

## The evaluation of the Center for Epidemiologic Studies Depression (CES-D) scale: Depressed and Positive Affect in cancer patients and healthy reference subjects

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### Abstract

This study examined the reliability and validity of a two-factor structure of the Center for Epidemiologic Studies Depression (CES-D) scale. The study was conducted in a large group of cancer patients ( $n = 475$ ) and a matched reference group ( $n = 255$ ). Both groups filled in a questionnaire at two points in time; patients 3 and 15 months after diagnosis. Factor analysis confirmed our hypothesis that the 16 negatively and four positively formulated items measure two relatively independent factors, i.e. Depressed Affect and Positive Affect. Therefore, these items should not be combined into an overall sumscore. In both groups, Depressed Affect proved to be a reliable and valid measure of depressive symptomatology, as indicated by its good internal consistency, its strong correlations with other measures of psychological distress and neuroticism, and its effectiveness in discriminating patients from the reference group on depressive symptomatology. In contrast, the validity of the Positive Affect factor could not be confirmed, since it was only weakly related to other measures of psychological distress and extraversion. Depressed and Positive Affect were about equally related to self-esteem, life satisfaction, and quality of life. These findings support the use of a sumscore based on the 16 negatively formulated CES-D items as a more valid measure of depressive symptomatology, in cancer patients and in healthy individuals from the general population.

**Key words:** Cancer, Depression, Positive Affect, The Center for Epidemiologic Studies Depression (CES-D) scale

### Introduction

There is a high prevalence of depressive symptoms among the medically ill [1]. Among cancer patients, a recent review reported that an average of 24% (range 1.5–50%) of all patients experience depressive symptoms in the initial period after diagnosis [2]. With regard to the course of depressive symptoms over time, most studies indicated an improvement in psychological functioning in the year after diagnosis [3]. Some studies, however, found no change in depressive symptoms [4] or a worsening of depressive symptoms over time [5].

Interpreting these differences in rates of depression is difficult because the studies vary by (a) definition of depression, (b) diagnostic method, (c) study cohort, and (d) time since diagnosis [2, 6, 7]. Nonetheless, they provide important clinical information. The recognition and treatment of depressive symptoms in cancer patients is crucial, because depressive symptoms may adversely affect survival, the length of hospital stay, compliance with treatment, the ability to care for oneself, and the quality of life [2].

With regard to the definition of depression, four different concepts are frequently used, i.e., mood

(i.e. predominant emotion), symptom, syndrome (i.e. group of symptoms), and psychiatric illness [8]. For instance, according to the DSM-IV diagnostic criteria, the central feature of a major depression is the presence of a 'depressed mood' and/or 'a loss of interest or pleasure' [9]. Other symptoms include a significant weight loss or gain, changes in appetite, sleeping problems, changes in motor and cognitive activity, fatigue or loss of energy, feelings of worthlessness or guilt, recurrent thoughts of death or suicide, and difficulty concentrating or thinking. This definition of depression emphasizes the presence of negative affect.

Differences in the definition of depression are reflected in the variety of diagnostic methods used to assess depressive symptomatology. As opposed to diagnostic interviews such as the Structured Interview for the DSM-IV (SCID) [10], which measure psychiatric disorders, self-report symptom scales such as the CES-D [11] measure depression as a group of symptoms.

The Center for Epidemiologic Studies Depression (CES-D) scale is one of the most widely used self-report instruments to measure current depressive symptomatology and to identify possible cases of depressive disorders, both in the general population [11–14], and in patients with cancer [15–17]. The scale was derived from five other depression scales: the Beck Depression Inventory [18], the Zung Depression Scale [19], parts of the Minnesota Multiphasic Personality Inventory [20], the Raskin Self-report Depression Scale [21], and the Gardner Symptom Checklist [11, 22]. The selected items are assumed to measure the most important components of depressive symptomatology, including depressed mood, feelings of guilt and worthlessness, feelings of helplessness and hopelessness, loss of appetite, sleep disturbances, and psychomotor retardation [11]. Using factor analysis, Radloff found that the 20 items clustered in four dimensions: (1) Depressed Affect, (2) Positive Affect, (3) Somatic-Retarded Activity, and (4) Interpersonal Relations. However, because they are all dimensions of depression, Radloff recommends the use of the total scale score.

The psychometric properties of the CES-D scale have been tested in several populations varying in sociodemographic factors and health status [11, 15, 23–29]. In general, these studies have supported the reliability and validity of the CES-D

scale in identifying individuals with depressive symptomatology. With regard to the internal structure of the CES-D, the results have yielded the four underlying factors, which were similar to the components of depression that the scale was intended to measure [8, 11, 23, 29]. However, a closer look at the findings of the studies that examined the factorial structure of the CES-D [23, 25, 27], showed that the original four-factor solution was not always replicable, as indicated by the crossover of items from one factor to another, especially between Depressed Affect and Somatic-Retarded Activity. Depressed Affect was also found to be highly correlated (0.87) to Somatic-Retarded Activity [29]. Only Positive Affect was consistently found to be composed of the four positively formulated items. These findings raise doubts about the usefulness and interpretation of the four original CES-D factors and suggest a two factor structure, differentiating between Positive Affect and the other three factors, thus combining Depressive Affect, Somatic-Retarded activity, and Interpersonal Relations. One study on the internal structure of the CES-D found this two-factor structure, differentiating between Positive Affect on one hand and Depressive Affect, Somatic-Retarded Activity, and Interpersonal Relations on the other hand [27].

