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Usefulness of the Geriatric Depression Scale 15-item version among very old people with and without cognitive impairment

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Objectives: The aim of this population-based study was to investigate the usefulness of the Geriatric Depression Scale 15-item version (GDS-15) to assess depressive symptoms among very old people with differing levels of cognitive function.
Methods: The 834 participants were aged 85 and over. Feasibility of GDS-15 was evaluated as the proportion of people who completed the scale. Concurrent criterion validity was evaluated by calculating correlations between GDS-15 and Philadelphia Geriatric Center Morale Scale (PGCMS). PGCMS measures psychological wellbeing which is closely related with depressive symptoms. Correlations were calculated within groups according to cognitive function assessed with Mini-Mental State Examination (MMSE); 0–4, 5–9, 10–14, 15–19, 20–24, 25–27, and 28–30, using Pearson's two-sided correlation and compared using Fisher r-to-z transformation. Internal consistency of the GDS-15 was evaluated by calculating Cronbach's α in each group.
Results: In total, 651 (78%) of the 834 participants completed the GDS-15. For the two MMSE-groups with scores of <10, the proportion who completed GDS-15 were 1% and 42%, respectively, compared to 65–95% in the MMSE-groups with scores of ≥ 10. Cronbach's α in each MMSE-group ranged from 0.636 (MMSE 28–30) to 0.821 (MMSE 5–9). The level of correlation between GDS-15 and PGCMS did not significantly differ between MMSE-groups with scores of 5–27 compared to the MMSE-group with scores of 28–30.
Conclusions: The GDS-15 seems to have an overall usefulness to assess depressive symptoms among very old people with an MMSE score of 10 or more. More studies are needed to strengthen the validity of GDS-15 among older people with MMSE scores of 10–14. For older people with MMSE scores lower than 10, there is a need to develop and validate other measurements.

Keywords: depression; aged, 80 and over; cognitive disorders; dementia; validation studies

Introduction

Depression is a common problem among older people causing emotional suffering and increased mortality as well as an increased risk of physical inactivity and disability (Blazer & Hybels, 2005). The highest prevalence of depressive symptoms has been found among the very old, aged 80 years and over, in older people living in residential care facilities, and among people with dementia (Bergdahl, Allard, & Gustafson, 2011; Bergdahl et al., 2005; Blazer & Hybels, 2005). Many older people with depression do not receive adequate treatment perhaps because depressive symptoms are not recognized (Bergdahl et al., 2005). Thus, instruments to assess depressive symptoms are required for both clinical and research purposes not only to enable recognition and assessment of the severity of depression among older people, but also to facilitate evaluation of treatment effects.

The Geriatric Depression Scale (GDS) is an instrument that was developed, regarding both content and design, to assess depressive symptoms and screen for depression among older people (Yesavage et al., 1983). Somatic symptoms such as weight loss, sleep disturbances, and pessimism about the future, are common symptoms of depression among younger people. However, these can be related to aging itself, and are not included in the GDS, which focuses instead on psychiatric symptoms. During development of the GDS, clinicians and researchers in the geriatric field were asked to suggest items that could separate those with and those without depression. From these suggestions, 30 items were chosen for inclusion in the scale. The GDS can be self-administered or presented as an interview, and the questions have a yes/no format in order to be easy to understand for older people who may suffer from impaired cognitive function. Shorter versions have been suggested to reduce problems in completing the scale arising from fatigue or concentration difficulties. A 15-item version was presented by Sheikh and Yesavage (1986), based on the items that correlated best with depressive symptoms, and was equally successful as the 30-item version in differentiating between those with and without depression among people aged 55 years and over and living in the community (Sheikh & Yesavage, 1986).

