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# **The Organic Brain Syndrome (OBS) Scale: A Systematic Review**

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## ABSTRACT

**Background/Objective:** The Organic Brain Syndrome (OBS) Scale was developed to determine elderly patients' disturbances of awareness and orientation as to time, place and own identity, and assessment of various emotional and behavioural symptoms appearing in delirium, dementia and other organic mental diseases. The aim of the study was to examine the OBS scale, using the eight criteria and guidelines formulated by the Scientific Advisory Committee of the Medical Outcomes Trust (SAC), and to investigate its relevance and suitability for use in various clinical settings.

**Method:** Systematic search and analysis of papers (30) on the OBS scale were carried out using the criteria suggested by the SAC.

**Results:** The OBS Scale in many aspects satisfies the requirements suggested by the SAC: conceptual and measurement model, reliability, validity, responsiveness, interpretability, respondent and administrative burden, alternative forms of administration, and cultural and language adaptations, but there is a need for additional evaluation, especially with regard to different forms of reliability, and the translation and adaptation to other languages.

**Conclusions:** The OBS Scale is a sensitive scale which is clinically useful for the description and long-term follow-up of patients showing symptoms of acute confusional state and dementia. Although the OBS scale has been used in several clinical studies there is need for further evaluation.

**Keywords:** OBS Scale; confusion; delirium; dementia; validity; reliability; MMSE; clinical usefulness.

# **The Organic Brain Syndrome (OBS) Scale: A Systematic Review**

## **Introduction**

Precise and reliable assessment of the mental status in elderly patients is essential as changes in cognition and behaviour often are the first symptom of an underlying psycho-physiologic disturbance (Foreman, 1987). A large number of rating scales have been designed for clinical assessment and diagnosis of organic mental disease. Many of these scales have been widely accepted and used without being subjected to a systematic analysis. Assessment instruments should meet the basic condition for acceptable psychometric characteristics such as presented by The Scientific Advisory Committee of the Medical Outcomes Trust (SAC), 2002. The SAC was created as a non-profit, international and independently operating entity with a commission to identify and review health status, functioning and quality of life instruments (Lohr *et al.*, 1996). SAC defined eight attributes and review criteria, based on current norms and principles of modern test theory (McDowell and Newell, 1996; Streiner and Norman, 1995), as guidelines for the evaluation of such instruments. These guidelines, revised in 2002, have been applied in several evaluations of functioning and disability measurement scales (Kulich *et al.*, 2003; Dziedzic *et al.*, 2004; Höfer *et al.*, 2004).

Within the field of emergency treatment and care there are increasing demands for specific and sensitive assessment tools for the evaluation of patients with an acute confusional state (ACS), delirium. ACS is probably the most frequent organic brain

syndrome (OBS), especially among elderly with physical illness (Burns *et al.*, 2004). Its physical and mental components are recognized as serious, painful, sometimes life-threatening problems in the treatment and care of frail elderly patients (Inouye, 1998). Elderly patients with hip fracture constitute a group at high risk for developing ACS postoperatively (Gustafson, Y. *et al.*, 1988). Studies concerning this group of patients have reported an incidence of ACS between 5% – 61.3%, depending on the diagnostic tools and criteria used to detect this (Williams *et al.*, 1985; Gustafson, Y. *et al.*, 1988; Brauer *et al.*, 2000; Andersson *et al.*, 2001; Milisen *et al.*, 2001; Burns *et al.*, 2004).

The diagnosis of ACS as classified in *The Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV) (1994), is based on four clinically key features: (1) disturbance of consciousness, (2) a change in cognition, (3) mental changes developing and often fluctuating over a short period of time, and (4) evidence that these disturbances are direct consequences of the general medical condition (American Psychiatric Association (APA), 1994).

The Organic Brain Syndrome scale (OBS scale) (Gustafson L *et al.*, 1985; 1995) was developed for clinical evaluation of disturbances of awareness and orientation together with other signs of confusion in elderly patients. The development of the OBS scale was partially based on studies focusing upon dementia and the relationship between psychiatric symptoms and brain function as measured by regional blood flow (rCBF) (Gustafson L. *et al.*, 1970; 1972; Gustafson L and Risberg, 1974) and psychometric testing (Gustafson L and Hagberg, 1975). The OBS scale was introduced as a ‘new rating scale for evaluation of confusional states and organic brain syndromes’ at the 2<sup>nd</sup> International Congress of Psychogeriatric Medicine in 1985 (Gustafson, L *et al.*,

1985). The English version of the OBS scale was published in 1993 (Jensen *et al.*, 1993). Bitsch *et al.* (2004) referred to the OBS scale as a standardized mental test similar to the Confusion assessment method (CAM) (Inouye, 1990). It is of considerable value to investigate to what extent the OBS scale fulfils the qualifications for clinical measurements.

## **Aims**

The aims of this study were: (1) to critically examine the OBS Scale using the criteria and guidelines formulated by the SAC for the evaluation of assessment instruments; and (2) to investigate its relevance and suitability for use in various clinical settings.

## **Method**

A two-stage strategy was used for identifying and reviewing papers for analyzation of the OBS scale. The first stage involved systematic search with quality library support, using data bases such as PubMed and Cinahl from 1966 to January 2005. MESH terms and keywords (confusion, delirium, acute confusional state, hip fractures, aged 65+, elderly, organic brain syndrome, and OBS Scale) were used in a variety of combinations resulting in 453 papers of which 431 were excluded as the OBS scale was not used. This was supplemented by manual searches from literature citations and reference lists resulting in eight papers. Only studies referring to the OBS scale, and

original papers in English-language publications were included, which resulted in 30 papers selected for further consideration. The second stage included analyses of each one of the 30 papers selected in relation to the SAC's eight criteria for instrument assessments (SAC, 2002), and to clinical suitability.