Two issues raise with regard to the inclusion of the Positive Affect items in the CES-D scale: (a) what is the function of positive affect in a measure of depressive symptomatology?, and (b) do the four positively formulated CES-D items measure depressive symptomatology or a different concept, e.g. positive affect?

First, with regard to the function of positive affect in a measure of depressive symptomatology, some theories assume independent unipolar dimensions of positive and negative affect [30], whereas other theories assume a bipolar positive-negative dimension [31]. Watson et al. found that high negative affect as well as low positive affect were related to depression, and concluded that the inclusion of positive affect in measures of depression might enhance their sensitivity [32]. They look upon positive and negative affect as being largely independent across a wide range of conditions [30]. The degree of their independence, often described in terms of the strength of the correlation, may be influenced by two conditions: (a) the greater the

importance of the goal, the more intense will be the positive or negative affective reaction to the goal-related circumstances in the encounter [33], and (b) the greater the intensity of the affective reaction, the stronger will be the inverse relationship between positive and negative affect [34, 35]. In contrast, Ross and Van Willigen viewed well-being and distress as the opposite poles on a single continuum [36]. They included positive affect in their measure of depression and defined depression as 'the balance of Depressed Affect minus Positive Affect'. In sum, Positive Affect in a measure of depression might enhance its sensitivity but its function and interpretation depends on the hypothesized relationship between both concepts, i.e. two unipolar or one bipolar dimension.

Second, when looking at the content and formulation of the Positive Affect items, it is ambiguous whether these items, after scored in reverse, relate to the concept of depression (i.e. content validity). The reason for formulating the four items positively was to avoid the possibility of patterned responses [8]. However, to what extent can depressive symptomatology be measured by means of positively formulated items (after scored in reverse)? As mentioned earlier, essential components of depression are a depressed mood, a loss of interest and pleasure, and feelings of worthlessness and hopelessness [9], in short the presence of symptoms of Negative Affect. When looking at the content of the four Positive Affect items, it is doubtful whether these positively formulated items (scored in reverse) measure depressive symptomatology. For example, to what extent is item 4 'felt as good as others' related to feelings of worthlessness, item 12 'happy' and item 16 'enjoyed life' related to a loss of interest and pleasure, and item 8 'hopeful future' to feelings of hopelessness? Iwata et al. found that the four positively formulated items of Positive Affect could not be used to adequately assess depressive symptomatology, but the corresponding negatively revised items (e.g. happy into unhappy, hopeful into not hopeful) were able to discriminate depressed patients from controls [37]. Thus, it seems more reasonable that the four items do not measure depressive symptomatology but a different concept, e.g. Positive Affect.

An additional problem with the use of the four positively formulated items in a mainly negatively

formulated symptom scale is the question whether respondents notice the difference in the formulation of these items. The reason for formulating the four items positively was to avoid the possibility of patterned responses. However, it seems questionable whether the inclusion of these items can actually reduce the effect of patterned responses.

In conclusion, only limited information is available about the internal structure of the CES-D and the use of a total scale score as an indicator of depressive symptomatology. Further research on the reliability and validity of the subscales is necessary to clarify the use of the CES-D as a measure of psychological functioning in populations varying in sociodemographic factors and health status. Specifically, little is known about the function of the four positively formulated items of Positive Affect in a scale purported to measure depressive symptomatology.

The aim of the present study was to investigate the psychometric properties of the CES-D scale. Since the CES-D is one of the most widely used self-report instruments to measure current depressive symptomatology in the general population as well as in patients with a medical illness, we examined its psychometric properties in a large group of cancer patients and in a reference group of healthy individuals from the general population. In addition, since the CES-D is often used in a longitudinal studies, we examined its psychometric properties at two points in time, thus taking into account possible fluctuations in the representation of depressive symptomatology over time. We hypothesized that the CES-D scale measures two relatively independent and weakly correlated factors, differentiating between the negatively and positively formulated CES-D items, subsequently labelled as Depressed Affect and Positive Affect. Second, we expected differences in the endorsement of the 16 negatively formulated items of Depressed Affect and the four positively formulated items of Positive Affect. Third, we expected Depressed Affect to be strongly related to other measures of psychological distress, to neuroticism, and to physical symptom distress, whereas we expected Positive Affect to be more strongly related to measures of extraversion, to well-being, and to self-esteem. Previous studies have related Positive Affect to extraversion [38–40] and Depressed (or Negative) Affect to neuroticism [38, 39, 41], low

self-esteem [42–44], and physical symptom distress [15, 17]. Finally, we expected Depressed Affect to be able to discriminate cancer patients from the reference group on depressive symptomatology, especially in the initial period after diagnosis. Because it is doubtful that Positive Affect measures depressive symptomatology, we expected no significant differences between the patient and reference group on Positive Affect.

## Method

### *Subjects and Procedures*

The data presented in this article were obtained as part of a longitudinal study on the psychosocial adjustment to cancer [45, 46]. The sample consists of a heterogeneous group of 475 patients with cancer and a group of 255 reference subjects. This latter group was matched at group level on age and gender-ratio with the patient group. All patients filled out questionnaires and were interviewed at three points in time, i.e., 3, 9, and 15 months after diagnosis; the reference group was interviewed at three occasions with similar intervals.