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Cognitive impairments are common among very old people, and whether the psychometric properties of the GDS are influenced by this is an important inquiry. Studies have investigated validity among people with cognitive impairment or dementia and have found decreasing validity along with decreasing level of cognitive function (Kørner et al., 2006; Müller-Thomsen, Arlt, Mann, Mass, & Ganzer, 2005; Smalbrugge, Jongenelis, Pot, Beekman, & Eefsting, 2008). Cognitive impairment is defined in various ways in these studies, and it is difficult to interpret the level to which the GDS is feasible and valid since studies have used a variety of cognitive levels for inclusion and for subgroup analyses. However, the GDS (15- and 30-item versions) seems to be valid for people with cognitive impairments down to scores of 15/30 on the Mini-Mental State Examination (MMSE) (Jongenelis et al., 2005; McGivney, Mulvihill, & Taylor, 1994; Smalbrugge et al., 2008). There is a lack of knowledge regarding the validity of the scale among people with even lower cognitive function specifically since this, to our knowledge, has only been evaluated in two studies which both used the 30-item version (Debruyne et al., 2009; Gerritsen, Steverink, Ooms, de Vet, & Ribbe, 2007). In addition, only one study has focused on very old people aged 85 years and over and that study included mainly people with no or mild cognitive impairment (de Craen, Heeren, & Gussekloo, 2003). The present study was performed in a large representative sample of very old people aged 85 years and over, including people with a wide variety of living situations, capacities in activities of daily living, and cognitive function. This enables a comparison of the usefulness of the GDS between people with differing levels of cognitive function.

Aim

The aim of the present population-based study was to investigate the usefulness of the GDS 15-item version to assess depressive symptoms among very old people with differing levels of cognitive function.

Methods

Study design

The study was based on cross-sectional data conceived from the Umeå 85+/GERDA (Gerontological Regional Database) study (Molander, Gustafson, & Lövheim, 2010; von Heideken Wågert et al., 2006). GERDA is a collaborative population-based cohort study performed by Umeå University, Sweden, and Åbo Akademi/Vaasa University, Finland. Data collection was carried out in the county of Västerbotten in the urban municipality of Umeå and in five rural municipalities during 2000–2002 and 2005–2007. Data collection was carried out in 2005–2006 in two municipalities in Pohjanmaa, Finland. The study included every second person aged 85 years, and the total population of people aged 90 and 95 and over, registered in the National Tax Board in Sweden and the Finnish Population Register Centre in Finland. The study was approved by the Regional Ethical Review Board in Umeå (§99–326 and §05–063M) and the Ethics Committee of Vaasa Central Hospital (registration number 05-87).

Participants

The present study included 834 participants who were assessed for cognitive function. A flowchart of the inclusion is displayed in Figure 1, and baseline characteristics in Table 1. A number of individuals ($n = 101$) took part in both Swedish data collections. For those individuals, only the data from 2005–2007 was used in the present study and the rational was that they would contribute with cross-sectional data from when they were older and thus were expected to have lower cognitive function which was of interest in the present study.

Procedure

A letter with information about the study was sent to all participants and followed up with a phone call about

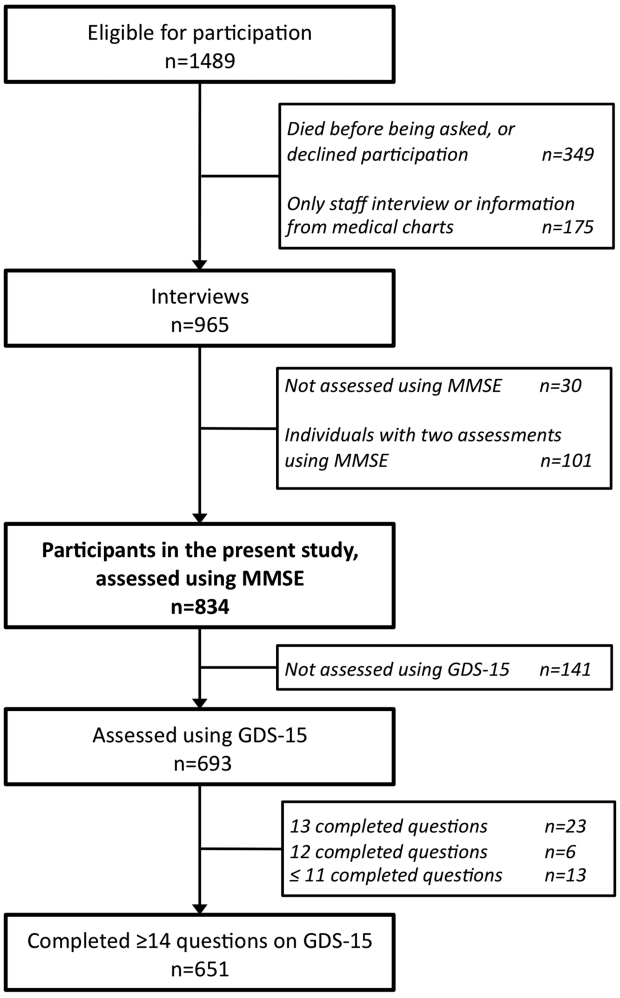

Figure 1. Flow chart over the inclusion of participants.