### **The SAC criteria for analysis**

The correlation of the data has been performed using SAC's principles and criteria for instrument assessments (SAC, 2002), which specifies the following eight attributes:

- (1) *Conceptual and measurement model*. The conceptual model is the underlying rationale for and description of the concepts and the populations that the measure is intending to assess and the relationship between those concepts. The measurement model represents the instrument's scale and subscale structure and the procedures used for deriving scale scores.
- (2) *Reliability*. Reliability is the degree to which an instrument is free from random error, i.e. its accuracy and reliability regardless of circumstances or location. The concept of reliability includes: (a) internal consistency, which reflects the precision of the scale based on the inter-correlation between the variables covered by the scale at any one time; and (b) reproducibility, i.e. the stability and reliability of the instrument used over a longer period of time (test – retest reliability, intra-rater and inter-rater reliability) during several administrations.
- (3) *Validity*. Validity is the degree to which the instrument measures what it is intended to measure. This covers: (a) that it is content-related: that the domain of an instrument is appropriate to its intended use; (b) construct-related: evidence that endorse a proposed interpretation of scores based on theoretical implications associated with the constructs

being measured; and (c) criteria-related: evidence which shows how the scores of the instrument are related and reflected to the stated criteria.

- (4) *Responsiveness* refers to the instrument's ability to discern change over time.
- (5) *Interpretability* is the degree to which the data and meaning of an instrument's quantitative scores can be easily understood.
- (6) *Respondent and administrative burden* is the time, effort and other demands put on the respondents or on those who administer the instrument.
- (7) *Alternative forms of administration* include other ways in which the instrument might be administered e.g. self-report, interviewer-administered or trained observer ratings.
- (8) *Cultural and language adaptations (translations)* include assessment of conceptual and linguistic equivalence and evaluation of measurement characters (SAC, 2002).

## **Results and Discussion**

### **Evaluation in relation to the SAC's criteria**

The result of the analysis showed that in 18 (Table 1) of the 30 (Table 2) papers the criteria stated by the SAC were considered.

Insert Table 1

Insert Table 2

### *The conceptual and measurement model*

The OBS scale consists of two subscales: 'OBS 1 - *The disorientation subscale*' and 'OBS 2 - *The confusion subscale*'. OBS 1 is an interview scale giving a short time

perspective of the patient's condition with 16 questions (initially 15, where the first question : 'what is your name?' was separated into two questions, one for the first name, and one for the second name). OBS 1 describes the patients' awareness of and orientation to own identity (five items), time (seven items), place (two items), and knowledge regarding some general topics (two items). The patient is assessed according to a four - point ordinal scale with a detailed description given for each level (0-3) where zero indicates a correct response, while 1, 2 and 3 indicate slightly, moderately or completely wrong answers (Jensen *et al.*, 1993; Gustafson L *et al.*, 1995).

OBS 2, the second subscale, is an observation scale with 39 clinical items and with a longer time perspective. OBS 2 covers a broad spectrum of psychopathology: emotional reactions (nine items), different types of time related variations and fluctuations in the clinical condition (six items), suspiciousness and delusions (four items), language and speech difficulties (four items), neurological symptoms (three items), spatial disorientation and impaired recognition (6 items), physical and practical disabilities (five items), and social interaction skills (two items). The severity of the symptoms is ranked in four ordinal scale steps according to their intensity and frequency: Score zero indicates lack of any symptoms, 1, 2 and 3 scores represent occasional, moderate or obviously constant or recurring symptoms. The evaluation covers the latest seven day period, if not otherwise stated (Jensen *et al.*, 1993; Gustafson L *et al.*, 1995).

Factor analysis is a construct validity tool aiming at extracting and identifying underlying clinical dimensions (McDowell and Newell, 1996). Validity has been

defined as the common variance of a factor, and construct validity is the meaning of this construct, studied by comparison with other constructions. Factor analysis, using the principal component method with orthogonal rotation, was used to determine the validity of the construction of the OBS scale, and to simplify the clinical description (Gustafson, L *et al.*, 1985; Jensen *et al.*, 1993; Gustafson L *et al.*, 1995). The separation between OBS 1 and 2 and further development were based upon data obtained from 55 patients suffering from different levels of confusion or dementia (Table 1 and 2). A sub-sample of 20 patients with acute or sub-acute confusional reactions was followed during a double-blind drug trial. The factor analysis of the OBS 1 revealed three factors called *Time*, *Recent memory* and *Identity* and described by items with factor loadings between 0.40 and 0.87 (Table 3). All items had a high factor loading in at least one factor, and all except three items were unique for one factor (Jensen *et al.*, 1993; Gustafson L *et al.*, 1995).

Insert Table 3.

Factor analysis of the confusion scale (OBS 2) resulted in several separate factors describing different cognitive and emotional disturbances, and neurological features (Table 4). The 39 items were reduced to 38, as one item (“epileptic seizures”) was excluded because of low symptom frequency (Gustafson, L *et al.*, 1995). Nine factors emerged, described with factor loadings between 0.40 and 0.83. Thirty-two items had one high factor loading, five had two, and one had three (Gustafson L *et al.*, 1995).

Insert Table 4

Both subscales exist in modified versions, OBS 1 reduced to 12 items, and the OBS 2 to 21 items in accordance with target population (Berggren *et al.*, 1987). These modified OBS scales have been used in several studies (Table 2). Another modification was made by Hallberg *et al.* (1990) with the purpose of identifying common patterns of reduced functionality or derangements in a group of vocally disruptive patients compared with a control group. To ensure that the OBS 2 was sufficiently discriminative to identify the different levels of dementia, the confusion scale was modified from a four to a seven-point response scale (*ibid.*). This version was also used by Edberg *et al.* (1999) (Table 1 and 2).