For the present study we used the data collected at the first and third assessment (here labelled as T1 and T2). Only respondents who filled in all 20 CES-D items were included in the analyses. At T1, eight percent of the respondents failed to respond to all items, resulting in a sample of 434 patients and 236 reference subjects. At T2, 403 patients and 224 reference subjects participated in the study. Seven percent of these respondents failed to respond to all items, resulting in a sample of 376 patients and 209 reference subjects at T2.

### *Measures*

For the present study we used the Dutch version of the CES-D scale to measure depressive symptomatology [47]. The CES-D scale consists of 20 items. Sixteen items are negatively formulated, e.g. 'felt depressed' (item 6), whereas the remaining four items are positively formulated, i.e. 'felt as good as others' (item 4), 'hopeful future' (item 8), 'happy' (item 12), and 'enjoyed life' (item 16). The scale is purported to measure the presence of depressive mood by asking respondents to rate how

often they have experienced each of the 20 symptoms during the past week. Each item is scored on a four-point scale: (0) 'rarely or none of the time' (less than once a week), (1) 'some or a little of the time' (1–2 days a week), (2) 'occasionally or a moderate amount of time' (3–4 days a week), or (3) 'most or all of the time' (5–7 days a week). The responses to the four positively formulated items (item 4, 8, 12, and 16) are subsequently scored in reverse, thus score 0 becomes score 3, score 1 becomes score 2, etc. In the present article, the reported scores on the positively formulated items are scored in reverse, with higher scores indicating less Positive Affect. The total score for a respondent consists of a sum score of the responses to all 20 items, ranging from 0 to 60. Radloff recommended that respondents with a total CES-D score of 16 or higher should be screened for a diagnosis of major depression [11].

Situational or current anxiety was measured by the State-subscale of the State-Trait Anxiety Inventory (STAI) [48]. Respondents rate each of the 20 items on a Likert type four-point scale, ranging from 1 'hardly ever' to 4 'almost always'. Several studies used the STAI as a measure of anxiety in patients with cancer [49–51]. In the present study, Cronbach's  $\alpha$  for State-Anxiety was 0.74 in both the patient and reference group.

Psychological distress was assessed with the 28-item version of the General Health Questionnaire (GHQ-28) [52, 53]. The scale consists of four subscales: Anxiety, Depression, Social, and Somatic distress. In the present study, Cronbach's  $\alpha$  for the total scale was in both groups 0.92.

Physical distress and psychological distress were assessed with the Rotterdam Symptom Checklist (RSCL) [54]. For the present study, a 27-items version of the RSCL was used. The physical distress subscale consisted of 17 items and the psychological distress subscale of 10 items. Cronbach's  $\alpha$  for physical distress was in the patient and reference group 0.79 and 0.84 respectively, and the  $\alpha$  for psychological distress was in both groups 0.87.

Neuroticism and extraversion were assessed using the Eysenck Personality Questionnaire [55, 56]. Both subscales consist of 12 items and respondents are asked to indicate whether or not they agree with a statement. The sumscores of both subscales range from 0 to 12. Cronbach's  $\alpha$  for neuroticism

was in the patient and reference group 0.83–0.86 respectively, and the  $\alpha$  for extraversion was 0.81 and 0.82 respectively.

Self-esteem was measured by the Rosenberg Self-esteem scale (RSE) [57, 58]. The  $\alpha$  for the total scale was in the patient and reference group 0.82 and 0.85 respectively.

Overall quality of life was assessed by the LASA. With one question on a Visual Analogue Scale, the degree to which an individual evaluated his or her quality of life was assessed.

Finally, satisfaction with life was measured by the Satisfaction With Life Scale (SWLS) [59]. The scale consists of five items. Alpha in both groups was high: 0.89 in the patient group and 0.87 in the reference group.

In a semi-structured interview data was collected regarding subjects' sociodemographic characteristics, i.e. gender, age, educational level, and marital status.

Medical data was available from the cancer registration, and included cancer site, stage, and initial treatment, i.e. surgery, radiotherapy, and/or chemotherapy.

### *Statistical analysis*

The validity of the scale, in terms of internal structure, was examined by an explorative Principal Component Analysis (PCA) with Varimax Rotation and by a confirmative Simultaneous Component Analysis (SCA) [60]. The first factor was expected to load high on the 16 negatively formulated items, i.e. Depressed Affect, and a second factor was expected to load high on the four positively formulated items, i.e. Positive Affect. The SCA was performed to test whether a two factor structure explains enough variance of the possible maximal explained variance. Differences between the results of the PCA and SCA in the amount of explained variance demonstrate the fit of the factor structure of the model. In addition, item-level analysis determined how the patient and reference group endorsed the individual items of the CES-D.

The reliability of the Depressed Affect and Positive Affect factors, in terms of internal consistency, was analyzed by using Cronbach's  $\alpha$ . Item-level analysis was performed by examining

the item-total correlations and the total alpha with each item removed.