Table 1. Characteristics of the participants ($n = 834$) and internal consistency (Cronbach's α) of the GDS-15.

MMSE score	0–4	5–9	10–14	15–19	20–24	25–27	28–30	0–30
Number of people, *n*	67	36	84	128	223	173	123	834
Women, *n* (%)	59 (88.1)	32 (88.9)	63 (75.0)	93 (72.7)	143 (64.1)	119 (68.8)	75 (61.0)	584 (70.0)
Age, mean ± SD	92.7 ± 4.6	93.1 ± 5.5	91.6 ± 4.8	90.8 ± 4.5	90.2 ± 4.2	88.8 ± 4.0	88.2 ± 3.9	90.2 ± 4.5
Living in institutional care, *n* (%)	63 (94.0)	32 (88.9)	63 (75.0)	68 (53.1)	70 (31.4)	33 (18.9)	15 (12.2)	344 (41.1)
Barthel ADL index, mean ± SD	4.4 ± 4.7 (*n* = 66)	8.6 ± 6.2 (*n* = 35)	10.3 ± 6.1 (*n* = 82)	15.0 ± 5.5 (*n* = 127)	17.5 ± 3.7	18.8 ± 2.4 (*n* = 171)	19.4 ± 1.7	15.5 ± 6.1 (*n* = 827)
GDS-15, *n* (%)*	1 (1.5)	15 (41.7)	55 (65.5)	98 (76.6)	204 (91.5)	161 (93.1)	117 (95.1)	651 (78.1)
GDS-15, mean ± SD	4.0	4.5 ± 3.5	4.6 ± 2.9	4.6 ± 3.0	3.8 ± 2.6	3.4 ± 2.3	2.6 ± 2.0	3.7 ± 2.6
Cronbach's α	–	0.821	0.728	0.775	0.740	0.659	0.636	0.736

Notes: MMSE (scores 0–30 points, higher score = better cognitive function), SD = Standard Deviation, ADL = Activities of Daily Living, Barthel ADL Index (scores 0–20 points, higher score = more independent in ADL), GDS-15 (scores 0–15 points, higher score = more symptoms of depression).
Number of participants after a characteristic indicates that assessments are missing.
*n is the number of people who completed the scale, i.e. at least 14/15 questions were answered.

one week later where informed consent to participation was obtained. For those living in institutions, staff was contacted and asked about the cognitive state of the individual. The next of kin was contacted for informed consent when appropriate due to cognitive impairment. A structured interview covering a variety of areas regarding health and sociodemographic data, including assessments, was carried out in the same order during one to three home visits (von Heideken Wågert et al., 2006). The assessors were trained physicians, nurses, physical therapists or medical students who were unaware of the aim of the present study. Data were also collected from relatives, caregivers and medical charts when approval was given.

Assessments

The 15-item Swedish version of the GDS (GDS-15) was used to assess depressive symptoms and was interview-administered for all participants (Agrell & Dehlin, 1989; Sheikh & Yesavage, 1986). The score ranges from 0 to 15 and a score of zero to four is considered to be within the normal range, five to nine indicates mild depression, and a score of 10 or more indicates moderate to severe depression (Almeida & Almeida, 1999).

Cognitive state was assessed using the MMSE, which is a test of cognitive aspects of mental function, e.g. orientation, memory, ability to follow verbal and written commands. The MMSE has a score ranging between 0–30, where a score of $\leq$17 indicates severe cognitive impairment and 18–23 indicates mild cognitive impairment (Tombaugh & McIntyre, 1992).

The Philadelphia Geriatric Center Morale Scale (PGCMS) was used to assess morale and was also interview-administered for all participants (Lawton, 1975). High morale is described as a basic sense of satisfaction with oneself, a feeling that there is a fit between personal needs and what the environment offers, and a certain acceptance of what cannot be changed (Lawton, 1975). It is suitable for use with older people living either in the community or in institutions, and the questions' yes/no format facilitates understanding for people with impaired cognitive function (Lawton, 1975; Ryden & Knopman, 1989). The 17-item version was used in the present study (Lawton, 1975), where scores of 0–9 indicate low morale, 10–12 the middle range and 13–17 high morale, according to the administration and scoring instructions.