### *Reliability*

Seven studies showed high identical scoring of OBS 1 and OBS 2 regarding inter-rater reliability (Table 5). In the study by Gustafson, L *et al.* (1995), 55 patients were repeatedly assessed by a qualified geriatrician and 30 of these patients also assessed by a trained clinical psychologist. The inter-rater reliability was significant ( $r_s = 0.71 - 1.0$ ,  $r_s = 0.61 - 1.0$ ). A discrepancy between the raters concerning only one of the symptoms in the OBS 2 disappeared after a minor modification of the item description (Gustafson L *et al.*, 1995). Hallberg *et al.* (1990) showed an inter-rater reliability of  $r_s = 0.93 - 0.98$ , the assessments performed by experienced nurses. Ninety-eight percent of the assessments in the studies by Gustafson, Y *et al.* (1988; 1991a) were performed by the same geriatrician, and the remaining by a co-author. In the same research group Berggren *et al.* (1987) reported a 90% agreement for all variables between two investigators whereas Brännström *et al.* (1989) showed a 95% agreement on all occasions between two raters. Later studies by the same group have shown more than 90% consensus between raters (Edlund *et al.*, 2001). The internal consistency,

reported by Edberg *et al.* (1999), as measured by Cronbach's alpha, showed an overall reliability of 0.88 for the OBS 2, which is considered as sufficient (Nunnally and Bernstein, 1994).

Thus the OBS scale has shown satisfactory inter-rater reliability, in several studies carried out by experienced researchers and clinicians with a recognized and acknowledged competence within the specific field. Other forms of reliability such as test-retest and intra-class correlations have not been used.

Insert Table 5

### *Validity*

The construct-related validity of the confusion subscale (OBS 2) was tested by comparing OBS 2 and its clinical dimensions described by the nine factors, with the results of previous factor analyses carried out on five other commonly used psychogeriatric scales (Gustafson, L *et al.*, 1995): The Stockton Geriatric Rating Scale (SGRS) (Meer and Baker, 1966), Psychiatric symptomatology in senile dementia (Jonsson *et al.*, 1972), Psychiatric symptoms in presenile dementia (Gustafson, L, 1975), The Sandoz Clinical Assessment-Geriatric (SCAG) rating scale (Shader *et al.*, 1974) and The Brief Psychiatric Rating Scale (BPRS) (Overall and Beller, 1984). The factors in the confusion scale (OBS 2) showed strong similarity to the factor solutions of the five psychogeriatric rating scales (Gustafson, L *et al.*, 1995).

Hallberg *et al.* (1990) in a discriminant analysis compared patients with and without vocally disruptive behaviour in a larger cohort (n = 264) of psychogeriatric patients

(Table 3). There were only small differences between the two patient groups in OBS 1, while in OBS 2 five of the seven factors were of significant importance for group classification. The vocally disruptive behaviour was significantly related to the patients' functional capacity, orientation in the ward, clinical fluctuations and emotional instability, as well as hallucinations and delusions. Speech dysfunction and a more placid temperament were more marked in the control group. Thus the OBS 1 showed important similarities, while the OBS 2 revealed several clinically relevant differences between the patient groups, indicating a predictive usefulness of the OBS scale.

The construct and the clinical dimensions of the OBS scale have been described in similar ways by two independent factor analyses. The three factors of the OBS 1 are described by several items with strong factor loadings, fulfilling the requirements of Gorsuch (1983), that the factors should on average contain about five strong variables and that the number of observations should be at least five times as many as there are variables to be analyzed. This would ensure that the total number of observations would be sufficient to regard the factor analysis of the OBS 1 as reliable. The number of observations in the OBS 2 in the study by Gustafson, L *et al.* (1995) was, however, slightly below these recommendations to ensure factor analytic reliability (Gorsuch, 1983). The structures of the factors as revealed in the rotated factor matrix were judged as significant on the 1% level and were considered as practically identical (Jensen *et al.*, 1993) which give an evidence of construct-related validity.

The OBS Scale has shown a satisfactory content-related validity since every item except for one (epileptic seizures) relates to the different clinical dimensions describing organic mental disease (Hallberg *et al.*, 1990; Gustafson L *et al.*, 1995).

Criterion-related validity, usually divided into concurrent and predictive validity (McDowell and Newell, 1996), of the OBS Scale was further evaluated by comparing it with the Mini-Mental-State-Examination (MMSE) (Folstein *et al.*, 1975) and the Gottfries, Bråne and Steen (GBS) Scale (Gottfries *et al.*, 1982) (Jensen *et al.*, 1993). Both scales have been translated into several languages and are widely used in clinical practice and research. Twenty-eight patients with different forms of dementia were assessed with the OBS Scale, the MMSE, and the GBS Scale together with the Global Deterioration Scale (GDS) (Reisberg *et al.*, 1982), and the Katz ADL index (Katz and Akpom, 1976) (Table 1, 2). The GBS Scale describes different clinical dimensions such as intellectual, emotional and motor functions, and other symptoms usually shown in patients with dementia. The GDS is based upon a clinical evaluation of the patient's total functional abilities. The comparisons between the OBS Scale, the MMSE, and the GBS Scale were based upon correlations between the patient's scores in the assessment scales, the subscales and the factors (Jensen *et al.*, 1993). Concurrent validity was satisfactory as the correlations between the score in the whole of the total OBS Scale, and the MMSE and GBS Scales were high. The MMSE score correlated significantly ( $p < 0.01 - p < 0.001$ ) with the scores in the OBS Scale ( $r_s = -0.83$ ), the OBS 1 ( $r_s = -0.56$ ), the OBS 2 ( $r_s = -0.75$ ), and the GBS scale ( $r_s = -0.80$ ). The OBS Scale also showed significant correlations with all other assessment scales (GBS Scale:  $r_s = 0.82$ , GDS:  $r_s = 0.57$ ), with the lowest correlation ( $p < 0.05$ ) with the Katz ADL index ( $r_s = 0.43$ ). The OBS 2 showed similar results, although with somewhat stronger

correlations with the GDS and the Katz ADL index, here used as a measure of discriminant validity. This was further supported by Minthon *et al.* (1996) presenting strong correlations between MMSE score and scores in the factor “dyspraxia - spatial disorientation” in the OBS 2 scale ( $r = 0.78$ ,  $p < .0001$ , Mann-Whitney  $U$  test). OBS 1 showed a significant ( $p < 0.01$ ) correlation with the GBS scale ( $r_s = 0.56$ ), but not with the GDS and the Katz ADL index (Jensen *et al.*, 1993). The mainly low and non-significant correlations between patients’ scores in the 12 factors in OBS 1 and OBS 2 emphasized the strength and stability of the factor structure. The comparisons with other clinical rating scales clearly showed their ability to describe, identify and assess a wide range of clinical dimensions (Jensen *et al.*, 1993). This study is one of the very few where the analysis of the MMSE scale has been based on patients with a wide range of organic and functional diagnoses. This limitation of earlier studies has been pointed out as one of the shortcomings regarding the utility of the MMSE in the detection of dementia (Field *et al.*, 1995).