Validity was further examined by the correlations between Depressed and Positive Affect. In order to examine the correlation between the negatively and positively formulated items, we calculated the mean of the 120 possible pairwise correlations among the 16 negatively formulated items, the mean of the 6 possible pairwise correlations among the four positively formulated items, and the mean of 64 possible pairwise correlations between the 16 negatively formulated and four positively formulated items. If the latter mean is significantly lower than the mean of possible pairwise correlations among the negatively and positively formulated items separately, the correlation between the negatively and positively formulated items is relatively low. Pearson correlation-coefficients were calculated to examine the relationship between Depressed Affect and Positive Affect, as well as to examine the relationships among Depressed Affect, Positive Affect, and other psychosocial measures expected to vary with depressive symptoms.

Finally, in order to test whether the two factors are able to discriminate patients from the reference group on depressive symptoms, we performed *t*-tests for independent samples to evaluate differences between both groups on Depressed Affect and Positive Affect.

## **Results**

### *Sample characteristics*

The sociodemographic and medical characteristics of the patient group and the reference group at the first assessment are presented in Table 1. Both groups were similar to each other with regard to their sociodemographic characteristics, with the majority being female, married, and lower educated. The mean age of the patient group was 58.1 years (SD = 14.28), ranging from 23 to 88 years old. The mean age of the reference group was 56.8 years (SD = 14.80), ranging from 19 to 88 years old. Using Pearson  $\chi^2$  analysis, we found no significant differences between both groups on gender, age, and marital status. The patient group

**Table 1.** Sociodemographic and medical characteristics of the patient and reference group

	Patient group (n = 434)		Reference group (n = 236)		p-Value
	N	%	N	%	
Gender					0.18
Female	312	72	158	67	
Male	122	28	78	33	
Age (years)					0.41
18–64	275	63	157	67	
≥65	159	37	79	33	
Educational status					0.03
Elementary schooling	171	41	80	35	
Low secondary schooling	158	37	79	34	
High secondary schooling	92	22	72	31	
Marital status					0.84
Married/cohabitant	334	77	186	79	
Widow/widower	61	14	31	13	
Divorced/separated	16	4	6	3	
Single	22	5	13	5	
Cancer site					
Breast	191	44			
Colorectal	123	29			
Gynaecological	62	14			
Lung	43	10			
Other	11	3			
Stage					
I	161	41			
II–IV	234	59			
Initial treatment					
Surgery	217	50			
Surgery and radiotherapy	120	28			
Surgery and chemotherapy, with/without radiotherapy	64	15			
Other	32	7			

was slightly lower educated, compared to the reference group ( $p < 0.05$ ).

#### Principal Component Analysis

In order to assess the internal structure of the CES-D, we performed a four-factor PCA with varimax rotation on all 20 items of the CES-D. Four factors had an Eigenvalue greater than one, explaining after rotation respectively 18.3, 14.4, 11.6, and 8.2% of the variance (total 52.5%) in the patient group and 17.4, 16.9, 12.3, and 8.0% of the variance (total 54.6%) in the reference group. However, some items were factorial com-

plex, i.e. had high loadings on more than one factor or did not load on their conceptually coherent factor. Especially, we found a crossover of several items from the original Depressed Affect factor to the Somatic-Retarded Activity factor and from the original Somatic-Retarded Activity factor to the Depressed Affect factor. Only the Positive Affect factor was consistently found in both groups.

Next, we conducted a two-factor PCA (see Table 2). We found two uncorrelated components, explaining after rotation respectively 28.2 and 12.4% of the variance (total 40.6%) in the patient group and 29.3 and 12.9% of the variance

**Table 2.** CES-D items and Factor-loadings (PCA, Varimax rotation)

Item	Patient group (n = 434)			Reference group (n = 236)		
	Factor 1 Before rotation	Factor 1 Depressed Affect	Factor 2 Positive Affect	Factor 1 Before rotation	Factor 1 Depressed Affect	Factor 2 Positive Affect
1 Bothered	0.609	0.592	0.153	0.494	0.517	0.022
2 Poor appetite	0.320	0.363	-0.063	0.536	0.513	0.157
3 Blues	0.686	0.670	0.162	0.766	0.763	0.142
5 Concentrating	0.625	0.634	0.086	0.653	0.661	0.094
6 Felt depressed	0.791	0.782	0.165	0.784	0.719	0.318
7 Effort	0.537	0.555	0.045	0.701	0.667	0.217
9 Life a failure	0.580	0.542	0.207	0.571	0.552	0.154
10 Felt tearful	0.682	0.709	0.046	0.647	0.626	0.173
11 Sleep restless	0.467	0.484	0.034	0.558	0.557	0.101
13 Talked less	0.503	0.509	0.071	0.503	0.533	0.006
14 Lonely	0.682	0.634	0.252	0.644	0.608	0.213
15 People unfriendly	0.328	0.319	0.080	0.346	0.390	-0.063
17 Crying spells	0.629	0.640	0.078	0.515	0.543	0.013
18 Felt sad	0.743	0.743	0.130	0.671	0.696	0.045
19 Other disliked you	0.467	0.443	0.147	0.574	0.615	-0.015
20 Not get going	0.584	0.606	0.041	0.576	0.580	0.091
4 As good as others	0.233	-0.023	0.750	0.253	0.005	0.734
8 Hopeful future	0.365	0.174	0.592	0.347	0.134	0.651
12 Happy	0.408	0.142	0.809	0.364	0.101	0.796
16 Enjoyed life	0.395	0.130	0.803	0.395	0.127	0.814

(total 42.2%) in the reference group. As expected, the first factor loaded high on the 16 negatively formulated items, subsequently labelled as Depressed Affect, and the second component loaded high on the four positively formulated items, herein after labelled as Positive Affect. Only item 2 'poor appetite' in the patient group and item 15 'people unfriendly' in both groups had relatively low factor loadings (i.e. <0.40). However, taking the large sample sizes into account, these factor loadings were still significant and therefore not excluded. Another reason for the inclusion of item 2 'poor appetite' was that a loss of appetite is part of the definition of depression and, that in the reference group, this item did have a relatively high factor loading on Depressed Affect.