The Barthel Index (0–20) was used to assess activities of daily living, where higher scores indicate a greater degree of independence (Collin, Wade, Davies, & Horne, 1988; Mahoney & Barthel, 1965). Assessment using the Organic Brain Syndrome Scale contributed to the assessment of depression, dementia and delirium and to differentiate between those diagnoses (Jensen, Dehlin, & Gustafson, 1993). Information was collected regarding diagnoses and prescribed drugs from the participants, staff and/or medical records. Diagnosis of depression and dementia were based on earlier diagnosis according to medical charts, ongoing pharmacological treatment, and on assessments during the interviews. All information was reviewed by an experienced physician, and diagnoses of depression and dementia were set according to the DSM-IV criteria (American Psychiatric Association, 1994).

Feasibility, internal consistency, and validity

The *feasibility* of GDS-15 was evaluated as the proportion of people who completed the scale. *Internal consistency* of the GDS-15 was evaluated using Cronbach's α, a measure of the inter-item correlation of a scale. *Concurrent criterion validity* refers to investigating whether scores on an instrument agree with a measurement of the same theme when assessed at the same point of time (McDowell, 2006). The concurrent criterion validity of the GDS-15 was evaluated against the PGCMS which measures morale. Morale is often used synonymously with psychological or subjective wellbeing, and the PGCMS has been

recommended for use in assessing subjective wellbeing among older people by the British Geriatrics Society and the Royal College of Physicians, London (Dall & Hopkins, 1992). The rationale for using PGCMS when evaluating concurrent criterion validity was that depressive symptoms are closely related with poor psychological well-being among older people (Coleman, Philp, & Mullee, 1995; Gerritsen et al., 2007; von Heideken Wågert et al., 2005; Woo, Ho, & Wong, 2005). Further, the scales are constructed in a similar way, both using the format of closed-ended questions where a yes or no answer indicates presence of symptoms.

Statistical analyses

Differences between those assessed with the GDS-15 ($n = 693$) and those who declined or were not able to answer the questions ($n = 141$) were evaluated regarding age and MMSE scores using independent samples *t*-test, and regarding sex using chi-square test. The criterion for a complete assessment was no more than one missing answer for GDS-15 and PGCMS, respectively, i.e. answering 14 questions or more on the GDS-15, and 16 or more in the PGCMS. Missing answers were imputed with the score zero. A logistic regression was made to evaluate the impact of MMSE scores for completion (feasibility) of the GDS-15. Completion (yes/no) was the dependent variable and MMSE score was the independent variable.

The sample was divided into seven groups according to MMSE, to compare the validity and the internal consistency of the GDS-15 among individuals with different levels of cognitive function. Each group represented five points on MMSE, except for the two groups with the highest scores which represented three points (0–4, 5–9, 10–14, 15–19, 20–24, 25–27, and 28–30). The rationale for choosing a smaller interval in the groups with the highest scores on MMSE was that many participants had high scores compared to low scores. Correlations were calculated between the GDS-15 and the PGCMS (concurrent criterion validity), within each MMSE-group using two-sided Pearson's correlation presented with correlation coefficients including 95% confidence intervals (CI), and *p*-values. Fisher r-to-z transformation, a two-tailed test for independent samples, was used to compare the correlation values for each MMSE-group with the value for the group with the highest cognitive function (MMSE 28–30). Cronbach's α (internal consistency) for the GDS-15 was calculated in each MMSE-group. All these analyses were also calculated using only individuals who completed all 15 questions in the GDS-15 and 17 in PGCMS, showing essentially the same results (data not shown).

Additional analyses were performed to evaluate the impact of age on the correlation analyses, by analyzing the age groups separately (85, 90, and 95 and over, respectively), and likewise to evaluate impact of sex by analyzing women/men separately. In the additional analyses, individuals were divided into two groups according to cognitive function; MMSE 10–24 and 25–30, to avoid risk of low power in the analyses because there were so few individuals in some MMSE-groups. Fisher r-to-z transformation test was used to compare correlation levels for sex and age, respectively, within each of the two MMSE-groups. For age, correlation values were compared to that of the youngest age group, 85-year-olds.

