB has a scoring from 0 (unable) to 4 points for every sub-test, with a maximum of 12 points in total (ordinal scaled). Sufficient validity and reliability of the SPPB have been described for older people with and without dementia [14–16].

Habitual **gait speed** in m/s over a distance of four meter was assessed as part of the SPPB. Timing was started when the participant began walking. The shorter time of two trials was used for analysis [17]. Walking speed is an objective and reliable physical performance test to evaluate functional capacity of the lower limbs and mobility with well-documented predictive value for major health-related outcomes in older people with and without dementia [11, 12, 16, 18, 19].

For the **5 times chair rise test (5xCRT)**, participants were asked to stand up and sit down from a chair as fast as possible for five times, with the hands being crossed in front of the chest. Shorter times indicate higher mobility. The 5xCRT seems to be a reproducible assessment in people with dementia [11, 20, 21].

The **Timed Up and Go test (TUG)** is a performance based test that assesses basic mobility functions. The patient is asked to stand up from a chair, walk 3 meter, turn around, walk back and return to the chair [22]. In the present study, chair height was 46 cm, the participant was placed with the trunk leant backwards, the arms rested on the armrest and a cone had to be encircled. Participants chose the turning side. A familiarization trial was followed by two counted trials, of which the mean (in sec) was the final TUG score. At least one counted trial must have been valid to be included in the analysis. Shorter times indicate higher mobility. There is conflicting evidence for the TUG to be a sufficiently reliable test in people with dementia [11, 12, 20, 21, 23], the construct validity has not been examined properly and feasibility limitations have been reported due to significant floor effects [23].

The **Barthel Index** [24] (BI; 0-100 points) is a performance based measure of functioning and independence in the activities of daily living (ADL). Higher scores indicate better functioning. The Barthel Index has been reported to be the most widely used measure of ADL function [25]. In this study, the BI was applied by the nursing staff as part of routine care within the first 7 days after admission. Since most of these scores were recorded in a considerable time frame from the DEMMI scores, the BI score was only used to describe the sample. For the psychometric analysis, we re-assessed the 3 mobility items *#transfer* (0 to 15 points), *#walking* (0 to 15 points) and *#climbing stairs* (0 to 10 points) [26] in the study assessment session. We summed these items to a Barthel Index mobility subscale (0 to 40 points). This subscale has sufficient face validity and the reliability of these 3 single BI items has been reported to be fair to excellent in various studies including individuals with stroke [27] and older people with and without cognitive impairment [28].

The **Mini Mental State Examination Test (MMSE)** [29] is an 11-item assessment of cognitive function that assesses orientation, registration, attention or calculation (serial sevens or spelling), recall, naming, repetition, comprehension (verbal and written), writing, and construction. Scores can range from 1 to 30. By convention, scores <24 points indicate increasing cognitive impairment [30, 31]. The cognitive impairment can be judged as severe ( $\leq 9$  points), moderate (10–18 points) or mild (19–23 points) according to the MMSE score, although other cut-off points have been suggested due to the wide spectrum in the severity of disease that people with dementia have [32, 33].

The **Clock Drawing Test (CDT)** [34] is one of the most widely used cognitive screening tools to measure a variety of cognitive functions, including selective and sustained attention, auditory comprehension, verbal working memory, numerical knowledge, visual memory and reconstruction, visuospatial abilities and executive function. There are multiple CDT administration and scoring systems [35]. The study hospital used a 6-point scoring system, with higher scores reflecting a higher number of errors and more cognitive impairment [36]. Scores  $\geq 3$  points are considered indicative of cognitive dysfunction.

The short version of the **Geriatric Depression Scale (GDS-15)** is a 15-item dichotomous patient-report outcome measure used to identify depression in older people [37, 38]. The severity of depressive symptoms can be judged as normal (0-4 points), mildly (5-8 points), moderately (9-11 points) and severely depressed (12-15 points) [38].

### **References Additional file 1**

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