The results of the PCA showed that the two subscales are sufficiently recognized by the data. This notion of sufficient structure was supported by the results of a SCA. In the patient group, the SCA indicated that a two-factor model explained 40.3% of the variance (40.6% explained variance possible). In the reference group, a two-factor model explained 42.0% of the variance (42.2%

explained variance possible). The small reductions in variance explained by the model (SCA) in comparison with the variance explained by the data (PCA), proves the fit of the two factor structure of the model.

In order to test the replicability of the two-factor structure, we repeated the analyses at T2. A PCA yielded the same two-factor structure, explaining after rotation respectively 34.3 and 14.0% of the variance (total 48.3%) in the patient group and 27.1 and 13.1% of the variance (total 40.2%) in the reference group. Again, the results of the SCA supported the notion of sufficient structure, with a two-factor model explaining in the patient group 48.1% of the variance (48.3% explained variance possible) and in the reference group 39.7% of the variance (40.2% explained variance possible).

In summary, the results of the explorative and confirmative factor-analyses proved our hypothesis that the CES-D measures two factors, differentiating between the negatively and positively formulated items. These two factors are subsequently labelled as Depressed Affect and Positive Affect.

*Item-analysis*

As mentioned earlier, the essential characteristics of depression are the presence of a depressed mood, a loss of interest or pleasure, a significant weight loss or gain, sleeping problems, changes in motor and cognitive activity, fatigue or loss of energy, feelings of worthlessness or guilt, recurrent thoughts of death or suicide, and difficulty concentrating or thinking. The content of the 16 negatively formulated items of Depressed Affect seems to reflect the definition of depression, whereas the content of the four positively formulated items of Positive Affect is less clear.

When examining the endorsement of the individual CES-D items, an interesting pattern was found. In response to the 16 negatively formulated items, 85–100% of the patient and reference group reported no or few depressive symptoms (i.e. score 0, 'rarely' or score 1, 'sometimes'). Thus, only 15% or less had a higher score on the negatively formulated items (i.e. score 2, 'occasionally' or score 3, 'most of the time'). In contrast, in response to the four positively formulated items (scored in reverse), 20–30% of both groups reported little or no positive affect (i.e. score 2, 'sometimes' or score 3, 'rarely'). If we want to add the negatively and positively formulated items together into an overall sumscore, we would expect a stronger correspondence between the endorsement of both types of items. That is, we would expect that the majority of both groups, in addition to low scores on the 16 negatively formulated items, also had low scores on the positively formulated items (scored in reverse). However, this was not found.

These differences in the endorsement of the negatively and positively formulated items was reflected in the relatively high mean item scores for Positive Affect, compared to those for Depressed Affect (see Table 3). In the patient group, the mean item score for Depressed Affect was 0.39 (SD = 0.19), compared to 0.98 (SD = 0.10) for Positive Affect. Similarly, in the reference group, the mean item score for Depressed Affect was 0.27 (SD = 0.13), compared to 0.87 (SD = 0.08) for Positive Affect.

We also found that in response to the positively formulated items 4, 8, and 16, score 3 'rarely' was endorsed more frequently than score 2 'some of the time', whereas in response to all negatively

**Table 3.** Mean item scores in the patient and reference group

CES-D items	Patient group (n = 434)		Reference group (n = 236)	
	Mean	SD	Mean	SD
1 Felt bothered	0.36	0.64	0.24	0.48
2 Poor appetite	0.31	0.67	0.11	0.36
3 Blues	0.17	0.47	0.14	0.39
4 As good as others	1.06	1.22	0.91	1.14
5 Difficulty concentrating	0.60	0.78	0.39	0.58
6 Felt depressed	0.38	0.63	0.33	0.56
7 Everything was an effort	0.71	0.81	0.43	0.66
8 Hopeful future	0.83	1.07	0.75	1.04
9 Life a failure	0.14	0.44	0.11	0.38
10 Felt tearful	0.33	0.58	0.19	0.47
11 Sleep restless	0.67	0.84	0.50	0.72
12 Happy	0.99	1.08	0.94	1.04
13 Talked less	0.45	0.71	0.33	0.63
14 Felt lonely	0.38	0.67	0.33	0.67
15 People unfriendly	0.16	0.51	0.19	0.41
16 Enjoyed life	1.03	1.10	0.87	1.05
17 Crying spells	0.30	0.58	0.13	0.46
18 Felt sad	0.40	0.63	0.27	0.51
19 Other disliked you	0.18	0.49	0.17	0.42
20 Not get going	0.68	0.78	0.46	0.67

formulated items, there was a gradual decrease in item-endorsement (i.e. score 0 was endorsed most frequently and score 3 was endorsed least of all). The non-gradual decrease in item-endorsement of the positively formulated items might indicate that, due to patterned responses, some respondents incorrectly answered one or more positively formulated items.