Analyses were performed using the SPSS software, version 17.0 (SPSS Inc., Chicago, IL), and a *p*-value of less than 0.05 was considered to indicate statistical significance.

Results

The characteristics of the 834 participants are presented in groups according to cognitive function (Table 1). The mean score on the MMSE for the whole sample was 19.8 (SD = 8.0, range 0–30). Mean age was 90.2 years, 584 participants (70%) were women, and 344 (41%) lived in institutional care. Six hundred and six participants (73%) lived in Sweden, 578 (69%) lived in urban areas, and 682 (82%) lived alone. Three hundred and twenty-eight participants (39%) had a dementia disorder, 293 (35%) a diagnosis of depression, 180 (22%) had previous stroke, and mean number of drugs for regular use was 6.9 (range 0–29).

Feasibility

In total, 651 (78%) of the 834 participants completed the GDS-15 (Figure 1, Table 1). The mean score for GDS-15 was 3.7 (SD = 2.6, range 0–14). Of the remaining 183 participants; 141 declined or were not able to answer the questions, and 42 answered less than 14 questions of the GDS-15. Those who declined or were unable to answer the GDS-15 ($n = 141$) were older (mean age 91.5 vs. 89.9, $p = 0.001$), more likely to be women (83% vs. 67%, $p < 0.001$), and had lower cognitive function (MMSE mean score 8.1 vs. 22.2, $p < 0.001$), than those who answered GDS-15 ($n = 693$).

With increasing cognitive impairment fewer people completed the GDS-15 interview (Figure 2), odds ratio = 1.22 (CI = 1.18–1.26, $p < 0.001$). For the two MMSE-groups with scores of < 10, the proportion who completed GDS-15 were 1% and 42%, respectively, compared to 65–95% in the MMSE-groups with scores of ≥ 10 (Table 1). Of the 651 who completed the GDS-15, 573 (88%) participants answered all 15 questions and 78 (12%) answered 14 (Figure 1). Among those participants who completed 14 questions, 25 (32%) did not answer question 10 'more problems with memory than most', 13 (17%) question 15 'most people better off', seven (9%) question 11 'wonderful to be alive', and seven (9%) did not answer question 9 'prefers to stay in'.

Internal consistency

The Cronbach's α for the GDS-15 among groups of people with MMSE scores of five or more ranged from 0.636 (MMSE 28-30) to 0.821 (MMSE 5-9) (Table 1).

Concurrent criterion validity

The correlations between the GDS-15 and the PGCMS were statistically significant among groups of people with MMSE scores of five or more and the coefficients ranged from −0.585 (MMSE 28–30) to −0.726 (MMSE 10–14) (Table 2, Figure 3). The correlations between the GDS-15 and PGCMS did not differ between the groups of people with MMSE scores of 5–9, 10–14, 15–19, 20–24, or 25–27 compared to the group of people with MMSE scores of 28–30 (data not shown).

Additional analyses

There were no significant differences in correlation levels between the age groups, or between males and females (data not shown).

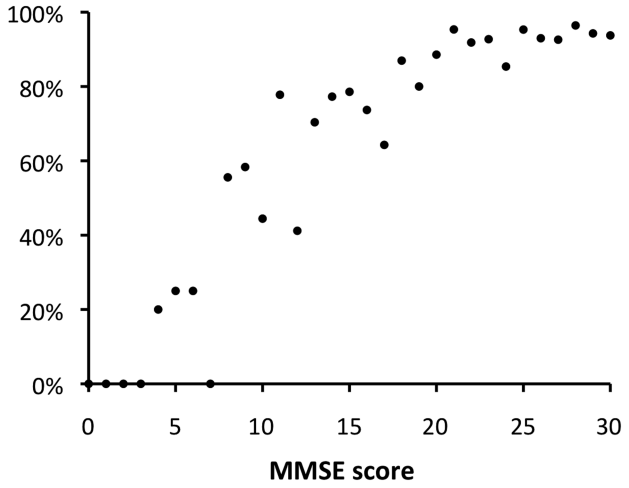

Figure 2. Proportion of people for whom the GDS-15 version was completed, in relation to level of cognitive function, measured with the MMSE.