A study focusing upon a single item ‘depressed mood’ in the OBS 2 scale showed strong correlations with the Montgomery-Åsberg Depression Rating Scale (MADRS) (Montgomery and Åsberg, 1979) and The Clinical Global Impression (CGI) Scale (Guy, 1976) (MADRS:  $r_s$  0.85, CGI scale:  $r_s$  0.88) (Sandberg *et al.*, 1998). Assessment of 457 patients regarding confusion and level of disorientation was made by Andersson *et al.* (2001). The agreement between the clinical assessments based on the criteria stated in DSM-IV, and the scores on the OBS 1 showed a Kappa-coefficient of 0.77 (95% confidence interval 0.71 – 0.83) and the exact agreement was 96.2% (Andersson *et al.*, 2001). The OBS scale was compared with the CAM (Inouye, 1990) showing a 100% agreement regarding the diagnosis of postoperative ACS as classified in the

DSM-IV (Eriksson *et al.*, 2002). The distinction between ACS and non- ACS was highly significant ( $p = 0.021 - p < 0.001$ , Fischer's exact test) in four clinical items. Another strong correlation between the OBS 1 scores and the scores in the MMSE (Pearson  $r = -0.899$ ,  $p \leq 0.001$ ) was presented by Lundström *et al.* (2003) giving evidence of a satisfactory criterion-related validity (Table 1 and 2).

### *Responsiveness*

Patients showing symptoms of ACS were tested repeatedly on a daily basis until, and if, their confusion had ceased (Andersson *et al.*, 2001). Even as early as at the admission to the hospital there were significantly higher OBS 1 scores in patients who later developed ACS. The authors maintain that the OBS 1 was sufficiently sensitive to recognize, at an early stage, those patients who are at risk to develop an ACS. In several studies the OBS 1 and 2 were used to detect and follow the clinical course of ACS (Berggren *et al.*, 1987; Edlund *et al.*, 2001; Gustafson Y *et al.*, 1988; 1991a; Lundström *et al.*, 1999; 2003). All patients in the study by Gustafson L *et al.* (1985; 1995) could be described by standardized factor scores in the different symptom clusters, based on factor analysis, and the symptom profile could be followed during treatment of the confusional state.

### *Interpretability*

The clinical assessment with the OBS 1 was based on a four point scale (total range 0 – 48) with a detailed and well-defined description of each step for every item. For example, the eighth item, 'What day of the week is it?' the following scores/steps were given: (0) correct answer, (1) wrong by one day, (2) knows whether it is the beginning,

in the middle or at the end of the week, and (3) answer completely wrong or no reply. The questions in the OBS 2 scale were formulated to reflect the severity and variation of the symptoms, ranked in four levels based on intensity and frequency of each symptom and item (total range 1 – 117). For example, the item “Restlessness” had following scores/steps: (0) not observed, (1) difficulty in keeping hands still, changes posture, (2) marked restlessness, hand wringing and attempt to rise, and (3) inability to sit still for more than short periods, pacing (Jensen *et al.*, 1993; Gustafson L *et al.*, 1995). As a cut-off score Berggren *et al.* (1987) suggested six points or less within three items in the modified OBS 1. Higher score indicated increased disorientation. The same cut-off score was used by Andersson *et al.* (2001) while Nyberg *et al.* (1996) considered the patient as lucid at nine points or less, out of a maximum of 36 points. The majority of studies also used the DSM-criteria for delirium in defining the patient as confused, which should confirm the grading of scores (Table 1 and 2).

### *Respondent and administrative burden*

The assessment using the OBS 1 takes approximately 5 - 10 min and is possible to integrate into ordinary nursing assessment (Andersson *et al.*, 2001). About 30 min was enough to complete the OBS Scale, for an experienced interviewer and a cooperative patient (Jensen *et al.*, 1993). The interview itself took approximately 10 - 15 min, and the patients never complained of feeling tired during the actual investigation. The assessment with both subscales took about 1h (Sandberg *et al.*, 1999). Further information concerning burden hasn't been found which could indicate that the scale isn't too strenuous to administer, nor for the respondent to answer or respond to.

### *Alternative forms of administration*

The OBS 1 scale is based on a limited number of questions on awareness and orientation to which the patient is expected to respond. Patients' mental status before the fracture may be judged by interviews with relatives and care staff (Gustafson, Y. *et al.*, 1991c; Edlund *et al.*, 2001) and the observational schedule of the confusion scale, OBS 2, may be grounded on information given by nurses and other staff members, well acquainted with the patient's condition and behavioural patterns, and with special training of patients with organic mental disease (Jensen *et al.*, 1993; (Gustafson, L. *et al.*, 1995). Other forms of administration have not been used.

### *Cultural and language adaptations (translations)*

The selection and formulation of the items in the OBS Scale were based on a comprehensive review of literature concerning psychogeriatric assessment scales, using Scandinavian research traditions and approaches. The questions in the orientation subscale also fulfill those commonly used to establish the clinical assessment of patients suffering of organic brain failure (Jensen *et al.*, 1993). The OBS Scale has been published in its original Swedish form and has been recommended for assessment of acute confusion in the Norwegian geriatric-psychiatric treatment and care (INFO-banken, 1996). Although the OBS Scale was originally founded on Swedish clinical concepts and tradition, it has shown a satisfactory concordance with other rating scales in the field of organic mental disease.

