



## ARTÍCULO ORIGINAL

# Psychometric properties and validity of the Center for Epidemiological Studies Depression Scale (CES-D) in a population attending an HIV clinic in Cali, Colombia

Héctor Mueses-Marín<sup>1</sup>, David Montaña<sup>1</sup>, Jaime Galindo<sup>1</sup>, Beatriz Alvarado-Llano<sup>1,2</sup>, Jorge Martínez-Cajas<sup>1,2</sup>

<sup>1</sup> Grupo de Educación y Salud en VIH/SIDA, Corporación de Lucha contra el Sida, Cali, Colombia

<sup>2</sup> Division of Infectious Diseases, Department of Medicine, Queen's University, Kingston, Canada

**Introduction:** Depression in people living with HIV/AIDS is associated with poor health outcomes. Despite this, assessment of depressive symptoms is not a routine clinical practice in the care of people with HIV in Colombia. One reason could be the lack of validated depression screening scales for this population.

**Objective:** To test the reliability and construct validity of the 20- and 10-item-Center for Epidemiological Studies Depression Scale in patients attending an HIV clinic in Cali, Colombia.

**Materials and methods:** A non-random sample of 105 adults was enrolled. The 20 item-CES-D (CES-D-20) scale was administered twice: At baseline and 2-4 weeks later. We calculated the Cronbach's alpha coefficient and the intraclass correlation coefficient. In addition, we used an exploratory and confirmatory factorial analysis, as well as the item response theory to assess the validity of the scale.

**Results:** Most participants were men (73%), with a mean age of 40 years, 53% of whom had not completed high school. Cronbach's coefficients were 0.92 and 0.94 at baseline and at the second interview, respectively. The intraclass correlation was 0.81 (95% CI: 0.72-0.88). Although all 20 items loaded distinctly in 4 factors, 5 items did not load as expected. The structure factor of the CES-D-20 was not confirmed, as 4 items had poor goodness of fit. The CES-D-10 appeared to perform better in this population.

**Conclusions:** These results support the reliability and validity of the CES-D-10 instrument to screen for depressive symptoms in people living with HIV in Colombia.

**Key words:** Psychometrics; depression; reproducibility of results; HIV; acquired immunodeficiency syndrome; adult; Colombia.

## Propiedades psicométricas y validez de la escala de depresión del *Center for Epidemiological Studies* (CES-D) en personas atendidas en una clínica de HIV en Cali, Colombia

**Introducción.** La depresión en personas con HIV/sida se asocia con resultados negativos para la salud. La evaluación de los síntomas depresivos no es una práctica clínica rutinaria en el cuidado de personas con HIV/sida en Colombia, lo cual puede deberse a la carencia de escalas validadas para la tamización de la depresión en esta población.

**Objetivo.** Evaluar la reproducibilidad y validez de constructo de dos versiones de la escala de depresión del *Center for Epidemiological Studies* (CES-D), la de 20 ítems y la de 10 ítems, en personas con HIV/sida atendidas en una clínica de Cali, Colombia.

**Materiales y métodos.** Se seleccionó una muestra no probabilística de 105 adultos con HIV/sida. La escala CES-D se utilizó dos veces (línea basal y 2 a 4 semanas después). La consistencia interna fue evaluada con el coeficiente alfa de Cronbach. La reproducibilidad se evaluó con el coeficiente de correlación intraclass. Para verificar la validez del constructo se utilizó un análisis factorial exploratorio y la teoría de respuesta al ítem.

**Resultados.** El 73 % de la muestra correspondía a hombres, la edad promedio fue de 40 años y el 53 % tenía baja escolaridad. El coeficiente alfa de Cronbach fue de 0,92 (línea basal) y de 0,94 (segunda entrevista). El coeficiente de correlación intraclass fue de 0,81 (IC<sub>95%</sub> 0,72-0,88). Aunque en cuatro de los factores en la escala de 20 ítems claramente hubo carga factorial, cinco de los ítems no tuvieron un ajuste adecuado. La CES-D de 10 ítems parece funcionar mejor en esta población.

**Conclusiones.** Los resultados respaldaron la reproducibilidad y la validez de la escala CES-D para la tamización de síntomas depresivos en personas con HIV/sida en Colombia.

**Palabras clave:** psicometría; depresión; reproducibilidad de los resultados; VIH; síndrome de inmunodeficiencia adquirida; adulto; Colombia.

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### Corresponding author:

Héctor F. Mueses-Marín, Carrera 56 N° 2-120, Cali, Colombia

Telephone: (572) 513 6152, extension 113  
centroinvestigaciones@cls.org.co

### Author contributions:

Héctor Mueses-Marín and Beatriz Alvarado-Llano: Conception and design of the study, and analysis and interpretation of data.

David Montaña: Design, acquisition and interpretation of data.

