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CRITERION VALIDITY OF THE CENTER FOR EPIDEMIOLOGICAL STUDIES DEPRESSION (CES-D) SCALE IN A SAMPLE OF REHABILITATION INPATIENTS

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The criterion validity of the Center for Epidemiological Studies Depression (CES-D) scale was evaluated among 101 orthopaedic and 50 neurological inpatients of a rehabilitation centre. The structured clinical interview for the DSM-IV (SCID-I) was used as criterion. Sensitivity of the CES-D to current major depressive disorder was 100% in both groups, while specificity was 57% (95% confidence interval = 48–67, likelihood ratio = +2.34) in orthopaedic patients and 36% (95% confidence interval = 23–49, likelihood ratio = +1.56) in neurological patients. Positive predictive value of the CES-D for current major depressive disorder was 24% (95% confidence interval = 10–32, likelihood ratio = +2.34) in orthopaedic patients and 31% in neurological patients (95% confidence interval = 18–43, likelihood ratio = +1.56), while negative predictive value was 100% in both groups. When a broader range of depressive disorders was considered, sensitivity dropped to 89% (95% confidence interval = 83–95, likelihood ratio = +3.52) and 96% (95% confidence interval = 91–100, likelihood ratio = +2.21) while specificity increased to 75% (95% confidence interval = 66–83, likelihood ratio = +3.52) and 57% (95% confidence interval = 43–70, likelihood ratio = +2.21), respectively.

Key words: depression, rehabilitation, validity, CES-D, SCID-I.

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INTRODUCTION

Clinical depression is often associated with physical illness and functional disability. Major depressive disorder (MDD) has prevalence rates between 4% and 13.5% in primary care patients (1, 2) and between 10% and 14% in medical inpatients (1). Depressive disorders taken altogether have a prevalence between 16% and 22.6% in primary care patients (2, 3) and a prevalence of 35.5% among elderly medical inpatients (4).

The treatment of depression is of particular interest when we refer to rehabilitation settings. In these structures depressive symptoms have prevalence rates between 29.4% and 47% (5, 6). Research on inpatients undergoing rehabilitation programs reports weak associations between depression and gain on functional status scales at discharge. Nevertheless, only a few studies have been performed and they tend to be contradictory; the majority of findings, though, support the existence of a close relationship between depression and functional impairment (5, 6).

Thus, depression can be assumed to be relatively frequent and related to physical impairment in patients undergoing rehabilitation. Hence, adequate recognition and assessment of depressive disorders is an important step in management and rehabilitation of physically ill patients. Time constraints and inadequate training of physicians often leave undetected psychiatric comorbidity in medical settings (7). Thus, in past decades, several screening tests for depression were developed to overcome these problems. All of these tests share the same ease of administration and usually do not require specific examiners' skills (8).

One of the most widely used screening devices for depression is the Center for Epidemiological Studies Depression (CES-D; 9) scale, a 20-item self-report measure of depressive symptoms. The CES-D was originally designed for epidemiological survey in the general population, but several studies have proved the good psychometric properties of the questionnaire among different target populations. In particular, the scale has shown its usefulness in physically ill populations (10–11) and in the elderly (12–13).

Thus, the CES-D could fit well in a rehabilitation setting where patients suffer from physical impairment, are often elderly people and are affected by one or more physical diseases. However, some considerations are necessary before drawing inferences about the usefulness of the questionnaire as a screening instrument for depression.

Generally speaking, screening scales for depression give information that is related but not equivalent to a diagnosis of depression. The scales usually quantify symptoms in a continuous way while a diagnosis of depression, made on the basis of clinical criteria, gives different weights to symptoms and classifies them into discrete syndromes (14). Therefore, high scores in depression screening tests do not necessarily identify cases of depression. On the other hand, scoring low on these scales does not necessarily mean that subjects are unaffected by depressive syndromes. Therefore, when a screening instrument is used for clinical purposes, it is relevant to know the extent of its criterion validity.