Discussion

The results from this population-based study indicate the overall usefulness of the GDS-15 to assess depressive symptoms among very old people with MMSE scores of 10 or more. Almost two thirds of the participants with MMSE scores of 10–14 were able to complete the assessment of GDS-15, compared to the two groups with MMSE scores of less than 10 where the proportion that completed GDS-15 were only 1% and 42%, respectively. For participants in groups with MMSE scores of five or more, the internal consistency of the GDS-15 seems comparable and the correlations between the GDS-15 and PGCMS did not differ from participants with the highest cognitive function (MMSE 28–30). The correlations did not differ between women and men, or between the age groups (85, 90, and 95 and over), respectively.

The results from the present study, indicating the usefulness of the GDS-15 among people with a level of

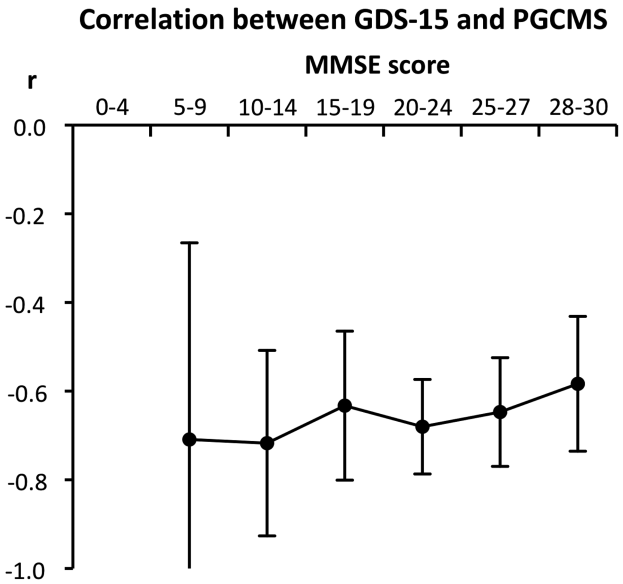

Figure 3. Correlation between the GDS-15 and the PGCMS among people with differing levels of cognitive function, measured using the MMSE. Correlations that were significant (Table 2) are presented. Bars represent 95% CIs for *r*.

Table 2. Correlation between the GDS-15 and the PGCMS among people with differing levels of cognitive function.

MMSE score	0–4	5–9	10–14	15–19	20–24	25–27	28–30	0–30
Both GDS-15 and PGCMS performed, *n** (%)	1 (1.5)	14 (38.9)	48 (57.1)	86 (67.2)	187 (83.9)	150 (86.7)	114 (92.7)	600 (71.9)
Correlation between GDS-15 and PGCMS, *r*, *p*-value	–	−0.709 0.005	−0.726 <0.001	−0.639 <0.001	−0.670 <0.001	−0.642 <0.001	−0.585 <0.001	−0.664 <0.001

Notes: MMSE (scores 0–30 points, higher score = better cognitive function), GDS-15 (scores 0–15 points, higher score = more symptoms of depression), PGCMS (scores 0–17 points, higher score = higher morale).
Correlation between variables calculated with two-sided Pearson's correlation, presented with correlation coefficient (*r*) and *p*-value. A *p*-value of less than 0.05 was regarded as statistically significant.
**n* includes assessments where GDS-15 and PGCMS was completed, i.e. at least 14/15 and 16/17 questions, respectively, were answered.

cognitive impairment down to MMSE scores of 10, seem to be in accordance with those Gerritsen et al presented when comparing GDS-30 with a self-rating scale for depression (Depression List) and one for psychological wellbeing (PGCMS) among nursing home residents (Gerritsen et al., 2007). Gerritsen et al found acceptable internal consistency and relatively strong correlations between GDS-30 and the self-rating scales among people with MMSE scores of 5 or more. The decline in completion rate with decreasing cognitive function was also found in the study by Gerritsen et al, which showed that 72% of people with MMSE scores of 5–12 completed the GDS, compared to 100% of people with MMSE scores 22–30 (Gerritsen et al., 2007). The higher completion rate in that study, compared to the present population-based study, might be due to a possible selection of the sample in the low cognition groups because the GDS-30 was not offered to all participants both for practical considerations and the frailty of the residents. The results from the present study showed overall stronger correlations than the results presented in a study by Debruyne et al, who compared GDS-30 scores with results from another scale assessing depressive symptoms (Cornell Scale for Depression in Dementia) among old people with varying levels of cognitive functions including those with severe cognitive impairment (Debruyne et al., 2009). One explanation for the low correlations in that study may be the administration of the Cornell scale, where the participants were interviewed together with a caregiver. Among people with MMSE-scores of five or more, self-reports of depressive symptoms and well-being seems more valid than ratings or observations by staff or family carers (Beer et al., 2010; Gerritsen et al., 2007).