## **Evaluation in relation to clinical relevance and suitability**

The structure of the OBS Scale and its clinical applicability has been studied in different clinical settings and patient populations with a wide range of age from 23 years to 102 years (Table 2). The majority of studies took place at different departments and hospitals in Sweden. In several studies the OBS Scale has been used to investigate the incidence of ACS and to follow the development of this condition, dementia, different psychiatric profiles and behavioural as well as cognitive symptoms in the elderly population. It has been applied on orthopedic patients, stroke patients, patients in coronary heart and intensive care units (ICU), showing good responsiveness and comprehensibility in a number of clinical conditions.

Assessing mental status in geriatric patients the OBS 1 Scale may well be used as it doesn't include writing and drawing, difficult tasks to standardize for elderly bedridden or otherwise disabled patients. Compared to other mental tests, in which the patient is assessed according to a nominal scale (right/wrong answer), the OBS Scale offers several well defined scoring steps which should make it more sensitive to changes in the patient's mental condition. Moreover, the assessment procedure with the OBS Scale is always started with three relevant questions concerning the patients' hearing, vision and speech.

The conformity of the scale with the criteria stated in DSM-III, DSM-III-R and DSM-IV (APA, 1980; 1987; 1994) have been supported by several studies (Berggren *et al.*, 1987; Sandberg *et al.*, 1998; Andersson *et al.*, 2001). The tests and cross-evaluations carried out in these studies strongly confirm the reliability of the diagnosis

of acute confusion and thus a confirmation of the usefulness in the populations for which the OBS Scale was intended; a conclusion further supported by the literature which has been examined and studied.

## **Conclusions**

The OBS scale is a sensitive and balanced rating scale offering description of a wide spectrum of clinical manifestations in organic brain disease. It is easy to apply on different patient samples in different clinical settings. The rating scale shows strong conformity with other rating scales used in this clinical context. The OBS Scale in many aspects satisfies the requirements of a valid clinical instrument, though with respect to the criteria suggested by the SAC (2002) there is a need for additional evaluation of the OBS Scale, especially with regard to reliability, and the translation and adaptation to other languages.

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## Tables and Legends

Table 1. Evaluation of the OBS scale (OBS 1+ OBS 2) in 18 studies according to the SAC's eight attributes and guidelines (SAC, 2001)

Table 2. Data in chronological order from 30 studies concerning confusion or psychiatric illness using OBS scale.

Table 3. Two different factor analyses of the disorientation subscale, OBS 1.

Table 4. Two different factor analyses of the confusion subscale, OBS 2.

Table 5. Inter-rater reliability tests of the OBS scale (OBS 1 and OBS 2) in elderly orthopedic and psychiatric patients.

Table 1. Evaluation of the OBS Scale (OBS 1+ OBS 2) in 18 studies in relation to the SAC's eight attributes and guidelines (SAC, 2001)

| Attribute<br>Source                        | Conceptual<br>measurement<br>model                                     | Reliability               | Validity                                                    | Responsiveness                                               | Interpretability                                                                                 | Respondent,<br>administrative<br>burden            | Alternative<br>forms                                       | Cultural, language<br>adaptations                              |
|--------------------------------------------|------------------------------------------------------------------------|---------------------------|-------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------------|
| Andersson<br><i>et al.</i> , 2001          |                                                                        |                           | Exact agreement<br>OBS 1 / DSM-IV                           | OBS 1<br>Sensitivity to<br>changes,<br>prediction            | Cut-off: 6 points or less<br>out of 36 in a maximum<br>of 3 items. Diagnostic<br>criteria DSM-IV | OBS 1<br>Integrated in<br>nurs.ass. 5 – 10<br>min. | Experienced<br>nurses/other<br>care staff spec.<br>trained |                                                                |
| Berggren <i>et al.</i> ,<br>1987           | Modified version<br>in number of<br>items                              | Inter-rater               |                                                             | OBS 1 + 2<br>Sensit.to changes                               | Cut-off: 6 points or less<br>out of 36 in a maximum<br>of 3 items. DSM-III                       |                                                    |                                                            | OBS 1: English<br>version                                      |
| Brännström <i>et al.</i> ,<br>1989         |                                                                        | Inter-rater               |                                                             | OBS 1 + 2<br>Sensit.to changes                               | Diagn.crit. DSM-III                                                                              |                                                    |                                                            |                                                                |
| Edberg <i>et al.</i> , 1999                |                                                                        | Intern consist.:<br>OBS 2 |                                                             | OBS 1 + 2<br>Sensit.to changes                               |                                                                                                  |                                                    |                                                            |                                                                |
| Edlund <i>et al.</i> , 2001                |                                                                        | Inter-rater               |                                                             | OBS 1 + 2<br>Sensit.to changes                               | Diagn. crit. DSM-IV                                                                              |                                                    | Interviews<br>relatives, staff                             |                                                                |
| Eriksson <i>et al.</i><br>2002             |                                                                        |                           | Exact agreement<br>OBS scale:4 variables<br>/ CAM / DSM-IV  |                                                              | Diagn. crit. DSM-IV                                                                              |                                                    |                                                            |                                                                |
| Gustafson L<br><i>et al.</i> 1985;<br>1995 | Concepts<br>Dimensions<br>Scale level,<br>scores, target<br>population | Inter-rater               | Factor analysis<br>OBS 2 / 5<br>psychogeriatric scales      | OBS 1 + 2<br>Sensit.to changes<br>Evaluation of<br>treatment | OBS 1, OBS 2<br>Score structure presented.                                                       |                                                    | Nurses/other<br>care staff spec.<br>trained                | Precise descriptions<br>and grading of<br>observations .       |
| Gustafson Y <i>et al.</i><br>1988          |                                                                        | Inter-rater               |                                                             | OBS 1 + 2<br>Sensit. o changes                               | Diagn.crit. DSM-III                                                                              |                                                    |                                                            |                                                                |
| Gustafson Y <i>et al.</i><br>1991a         |                                                                        | Inter-rater               |                                                             | OBS 1 + 2<br>Sensit.to changes                               | Diagn.crit. DSM-III                                                                              |                                                    |                                                            |                                                                |
| Gustafson Y <i>et al.</i><br>1991c         |                                                                        |                           |                                                             |                                                              |                                                                                                  |                                                    | Interviews<br>relatives, staff                             |                                                                |
| Hallberg <i>et al.</i><br>1990             | Modified in scale<br>steps                                             | Inter-rater               | Factor analysis<br>Discriminant validity                    |                                                              |                                                                                                  |                                                    |                                                            |                                                                |
| Jensen <i>et al.</i> 1993                  |                                                                        |                           | Concurrent/<br>discriminant validity<br>MMSE / GBS          |                                                              | OBS 1, OBS 2 Score<br>structure and levels<br>presented. DSM-III-R                               | OBS 1+2 30 min.<br>no complaints/<br>tiredness     | Nurses/other<br>care staff spec.<br>trained                | OBS 1+2: English<br>version Scandinavian<br>research tradition |
| Lundström <i>et al.</i><br>2003            |                                                                        |                           | Concurrent validity<br>OBS 1 / MMSE                         | OBS 1 + 2<br>Sensit.to changes                               | Diagn. crit. DSM-IV                                                                              |                                                    |                                                            |                                                                |
| Lundström <i>et al.</i><br>2005            |                                                                        |                           |                                                             | OBS 1 + 2<br>Sensit.to changes                               | Diagn. crit. DSM-IV                                                                              |                                                    |                                                            |                                                                |
| Minthon <i>et al.</i> 1996                 |                                                                        |                           | Correlation OBS 2:<br>dyspraxia-spatial<br>disorient./ MMSE |                                                              | Diagn.crit.<br>DSM-III-R                                                                         |                                                    |                                                            |                                                                |
| Nyberg <i>et al.</i> 1996                  |                                                                        |                           |                                                             |                                                              | Cut-off: 9 points or less<br>out of 36 items                                                     |                                                    |                                                            |                                                                |
| Sandberg <i>et al.</i><br>1998             |                                                                        |                           | Concurrent validity:<br>OBS 2, depr.mood /<br>MADRS / CGI   |                                                              | Diagn. crit.<br>DSM-III-R                                                                        |                                                    |                                                            |                                                                |
| Sandberg <i>et al.</i><br>1999             |                                                                        |                           |                                                             | OBS 1 + 2<br>Sensit. to<br>changes                           | Diagn. crit.<br>DSM-III-R                                                                        | OBS 1+2<br>One hour                                | Experienced<br>nurses/other<br>care staff spec.<br>trained |                                                                |