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Table I. *Subjects' characteristics on demographic measures and distribution of the different pathologies*

Variables	*n*	%
Orthopaedic patients (n = 101)		
Sex (female)	69	68
Not/no longer married	60	59
Not/no longer employed	84	83
Arthroplasty	52	51
Bone fractures	24	24
Arthrosis	22	22
Amputations	3	3
Neurological patients (n = 50)		
Sex (female)	26	52
Not/no longer married	19	38
Not/no longer employed	40	80
Stroke	24	48
Spinal lesions	13	26
Tumours	4	8
Multiple sclerosis	4	8
Parkinson's disease	3	6
Cerebral anoxia	1	2
Friedreich's syndrome	1	2

Studies report modest to moderate agreement between CES-D and structured clinical interviews based on diagnostic criteria (11–13, 15, 16). The questionnaire generally shows good sensitivity and low specificity, but proportions vary among different populations. For example, the comparison between clinical diagnosis of MDD and CES-D scores above the standard cut-off of 16 reached a sensitivity of 100% and a specificity of 88% in an elderly community-based sample (12). By contrast, sensitivity and specificity were 79.5% and 71.1%, respectively, in a sample of primary care patients (16).

Our study was aimed at evaluating criterion validity of the CES-D among rehabilitation inpatients, where an early detection of depression is called for. A fast and easy screening test would be appreciated, if sensitivity and specificity appeared to be at convenient levels. After thorough review of the literature, to our knowledge this is the first study on this issue.

METHODS

Subjects

During a three-month period 202 persons were admitted to our rehabilitation centre and entered into a database. The inclusion criteria were the ability to comply with the CES-D and a score $\geq$17 on the Mini Mental State Examination (MMSE). Thirty-five neurological and 17 orthopaedic patients were then excluded. Among them 22 were affected by overt dementia, 10 by aphasia, 14 were too severely weak at the time of examination and 6 gave no consent. Among the 151 consecutive patients left, 101 were orthopaedic (OP) and 50 were neurological patients (NP), with various disease aetiologies (Table I).

Measures

The CES-D (9) consists of 20 items, which represent major symptoms of depression. Total score ranges from 0 to 60. The cut-off point is fixed at 16. An equivalent or higher score classifies a subject as depressed. For the present study we used a translated and validated version (17).

The chosen criterion was a diagnosis of depression made on the basis of the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; 18). Clinical diagnosis of depression was made by a certified psychologist based on clinical interviews according to the guidelines of the Structured Clinical Interview for the DSM-IV: Axis I Disorders: Clinical Version (SCID-I; 19).

For further evidence CES-D scores were also compared with the observer rating scale Hamilton for Depression (Ham-D; 20), which consists of 17 items regarding main symptoms of clinical depression. The Ham-D total score ranges from 0 to 62 and a score of 17 or more is considered as depression.

Special attention was paid to the effect of potentially confounding variables such as cognitive and physical impairment and comorbid physical illness, which were assessed by the MMSE (21), the Functional Independence Measure (FIM; 22) and the Cumulative Illness Rating Scale (CIRS; 23), respectively. The MMSE explores six areas that represent basic cognitive functions. The total score ranges from 0 to 30 and scores under 24 are generally associated with cognitive impairment. Corrected values for ethnic background, age and educational level were used (24). The FIM scale consists of 13 motor and 5 cognitive items. The total score ranges from 18 to 126. We used total scores except in the analysis on confounding variables, where cognitive items were not considered. The CIRS consists of 15 items related to different aspects of illness. From these items the Illness Severity Index (SI, summary score based on the average of all CIRS items) as well as the Comorbidity Index (summary score based on a count of organ systems with moderate or greater impairment) were automatically calculated. In this study SI was used, that is a continuous variable.