The analyses at T2 yielded similar results as above, indicating that in both groups, the mean item scores for Positive Affect were significantly higher, compared to those for Depressed Affect. In the patient group, the mean item score for Depressed Affect was 0.32 (SD = 0.15), compared to 1.04 (SD = 0.14) for Positive Affect. Similarly, in the reference group, the mean item score for Depressed Affect was 0.23 (SD = 0.15), compared to 1.08 (SD = 0.18) for Positive Affect.

In sum, there was a weak correspondence between the endorsement of the negatively and positively formulated items, which was reflected in the relatively high mean scores for Positive Affect. Thus, when combining the negatively and positively formulated items into an overall sumscore, the positively formulated items have a relatively high impact on the total score.



### Reliability analysis

Cronbach's  $\alpha$  for Depressed Affect was high, in the patient and reference group 0.87 and 0.88 respectively (see Table 4). These values were slightly higher than the  $\alpha$  for the total 20-item CES-D scale, i.e. 0.85 in both groups, and suggest high internal consistency. Cronbach's  $\alpha$  for Positive Affect was in the patient and reference group 0.75 and 0.76 respectively. Since  $\alpha$  is a function of the number of items, a possible reason for the slightly lower  $\alpha$  for Positive Affect may be that this scale consists of only four items. To further insure that no single item within the scale was significantly reducing the reliability of the total scale,  $\alpha$  coefficients were recalculated with each item removed. The result was that no single item significantly reduced the internal consistency of both subscales. In the patient group,  $\alpha$  for Depressed Affect ranged from 0.85 to 0.87 and for Positive Affect from 0.64 to 0.75. In the reference group,  $\alpha$  for Depressed Affect ranged from 0.86 to 0.88 and for Positive Affect from 0.65 to 0.76.

Item-total correlations for Depressed Affect ranged in the patient group from 0.27 (item 15, 'people unfriendly') to 0.72 (item 6, 'felt depressed'), with 13 of the 16 items strongly to moderately correlated with the total subscale score (i.e.  $>0.40$ ). This indicated that each item contributed some common and some unique variance in the total subscale score. In the reference group, item-total correlations for Depressed Affect ranged from 0.31 (item 15, 'people unfriendly') to 0.71 (item 6, 'felt depressed'), with 15 of the 16 items

strongly to moderately correlated with the total subscale score. For Positive Affect, item-total correlations ranged in the patient group from 0.41 (item 8, 'hopeful future') to 0.62 (item 12, 'happy' and item 16, 'enjoyed life') and in the reference group from 0.45 (item 8, 'hopeful future') to 0.64 (item 16, 'enjoyed life'), with in both groups all four items strongly to moderately correlated with the total subscale score.

The replication of the reliability analyses at T2 showed the same picture. The  $\alpha$  for Depressed Affect was in the patient and reference group 0.91 and 0.86 respectively, again slightly higher than the  $\alpha$  for the total 20-item CES-D scale (in the patient and reference group 0.88 and 0.81 respectively). The  $\alpha$  for Positive Affect was in the patient and reference group 0.82 and 0.78 respectively. The item-total correlations for Depressed Affect and Positive Affect were also similar to those at T1. For Depressed Affect, item-total correlations ranged in the patient group from 0.31 (item 2, 'poor appetite' and item 15, 'people unfriendly') to 0.78 (item 6, 'felt depressed'), with 13 of the 16 items strongly to moderately correlated with the total subscale score. In the reference group, item-total correlations for Depressed Affect ranged from 0.17 (item 15, 'people unfriendly') to 0.70 (item 6, 'felt depressed'), with 10 of the 16 strongly to moderately correlated with the total subscale score. Item-total correlations for Positive Affect ranged in the patient group from 0.52 (item 4, 'as good as others') to 0.69 (item 12, 'happy') and in the reference group from 0.48 (item 4, 'as good as others') to 0.67 (item 8, 'hopeful'), with in both groups all four items strongly to moderately correlated with the total subscale score.

In sum, Depressed Affect and Positive Affect demonstrated good reliability in both groups, as indicated by high Cronbach's  $\alpha$ . Most items for Depressed Affect and all four items for Positive Affect were moderately to strongly correlated with the total subscale score.

### Correlations between Depressed and Positive Affect

In both the patient and reference group, the individual items of Positive Affect and Depressed Affect were weakly correlated with each-other. The mean of the possible pairwise correlations among

**Table 4.** Intercorrelations and Cronbach's  $\alpha$  for Depressed Affect and Positive Affect in the patient and reference group

	Depressed Affect	Positive Affect
Patient group (n = 434)		
Depressed Affect	<b>0.87<sup>a</sup></b>	
Positive Affect <sup>b</sup>	0.30	<b>0.75</b>
Reference group (n = 236)		
Depressed Affect	<b>0.88</b>	
Positive Affect	0.29	<b>0.76</b>

<sup>a</sup> Bold-faced diagonal values indicate Cronbach's  $\alpha$  for the subscale.