It seemed that two items in particular were more difficult to answer in the present study. These were items 10 and 15, which are both questions which include a comparison to other people. Sutcliffe et al suggested that GDS-15 could be shortened for people living in residential care facilities because they found increased internal consistency when three items (item 9, 10, and 15) were removed (Sutcliffe et al., 2000). This was based on difficulties experienced with these specific questions, perhaps because of reluctance among old people to make assumptions about other people's life situations (item 10 and 15), or because some people simply never go outside (item 9) (Sutcliffe et al., 2000).

Methodological considerations

The large sample size in the present population-based study made it possible to divide the sample into groups according to level of cognitive function and to compare groups with severe cognitive impairments with a group with high cognitive function. The sample comprised very old people and with a wide variety of health and living conditions, reflecting the heterogeneity existing in this group. Unfortunately, the reliability of the GDS-15 was not evaluated but all participants were assessed by a trained investigator following the same procedure. No consensus was found in the literature on how to handle missing answers on the GDS-15; some allow and some do not allow missing answers (McGivney et al., 1994; Sutcliffe et al., 2000). One missing answer was allowed in the present study with regard to the population studied, and it was considered unlikely to have a significant impact on the results, as was confirmed in the analyses.

The PGCMS seems to be an appropriate choice when evaluating concurrent criterion validity of the GDS-15 since depressive symptoms are closely related with poor psychological well-being among older people (Coleman et al., 1995; Gerritsen et al., 2007; von Heideken Wågert et al., 2005; Woo et al., 2005). The correlations between GDS-15 and PGCMS and the internal consistency of the GDS-15 in our study indicate that answers are not given randomly, which could be expected from people with cognitive impairments or dementia. In order to further investigate the usefulness of the GDS-15, future studies should evaluate the validity of GDS-15 against a depression diagnosis or another scale of depressive symptoms among people with MMSE scores of 10–14. Unfortunately, this was not possible in the present study since the depression diagnosis was partly based on the score from the GDS-15.

The instructions for the GDS-15 calls for the depressive symptoms to be rated according to how they have been during the preceding week, which is a task that requires recalling the preceding week. This may be difficult for individuals with severe cognitive impairment both to understand and answer and it is likely that, among those with cognitive impairment in the present study, the answers are probably mainly based on their feelings at the time of the interview rather than the preceding week. However, there is support in the literature that a large proportion of people with cognitive levels down to MMSE scores of 10 can answer questions about their quality of life in a valid way (Beer et al., 2010; Hoe, Katona, Roch, & Livingston, 2005; Mozley et al., 1999), which strengthens the proposed conclusions that the answers to GDS-15 were not given randomly in this group of old people. Further, the GDS-15 seems suitable because of the yes/no format of the questions compared to questionnaires that use Likert scale alternatives (McDowell, 2006). In addition, administrating the GDS-15 as an interview facilitates the completion of the questions for people with impairments concerning, e.g. vision.

Conclusions

In conclusion, since almost two thirds of the participants with MMSE scores of 10–14 were able to complete the scale, and that the internal consistency of the GDS-15 and the level of agreement with

PGCMS did not differ from that for people with higher cognitive function, the GDS-15 seems to have an overall usefulness for assessing depressive symptoms in clinical and research purposes among very old people with an MMSE score of 10 or more. More studies are needed to strengthen the validity of GDS-15 among older people with MMSE scores of 10–14, by evaluating GDS-15 against a depression diagnosis or another scale of depressive symptoms. For older people with MMSE scores lower than 10, and those over 10 not able to complete the GDS-15, there is a need to develop and validate other measurements to assess depressive symptoms.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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