Procedure

At the time of admission, each patient was examined by a physician and evaluated on CIRS and FIM scales. Case history and demographic data were collected. A week after the first examination, selected subjects were evaluated by a trained psychologist on the CES-D, Ham-D and MMSE scales. During the administration of the CES-D, the subjects were encouraged to answer on their own, but the examiner was ready to repeat the instructions whenever the patients requested it or to provide the necessary motor help without influencing the response. The day after, each patient received the DSM-IV type interview, conducted by another psychologist blind to the results of the psychometric scales.

Statistics

The Shapiro-Wilk's W test for normality was applied. As our data did not show normal distributions, non-parametric statistics were subsequently adopted. Group comparisons were performed by means of Mann-Whitney's U test for unpaired continuous variables and by means of chi-square analysis for categorical variables. The relationship between CES-D and Ham-D total scores was evaluated by means of Spearman's *r*. Criterion validity of the CES-D was determined calculating sensitivity, specificity, positive predictive values, negative predictive values and likelihood ratios (including 95% confidence intervals) for the CES-D compared with the SCID-I diagnosis. Agreement between CES-D and SCID-I was also determined by means of a direct comparison between over-threshold CES-D scores and all cases of depressive disorders, with CES-D scores and SCID-I diagnosis considered as dichotomic variables. For this analysis Kappa statistics were used. Analysis on confounding variables was performed comparing the false positives group with the true positives group on the variables age, sex, educational level, occupational status, marital status, MMSE, FIM (motor items) and CIRS-SI scores on admission. Subsequently, all of these variables were entered into a stepwise multiple regression analysis applied to the false positives group.

RESULTS

Data from OP and NP were treated separately.

Characteristics of the two patient groups are given in Tables I and II. As one can see, median age was elevated, compared with the Italian general population (median value = 48 years), in both groups. The educational level was quite low, compared with the Italian general population (median value = 7 years), especially in OP (U = 1934, $p = 0.05$). They were also more likely to be

Table II. *Subjects' characteristics on demographic, cognitive impairment, cumulative illness, functional independence and depressive symptoms measures for orthopaedic and neurological patients*

	Orthopaedic patients ($n = 101$)			Neurological patients ($n = 50$)		
Measures	1st Q	Median	3rd Q	1st Q	Median	3rd Q
Age (years)	61	70	77	50	67	73
Education (years)	5	8	8	5	8	13
MMSE	25	27	28	23.2	25.6	27.9
CIRS-SI	1.1	1.2	1.3	1.2	1.3	1.5
FIM	72	81	103	65	85	99
Ham-D	5	8	13	6	12.5	18
CES-D	9	15	24	14	18.5	29

1st Q = first quartile; 3rd Q = third quartile; MMSE = Mini Mental State Examination; CIRS, SI = Cumulative Illness Rating Scale, Severity Index; FIM = Functional Independence Measure; Ham-D = Hamilton rating scale for Depression; CES-D = Center for Epidemiological Studies-Depression scale.

women ($\chi^2 = 3.82$, $p = 0.05$) and not to (or no longer) be married ($\chi^2 = 6.14$, $p = 0.01$). On the other hand, NP scored lower on the MMSE scale (U = 1332.5, $p = 0.00001$) and higher on the CIRS-SI scale (U = 1696.5, $p = 0.01$). There were no significant differences between the two groups on occupational status and on FIM scores. Ham-D and CES-D total scores highlighted the wide diffusion of depressive symptoms among our sample. In particular, NP scored higher on both scales (Ham-D: U = 1906.5, $p = 0.01$; CES-D: U = 1901, $p = 0.01$). The difference appeared to be significant even when the two groups were compared on the proportion of subjects scoring above and below the cut-off points (Ham-D: $\chi^2 = 27.45$, $p = 0.0001$; CES-D: $\chi^2 = 6.90$, $p = 0.01$).