<sup>b</sup> The Positive Affect items are scored in reverse, with higher scores indicating less positive affect.

the items of Depressed Affect and Positive Affect (in the patient and reference group 0.14 and 0.13 respectively) were lower than the mean of the possible pairwise correlations among the items of Depressed Affect (in the patient and reference group 0.30 and 0.33 respectively) and among the items of Positive Affect (in the patient and reference group 0.43 and 0.44 respectively) separately.

Using Pearson correlation coefficients, we found a significant but relatively low correlation between Depressed Affect and Positive Affect, in the patient and reference group 0.30 and 0.29 respectively ( $p < 0.001$ ) (see Table 4).

This finding was validated at T2, as indicated by a correlation between Depressed and Positive affect in the patient group of 0.34 ( $p < 0.001$ ) and in the reference group of 0.22 ( $p < 0.01$ ).

*Correlations among Depressed Affect, Positive Affect, and related psychosocial measures*

Further validity for the hypothesis that Depressed Affect and Positive Affect are relatively independent factors was supported by their correlations

with related psychosocial measures. As can be seen in Table 5, Depressed Affect was strongly related to other measures of psychological distress, physical symptom distress, and neuroticism. In contrast, Positive Affect was only weakly related to other measures of psychological distress as well as to extraversion. Depressed and Positive Affect were both moderately strong related to self-esteem, life satisfaction, and quality of life.

The findings at T2 were similar, showing that in both groups, Depressed Affect was strongly related to other measures of psychological distress, physical symptom distress, and neuroticism, whereas Positive Affect was weakly related to other measures of psychological distress and to extraversion.

*Depressive symptoms in the patient and reference group*

Finally, we examined whether Depressed Affect and Positive Affect were able to discriminate patients from the reference group on depressive symptomatology. At T1 (3 months after diagnosis), the patient group scored significantly higher on

**Table 5.** Relationships among Depressed Affect, Positive Affect, and related psychosocial measures

	Patient group (n = 434)		Reference group (n = 236)	
	Depressed Affect	Positive Affect	Depressed Affect	Positive Affect
STAI				
State anxiety	0.64***	0.39***	0.59**	0.50**
GHQ				
Anxiety	0.74***	0.25***	0.65**	0.28**
Depression	0.67***	0.36***	0.60**	0.31**
Social distress	0.60***	0.22***	0.47**	0.15**
Somatic distress	0.66***	0.19***	0.59**	0.19**
RSCL				
Psychological distress	0.77***	0.26***	0.74**	0.36**
Physical distress	0.54***	0.22***	0.58**	0.23**
LASA				
Quality of life	-0.44***	-0.33***	-0.43**	-0.24**
SWLS				
Satisfaction with life	-0.50***	-0.40***	-0.45**	-0.32**
EPQ				
Neuroticism	0.62***	0.32***	0.61**	0.34**
Extraversion	-0.12*	-0.13**	-0.22**	-0.07
RSE				
Self-esteem	-0.41***	-0.37***	-0.45**	-0.33**

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

Depressed Affect, compared to the reference group; 6.24 (SD = 6.04) in the patient group compared to 4.33 (SD = 5.12) in the reference group ( $t = 4.310$ ,  $p < 0.001$ ). As expected, we found no significant differences between the patient and reference group on Positive Affect; 3.91 (SD = 3.37) in the patient group, compared to 3.47 (SD = 3.25) in the reference group ( $t = 1.618$ ,  $p = 0.106$ ).

The same picture was found at T2 (15 months after diagnosis), with the patient group scoring significantly higher on Depressed Affect than the reference group; 5.14 (SD = 6.30) in the patient group compared to 3.75 (SD = 4.58) in the reference group ( $t = 3.071$ ,  $p < 0.01$ ). Again, we found no significant differences between both groups on Positive Affect ( $t = 0.496$ ,  $p = 0.663$ ).

## Discussion

In the present study, the CES-D scale was evaluated for its reliability and validity as a measure of current depressive symptomatology in cancer patients and in a matched reference group of healthy individuals from the general population. Specifically, we were interested in the reliability and the validity of a two-factor structure, differentiating between the negatively and the positively formulated items. The results confirmed our hypothesis that the CES-D measures two relatively independent and weakly correlated factors, subsequently labelled as Depressed Affect and Positive Affect. Both factors demonstrated good reliability in terms of internal consistency. However, apart from good reliability, the validity of a measure has to be demonstrated. Item-analyses showed a weak correspondence between the endorsement of the negatively and positively formulated items. In both groups, only a minority had high scores on Depressed Affect, indicating the presence of depressive symptoms, whereas about a quarter had high scores on Positive Affect, indicating little positive affect. These differences were reflected in the relatively high mean item scores for Positive Affect (scored in reverse), compared to the mean item scores for Depressed Affect. Hence, the four positively formulated items have a relatively high impact on the total 20-item CES-D sumscore, compared to the 16 negatively formulated items.

This is an important finding, since it emphasizes the importance of examining the validity of the four positively formulated items. It should be clear which concept they measure, otherwise the use of the total 20-item sumscore may not accurately reflect depressive symptomatology.