Table 2. Data in chronological order from 30 studies concerning confusion or psychiatric illness using the OBS scale

| Source                                | n        | Population                    | Age                | Study aim                                                              | Diagnostic instruments                   |                                                                | Diagnosis/<br>Diagnostic criteria                  |
|---------------------------------------|----------|-------------------------------|--------------------|------------------------------------------------------------------------|------------------------------------------|----------------------------------------------------------------|----------------------------------------------------|
|                                       |          |                               |                    |                                                                        | OBS scale                                | Validation (other purpose)                                     |                                                    |
| Gustafson L <i>et al.</i> 1985; 1995  | 55       | Confusion or dementia         | 67 - 92            | OBS scale construction, ACS: evaluation of treatment                   | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | Factor analysis<br>5 psyc.geriatr. scales                      | DAT <sup>11</sup> , VD <sup>12</sup> or other type |
| Berggren <i>et al.</i> 1987           | 57       | Hip fracture                  | 65 - 92            | Comparing incidence of ACS between 2 groups                            | OBS 1 <sup>3</sup><br>OBS 2 <sup>4</sup> | --                                                             | DSM-III                                            |
| Gustafson Y <i>et al.</i> 1988; 1991b | 111      | Hip fracture                  | 65 -96             | Estimation of ACS incidence                                            | OBS 1 <sup>3</sup><br>OBS 2 <sup>4</sup> | --                                                             | DSM-III                                            |
| Brännström <i>et al.</i> 1989; 1991   | 35       | Hip fracture                  | 61 - 88            | Identif. ADL-perf. and nursing problems. ACS diagnose test             | OBS 1 <sup>3</sup><br>OBS 2 <sup>4</sup> | (Katz ADL-index)                                               | DSM-III                                            |
| Hallberg <i>et al.</i> 1990           | 74       | Dementia                      | median: 85         | Identif. of functional impairment behavioural disturbances             | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | Factor analysis (Katz ADL-index)                               | DAT, VD or other type                              |
| Gustafson Y <i>et al.</i> 1991a       | 103      | Hip fracture                  | 65 - 102           | Evaluation of intervention program r/t ACS incidence                   | OBS 1 <sup>3</sup><br>OBS 2 <sup>4</sup> | --                                                             | DSM-III                                            |
| Gustafson Y <i>et al.</i> 1991c       | 155      | Stroke                        | 40 - 101           | Estimation of ACS incidence                                            | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | (MMSE <sup>5</sup> )                                           | DSM-III-R                                          |
| Andersson <i>et al.</i> 1993          | 1        | Hip fracture                  | 86                 | Identif. and investigation of developing ACS episodes                  | OBS 1 <sup>3</sup>                       | (Case study)                                                   |                                                    |
| Gustafson Y <i>et al.</i> 1993        | 83       | Stroke                        | 44 - 89            | Investigating activity of HPA axis r/t ACS                             | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | (MMSE)                                                         | DSM-III-R                                          |
| Jensen <i>et al.</i> 1993             | 28       | Dementia                      | 66 - 89            | Evaluation of the OBS scale comparing it with 3 scales                 | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | MMSE, GBS <sup>6</sup> , GDS <sup>7</sup><br>Katz ADL-index    | DAT, VD, other<br>DSM-III-R                        |
| Minthon <i>et al.</i> 1996            | 34<br>22 | Dementia                      | 50 - 76<br>35 - 75 | Analyzing if CFS NPY-levels r/t clinical emotional symptoms            | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | OBS 2: factor 1 with MMSE                                      | DAT (DSM-III-R) and FTD <sup>13</sup>              |
| Nyberg <i>et al.</i> 1996             | 123      | Hip fracture                  | 65 - 94            | Analyzing falls mechanism<br>Screening for lucid/not lucid             | OBS 1 <sup>3</sup>                       | --                                                             | --                                                 |
| Elmståhl <i>et al.</i> 1997           | 105      | Dementia                      | m: 83<br>± 6.0     | Studying design of group living units r/t psychiatric symptoms         | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | (MMSE, Katz ADL-Index)                                         | DAT (DSM-III-R), VD or other type                  |
| Sandberg <i>et al.</i> 1998; 1999     | 717      | Elderly (diff. diagnosis)     | 75 - 100           | Studying the prevalence of psychiatric symptoms-/ profiles             | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | Item Depressed mood with MADRS <sup>8</sup> , CGI <sup>9</sup> | DSM-III-R                                          |
| Edberg <i>et al.</i> 1999             | 22       | Dementia                      | 83-91              | Evaluation of the effects of one year intervention program.            | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | (MMSE)                                                         | DAT, VD or other type                              |