By considering the DSM-IV diagnosis of depression, the prevalence of depressive disorders was 38% in OP and 54% in NP ($\chi^2 = 5.54$, $p = 0.01$). Current MMD affected 12% of the orthopaedic and 22% of the neurological group. The prevalence of dysthymic disorder was 8% and 6%, respectively. Adjustment disorders with depressed or mixed mood affected 5% of OP and 10% of NP. Prevalence of minor depressive disorder was 13% in OP and 16% in NP.

The correlation between CES-D and Ham-D was high and significant, in both groups of patients (OP: $r = 0.60$, $p = 0.0001$; NP: $r = 0.66$, $p = 0.0001$).

Sensitivity, specificity, positive predictive values, negative predictive values and likelihood ratios (including 95% confidence intervals) of the CES-D compared with the criterion, i.e. SCID-I diagnosis, are presented in Table III. As one can see, sensitivity of the CES-D to current major depressive disorder was 100% in both groups, while specificity was 57% (95% confidence interval = 48–67, likelihood ratio = +2.34) in OP and 36% (95% confidence interval = 23–49, likelihood ratio = +1.56) in NP. Positive predictive value of the CES-D for current major depressive disorder was 24% (95% confidence interval = 10–32, likelihood ratio = +2.34) in OP and 31% in NP (95% confidence interval = 18–43, likelihood ratio = +1.56), while negative predictive value was 100% in both groups. When we considered depression diagnoses altogether, including dysthymic disorder, adjustment disorders with depressed or mixed mood and minor depressive disorder, sensitivity dropped to 89% (95% confidence interval = 83–95, likelihood ratio = +3.52) and 96% (95% confidence interval = 91–100, likelihood ratio = +2.21) while specificity increased to 75% (95% confidence interval = 66–83, likelihood ratio = +3.52) and 57% (95% confidence interval = 43–70, likelihood ratio = +2.21), respectively. Positive predictive value of the CES-D for all depressive disorders was 68% (95% confidence interval = 59–77, likelihood ratio = +3.52) in OP and 72% in NP (95% confidence interval = 60–85, likelihood ratio = +2.21), while negative predictive value was 92% (95% confidence interval = 87–97, likelihood ratio = +3.52) and 93% (95% confidence interval = 86–100, likelihood ratio = +2.21), respectively.

The results of the Kappa statistics showed a strong agreement between CES-D and SCID-I, in both OP and NP (OP: Kappa = 0.60, $p = 0.0001$; NP: Kappa = 0.54, $p = 0.0001$).

In OP false positives were more likely to have a lower educational level (U = 146.5, $p = 0.05$). In NP false positives were more likely to have higher CIRS-SI scores (U = 56.5, $p = 0.05$) and more likely to be older–old (U = 75, $p = 0.05$). When the stepwise multiple regression was applied on false positives, the association with education, in OP, and with age, in NP, was no longer significant. By contrast, the association between CIRS-SI and CES-D scores in NP was confirmed.

DISCUSSION

The CES-D achieved a satisfactory level of criterion validity for depressive disorders in this sample of rehabilitation inpatients. Our data support the good sensitivity of the scale and its low specificity, previously reported by other authors, but in different sub-populations. These psychometric properties appeared more pronounced when we considered MDD alone. In this case, the CES-D produced a maximum of false positives with a minimum of false negatives. Otherwise, there is a gain in specificity with a drop in sensitivity, if one considers a broader range of depressive disorders. In this case, the relatively low level of false positives with the small percentage of false negatives supports the usefulness of the scale in the detection of even mild depressive

Table III. *Percentages for sensitivity, specificity, positive predictive value and negative predictive value (95% confidence intervals and likelihood ratios included) of the CES-D for orthopaedic and neurological patients*