The content of the negatively formulated items of Depressed Affect seem to reflect the definition of depression, but the content of the positively formulated items is less clear. Validity of Depressed Affect was also demonstrated by moderate to high correlations with other measures of psychological distress, physical symptom distress, and neuroticism. In contrast, the validity of Positive Affect was not confirmed, since Positive Affect was only weakly related to measures of psychological distress and to extraversion. The validity of Depressed Affect was also supported by the finding that the patient group scored significantly higher on Depressed Affect, thus reporting more depressive symptoms than the reference group. As expected, we found no significant differences between both groups on Positive Affect.

The original four-factor structure of the CES-D was not found in the present study. More specifically, there appeared to be a crossover of items between the original Depressed Affect factor and the Somatic-Retarded Activity factor. A major problem in the study of depression in patients with a medical illness such as cancer has been the difficulty distinguishing the symptoms that are associated with depression from the symptoms that are caused by the patients' medical illness and/or its treatment [2, 61, 62]. Although symptoms such as weight loss, loss of appetite, lack of energy, and sleeping difficulties may reflect depression in physically healthy populations, they may be confounded by cancer and its treatment. In the present study, we combined the original Depressed Affect and Somatic-Retarded Activity factor. Thus, the 16-item Depressed Affect factor still includes a few somatic items that may represent symptoms of depression and/or symptoms of cancer and its treatment. This may partly explain the strong relationship between Depressed Affect and physical symptoms distress found in the present study, but previous research has indicated that the presence of severe physical symptoms is an important riskfactor of depression in cancer patients. Nevertheless, the fact that the CES-D scale in-

cludes a few somatic items should be taken into account when using the scale for diagnosing depressive symptomatology in patients with a medical illness.

With regard to Positive Affect, patients did not differ markedly from the reference group. Since previous research has indicated that cancer patients are significantly depressed, especially in the initial period after diagnosis, this finding suggest that Positive Affect does not measure depressive symptomatology. Another explanation for the finding that both groups had similar scores on Positive Affect may be that cancer patients do experience positive affect in the period after diagnosis. Coping theory has traditionally focused on coping processes that help manage or reduce aversive states [63]. A recent study of Folkman, however, showed that in the context of intense distress both negative and positive psychological states are experienced [64]. Since the present study was not able to validate the construct validity of the Positive Affect factor, it remains unclear whether this factor measures a concept related to positive psychological states.

In conclusion, the present study strongly suggest that the use of a sumscore based on the 16 negatively formulated items of the CES-D, instead of a sumscore based on all 20 items, is a more valid measure of depressive symptomatology, both in cancer patients and in a matched reference group of healthy individuals from the general population. Future research should examine more closely the validity of the Positive Affect factor. In addition, more research should be conducted to examine the effect of patterned responses on answering positively formulated items in a scale that consists mainly of negatively formulated items and the reverse scoring of positively formulated items in order to calculate an overall sumscore based on negatively and positively formulated items. Finally, although the validity of the Positive Affect factor could not be validated in the present study, the relatively weak relationship between Positive Affect and Depressed Affect is an interesting finding. The co-occurrence of depressed and positive affect in the context of stressful circumstances should receive further attention in future studies on the psychosocial adjustment to stressful life events such as a diagnosis of cancer.

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## Appendix

Endorsement of CES-D items in cancer patients and reference subjects

Item	Cancer patients % (n = 434)	Reference subjects % (n = 236)	Item description
Item 1			
0	72	78	I was bothered by things that usually don't bother me
1	21	19	
2	6	3	
3	1		
Item 2			
0	78	90	I did not feel like eating, my appetite was poor
1	15	9	
2	5	1	
3	2		
Item 3			
0	86	88	I felt that I could not shake off the blues even with the help from my family or friends
1	11	10	
2	2	2	
3	1		
Item 4			
0	50	53	I felt that I was just as good as other people
1	16	18	
2	13	13	
3	21	16	
Item 5			
0	55	66	I had trouble keeping my mind on what I was doing
1	34	30	
2	8	4	
3	3		
Item 6			
0	69	70	I felt depressed
1	26	27	
2	4	2	
3	1	1	

## Appendix Continued

Item 7			
0	47	66	I felt that everything I did was an effort
1	38	27	
2	11	6	
3	4	1	
Item 8			
0	54	58	I felt hopeful about the future
1	23	20	
2	10	11	
3	13	11	
Item 9			
0	88	91	I thought my life had been a failure
1	10	7	
2	1	2	
3	1		
Item 10			
0	72	84	I felt tearful
1	24	13	
2	3	2	
3	1	1	
Item 11			
0	53	61	My sleep was restless
1	32	30	
2	11	7	
3	4	2	
Item 12			
0	44	45	I was happy
1	26	28	
2	16	15	
3	14	12	
Item 13			
0	66	74	I talked less than usual
1	27	20	
2	5	5	
3	2	1	
Item 14			
0	71	76	I felt lonely
1	22	17	
2	5	5	
3	2	2	
Item 15			
0	89	82	People were unfriendly
1	8	17	
2	2	1	
3	1		
Item 16			
0	43	50	I enjoyed life
1	26	26	
2	15	11	
3	16	13	
Item 17			
0	75	90	I had crying spells
1	20	8	
2	5	1	
3		1	

## Appendix Continued

Item 18			
0	67	75	I felt sad
1	27	23	
2	5	2	
3	1		
Item 19			
0	85	84	I felt people disliked me
1	12	15	
2	2	1	
3	1		
Item 20			
0	49	62	I could not get going
1	37	32	
2	11	4	
3	3	2	

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