| Edlund <i>et al.</i> 1999             | 54       | Hip fracture                  | 40 - 98            | ACS: incidence, predispos.factors, clin.profile, consequences          | OBS 1 <sup>3</sup><br>OBS 2 <sup>4</sup> | --                                                             | DSM-III-R                                          |
| Lundström <i>et al.</i> 1999          | 49       | Hip fracture                  | 65 - 98            | Evaluation of intervention program r/t ACS incidence                   | OBS 1 <sup>3</sup><br>OBS 2 <sup>4</sup> | --                                                             | DSM-III-R                                          |
| Nilsson <i>et al.</i> 2000            | 29       | Dementia                      | m: 78.9<br>± 6.8   | Investig. cobolamin deficienc r/t clin. changes and brain function     | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | 10 patients tested with OBS+(MMSE)                             | DAT, VD or mixed; DSM-III-R                        |
| Andersson <i>et al.</i> 2001          | 457      | Hip fracture<br>Cox/gonarthr. | ≥ 65               | Identif. and investigation of developing ACS episodes                  | OBS 1 <sup>3</sup>                       | OBS 1 score with DSM-IV                                        | DSM-IV                                             |
| Edlund <i>et al.</i> 2001             | 101      | Hip fracture                  | ≥ 65               | Investig. of differences between pre-, and postoperative ACS           | OBS 1 <sup>3</sup><br>OBS 2 <sup>4</sup> | (MMSE)                                                         | DSM-IV                                             |
| Sandberg <i>et al.</i> 2001           | 133      | Stroke                        | 75 - 100           | Investigation of sleep apnea r/t ACS, depressed mood, cognition        | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | (MMSE, MADRS BarthelADL-Index)                                 | DSM-IV                                             |
| Granberg-Axell <i>et al.</i> 2001     | 31       | ICU patients                  | 23 - 85            | Investig. and describing ICU-syndrome                                  | OBS 1 <sup>1</sup>                       | --                                                             | --                                                 |
| Eriksson <i>et al.</i> 2002           | 52       | Coronary Bypass patients      | ≥ 60               | Investig. psychiatric patterns of ACS after cardiac surgery            | OBS 1 <sup>1</sup><br>OBS 2 <sup>2</sup> | CAM <sup>10</sup>                                              | DSM-IV                                             |
| Holmquist <i>et al.</i> 2003          | 175      | Elderly                       | m: 87              | Investig. prescript.of psychotrop. drugs r/t living, psychiatr. diagn. | OBS 2                                    | (OBS 2: 17 items)                                              | --                                                 |
| Lundström <i>et al.</i> 2003          | 78       | Hip fracture                  | 65 - 98            | Investig. of dementia incidence and mortality rate r/t ACS             | OBS 1 <sup>3</sup><br>OBS 2 <sup>4</sup> | MMSE                                                           | DSM-IV                                             |
| Lundström <i>et al.</i> 2005          | 400      | General internal medicine     | ≥ 70               | Investig. patient's outcome r/t intervention program                   | OBS 2 <sup>2</sup>                       | (MMSE)<br>(Katz ADL-index)                                     | DSM-IV                                             |

<sup>1</sup> OBS 1: 15 or16 items<sup>2</sup> OBS 2: 39 items<sup>3</sup> OBS 1 modified: 12 items<sup>4</sup> OBS 2 modified: 21 items<sup>5</sup> MMSE: Mini-Mental StateExamination<sup>6</sup> GBS: Gottfries- Bråne-Steen scale<sup>7</sup> GDS: Global Detoriation scale<sup>8</sup> MADRS Montgomery-Åsberg Depression scale<sup>9</sup> CGI Clinical Global Impression scale<sup>10</sup> CAM Confusion Assessment Method<sup>11</sup> DAT Dementia of the Alzheimer type<sup>12</sup> VD Vascular dementia<sup>13</sup> FTD Frontotemporal dementia



Table 3. Two different factor analyses of the disorientation subscale, OBS 1

| Gustafson, L et al., 1985,1995 <sup>1</sup> (n=55) (15 items) |       |                              |             |            | Hallberg et. al., 1990 (n=74) (16 items <sup>2</sup> ) |       |                              |             |            |
|---------------------------------------------------------------|-------|------------------------------|-------------|------------|--------------------------------------------------------|-------|------------------------------|-------------|------------|
| Factor                                                        | Items | Factor loadings <sup>3</sup> | Eigen-value | Variance % | Factor                                                 | Items | Factor loadings <sup>4</sup> | Eigen-value | Variance % |
| Time                                                          | 7     | 0.45 – 0.83                  | 3.5         | 23.3       | Time                                                   | 6     | -                            | 5.60        | 35.0       |
| Recent memory                                                 | 6     | 0.46 – 0.87                  | 2.7         | 17.8       | Past and present events                                | 5     | -                            | 1.68        | 10.5       |
| Identity                                                      | 5     | 0.40 – 0.73                  | 2.4         | 16.3       | Person                                                 | 5     | -                            | 2.51        | 15.7       |
| <i>Cumulative variance %</i>                                  |       |                              |             | 57.5       | <i>Cumulative variance %</i>                           |       |                              |             | 61.2       |

<sup>1</sup> Factor analysis presented in Gustafson L *et al.*, 1995.