	Orthopaedic patients ($n = 101$)		Neurological patients ($n = 50$)	
	Major depression (LH = +2.34)	All depressive diagnoses (LH = +3.52)	Major depression (LH = +1.56)	All depressive diagnoses (LH = +2.21)
Sensitivity	100	89 (95% CI = 83–95)	100	96 (95% CI = 91–100)
Specificity	57 (95% CI = 48–67)	75 (95% CI = 66–83)	36 (95% CI = 23–49)	57 (95% CI = 43–70)
PPV	24 (95% CI = 10–32)	68 (95% CI = 59–77)	31 (95% CI = 18–43)	72 (95% CI = 60–85)
NPV	100	92 (95% CI = 87–97)	100	93 (95% CI = 86–100)

LH = Likelihood ratio; CI = confidence interval; PPV = positive predictive value; NPV = negative predictive value.

syndromes. Numerous recent findings outline the wide diffusion of such forms of mild depression, which were considered sub-syndromic in the past. Moreover, it has recently been demonstrated that even mild forms of depression can affect levels of functional impairment and physical illness (3, 25).

In this consecutive sample of rehabilitation inpatients overall prevalence rates for depression were 38% and 54% for OP and NP, respectively. These prevalence rates are high compared with the majority of previous findings. A possible explanation for these discrepancies can be seen in the recent inclusion of "minor depression" in DSM-IV classifications. Nevertheless, our findings partially agree with those of Schneider et al. (4) and of Sinyor et al. (5), who reported a prevalence of 35.5% among medical elderly inpatients and a prevalence of 47% among post-stroke patients undergoing rehabilitation programs. However, those studies used diagnostic criteria other than DSM-IV. The higher rate in NP is probably accounted for by the lesser expectancy of a satisfactory recovery. Indeed, the majority of OP were cases of arthroplasty and bone fractures, which can be followed by good functional status even in elderly patients with hip fracture (26). Although bio-pathological changes may also play a role in the higher rate of depression in NP compared with OP, new data on post-stroke depression seem to support the hypothesis that psychological rather than neurological factors mostly account for the occurrence of depression among NP (27).

The direct comparison between over-threshold CES-D scores and all cases of depressive disorders supported the existence of a close relationship between the CES-D and a diagnosis of depression. Nevertheless, the scale did not discriminate between mild and more severe cases of depression or between different syndromes equally characterized by depressed mood.

The analysis of false positives showed that the CES-D was biased neither by mental nor by functional status of our patients, as evaluated by MMSE and FIM scales. On the other hand, higher comorbidity significantly affected false positives in NP. This is at odds with previous findings by Foelker & Shewchuk (28) who reported that the CES-D was relatively unbiased by the respondent's somatic complaints, but agrees with evidence from a recent study by Grayson et al. (29), who described the occurrence of physical disorder-related artefacts in CES-D use. An effect of age was found in NP, but not in OP. Indeed, the former age range was wider. By contrast, OP had a lower educational level, probably due to a cohort effect, which biased CES-D scores. However, it should be admitted that the multiple regression did not show a significant effect of any confounding variable except for CIRS-SI scores, when the false positive group was considered.

The high correlation between Ham-D and CES-D scores proved the good concurrent validity of the scale. Those data showed that the CES-D was as effective as the Ham-D in the detection of depressive symptoms. Nevertheless, the CES-D could be administered by untrained staff members with high inter-rater reliability (30). By contrast, the administration of the Ham-D requires trained personnel. However, interviewed-based scales of depression, such as the Ham-D, could be more useful with severely impaired patients.

We conclude that the CES-D can be seen as a valid screening instrument for depression in a rehabilitation setting. Its high sensitivity, low specificity and the lack of discrimination between different degrees of mental disease point to the usefulness of the CES-D as a first step in a two-stage procedure of assessment of depressive disorders among large samples of inpatients. Since total scores of the CES-D were affected by elevated comorbidity in our sub-sample of NP, caution is recommended when the scale is used among severely ill patients.

Further analysis is warranted to verify the present findings in younger sub-groups of orthopaedic and neurological inpatients of rehabilitation units.

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