<sup>2</sup> Item "What is your name" is divided into two items: "What is your first name" and "What is your second name".

<sup>3</sup> Factor loadings above 0.40 are presented.

<sup>4</sup> Factor loadings are not presented.

Table 4. Two different factor analyses of the confusion subscale, OBS 2

| Gustafson, L et al., 1985, 1995 <sup>1</sup> (n=55) (38 items <sup>2</sup> ) |       |                              |             |            | Hallberg et. al., 1990 (n=74) (37 items <sup>3</sup> ) |       |                              |             |            |
|------------------------------------------------------------------------------|-------|------------------------------|-------------|------------|--------------------------------------------------------|-------|------------------------------|-------------|------------|
| Factor                                                                       | Items | Factor loadings <sup>4</sup> | Eigen-value | Variance % | Factor                                                 | Items | Factor loadings <sup>4</sup> | Eigen-value | Variance % |
| Dyspraxia and spatial disorientation                                         | 10    | 0.41 – 0.81                  | 6.8         | 17.9       | Functional perform., orientation in ward               | 9     | 0.44 – 0.92                  | 9.02        | 24.4       |
| Hallucinations-syncope                                                       | 7     | 0.40 – 0.79                  | 3.6         | 9.5        | Hallucinations, illusions                              | 2     | 0.84 – 0.85                  | 1.68        | 4.5        |
| Lack of vitality                                                             | 6     | 0.40 – 0.74                  | 3.4         | 8.9        | Mobility <sup>5</sup>                                  | 9     | -0.41, 0.42 – 0.74           | 2.04        | 5.5        |
| Dysphasia                                                                    | 5     | 0.44 – 0.72                  | 2.5         | 6.6        | Speech perform., psychomotor slowing                   | 8     | 0.42 – 0.79                  | 3.34        | 9.0        |
| Paranoia                                                                     | 4     | 0.44 – 0.78                  | 2.1         | 5.5        | Hostility                                              | 4     | 0.45 – 0.81                  | 1.98        | 5.4        |
| Aggressiveness                                                               | 2     | 0.82 – 0.83                  | 1.8         | 4.7        |                                                        |       |                              |             |            |
| Depression-anxiousness                                                       | 5     | -0.48, 0.43 – 0.65           | 1.7         | 4.5        | Fluctuations in mental state, emotional disturbances   | 7     | 0.55 – 0.84                  | 4.19        | 11.3       |
| Clinical variations                                                          | 4     | -0.44, 0.48 – 0.74           | 1.6         | 4.2        |                                                        |       |                              |             |            |
| Restlessness                                                                 | 3     | 0.45 – 0.79                  | 1.5         | 3.9        | Sensitivity and euphoria                               | 4     | 0.43 – 0.65                  | 1.53        | 4.1        |
| <i>Cumulative variance %</i>                                                 |       |                              |             | 65.7       | <i>Cumulative variance %</i>                           |       |                              |             | 63.6       |

<sup>1</sup> Factor analysis presented in Gustafson *et al.*, 1995.<sup>2</sup> Item "Epileptic seizures" excluded.<sup>3</sup> Four items ("Perseverations", "Suspicious of relatives", "Syncope", "Manages to recognize relatives") are not presented in the original article and two of these four items are not presented in the factor analysis, probably because the factor loadings were too small.<sup>4</sup> Factor loadings above 0.40 are presented.<sup>5</sup> lack of mobility, (*Author's note*).

Table 5. Inter-rater reliability tests of the OBS Scale (OBS 1 and OBS 2) in elderly orthopedic and psychiatric patients

| Reference                                      | Cases<br>(n) | OBS 1                   |                | OBS 2                   |                | Patients<br>tested<br>times | Number<br>of raters |
|------------------------------------------------|--------------|-------------------------|----------------|-------------------------|----------------|-----------------------------|---------------------|
|                                                |              | Inter-rater<br>$r_s^1$  | Identical<br>% | Inter-rater<br>$r_s^1$  | Identical<br>% |                             |                     |
| Berggren <i>et al.</i> , 1987 <sup>2</sup>     | 57           |                         | > 90           |                         | > 90           | ≥ 3                         | 2                   |
| Brännström <i>et al.</i> , 1989 <sup>2</sup>   | 35           |                         | > 95           |                         | > 95           | ≥ 7                         | 2                   |
| Edlund <i>et al.</i> , 2001 <sup>2</sup>       | 101          |                         | > 90           |                         | > 90           | 4                           | 1-3                 |
| Gustafson, L <i>et al.</i> , 1985; 1995        | 55           | 0.71 – 1.0 <sup>3</sup> | 95 ± 7         | 0.61 – 1.0 <sup>4</sup> | 89 ± 10        | ≥ 5                         | 2                   |
| Gustafson, Y <i>et al.</i> , 1988 <sup>2</sup> | 111          |                         | > 90           |                         | > 90           | ≥ 4                         | 1-3 <sup>5,6</sup>  |
| Gustafson Y <i>et al.</i> , 1991a <sup>2</sup> | 103          |                         | > 90           |                         | > 90           | ≥ 4                         | 1-3 <sup>6</sup>    |
| Hallberg <i>et al.</i> , 1990                  | 74           | 0.93-0.98               |                | 0.93-0.98               |                | ≥ 1                         | 3-4                 |

<sup>1</sup>  $r_s$  = Spearman rank correlation

<sup>2</sup> modified OBS scale

<sup>3</sup> mean  $r_s$ : 0.92 ± 0.1

<sup>4</sup> mean  $r_s$ : 0.90 ± 0.11

<sup>5</sup> 10 patients rated by 3 raters

<sup>6</sup> 98% performed by the same rater