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Depression has emerged as a significant mental health issue worldwide (1-3), and people living with HIV/AIDS are not an exception. People living with HIV/AIDS are disproportionately affected by depression with a 5 to 10 times higher prevalence than in the general population (4). In North America, approximately half of the people living with HIV/AIDS have significant depressive symptoms and 20 to 25% of them meet diagnostic criteria for a depressive disorder (5,6) while in low and middle-income countries depression among people living with HIV/AIDS ranges from 10% to 68% (7-10). Moreover, depression in people living with HIV/AIDS is a strong predictor of low levels of treatment adherence, poor virologic response, and increased risk of other chronic conditions (6,11). Depression is associated with increased HIV-specific morbidity and earlier mortality despite access to adequate antiretroviral therapy (12-14), and with overall lower quality of life as measured by a decreased concentration span, poor sleep quality, decreased memory, lower motivation, and increased stress (11,15-19). On this basis, the assessment and treatment of depression are essential in the care of people living with HIV/AIDS. Despite its importance, screening for depression is not consistently performed in the routine clinical care of people living with HIV/AIDS in Colombia. This may be due in part to the lack of validated scales to screen for depression in this population.

The Depression Scale of the Center for Epidemiologic Studies (CES-D) is a widely used screening scale for depression which has been demonstrated to hold construct and concurrent validity in Colombian adolescents and adults (20-22). In the general population, the CES-D original cut-off point for depression was  $\geq 16$  points, although in Colombian populations a better trade-off of sensitivity and specificity was found to be  $\geq 20$  points (21). The reliability of the original English language scale had alpha coefficients ranging from 0.85 to 0.9 (20-23). In people living with HIV/AIDS, the CES-D preserved its validity in multiple settings (24-27). A cut-off point of  $\geq 16$  points has been found to have a sensitivity ranging from 72.7% to 79.8% and a specificity ranging from 78.5% to 83.0% in different studies (25-28). Shorter CES-D scales have also been validated with the 10-item version working as efficiently as the 20-item one (29).

However, inconsistent results have been found for somatic and positive affect items of the CES-D in people living with HIV/AIDS (30-32). This lack of consistency of the scale in several people living with HIV/AIDS populations emphasizes the need for its cross-cultural validation (33). Thus, we tested the reliability and construct validity of the 20-item and the 10-item versions of the CES-D (proposed by Zhang, *et al.*) (29).

## Materials and methods

### *Study population*

People living with HIV/AIDS followed in an HIV clinic in Cali (*Corporación de Lucha contra el Sida*) were invited to participate in a validation study of depression, stigma and adherence scales. The *Corporación de Lucha contra el Sida* clinic is a non-profit organization that provides comprehensive care to people living with HIV/AIDS in Cali and nearby cities in the southwestern part of Colombia.

Participants were invited if they were 18 years of age or older, were able to provide informed consent, and could be on or off antiretroviral therapy. Potential participants were approached at the clinic during regular appointments and a non-random sample of participants was recruited.

One hundred and nine patients were invited to participate of whom 105 accepted. All participants were asked to attend two visits, two to four weeks apart. Eighty-four of them completed the follow-up at 2 to 4 weeks. The sample size was calculated to obtain 60 participants in each of three groups: One group of participants naïve to antiretroviral therapy (ART), one with less than one year of ART, and the last one with participants with more than one year of ART. After 6 months of recruitment, we were unable to recruit participants to the first group and, thus, recruitment was halted before completing the sample of 180.

### **Data collection**

An interviewer conducted face-to-face interviews with each participant. Interviews lasted from 30 minutes to an hour and took place at the *Corporación de Lucha contra el Sida* in a room that ensured privacy and confidentiality. The baseline questionnaire included data on age (years), sex at birth, sexual orientation (homosexual, bisexual, heterosexual), ethnicity, civil status (married/living with a partner or not), education level, work status, number of dependent children, level of satisfaction with the place of residence, history of incarceration, and lifestyle characteristics such as regular exercise, smoking, frequency of alcohol and drug use, sexual health (sexually active, condom use, etc.). In addition, clinical factors were extracted from the participants' charts: The viral load and T lymphocyte subpopulation levels including CD4/CD8 ratios.

### **Center for Epidemiological Studies Depression Scale (CES-D)**

The CES-D is a 20-item scale (23). Each item is scored on a 4-point scale ranging from 0 (rarely/none of the time) to 3 (most/all of the time). Scores on the CES-D range from 0 to 60 with greater scores indicating a greater degree of depressive symptoms. The scale is composed of four dimensions as per the original development: negative affect (items 3, 6, 9, 14, 17, and 18); positive affect (items 4, 8, 10, 12, and 16); somatic (items 1, 2, 5, 7, 11, and 20), and interpersonal (items 13, 15, and 19) manifestations of depressive illness.

We used a Spanish translation of the CES-D scale that other authors had previously tested for validity and reliability in different populations (22,34). The cut-off points of 16 and 20 were used to define the presence of depression since previous studies have suggested that such thresholds were discerning for the presence of depression (21,22,24,25,27,34,35). It should be pointed that the 10-item version proposed by Zhang, *et al.* (29), has demonstrated to have a sensitivity of 91% and a specificity of 92%, with a cut-off of  $\geq 10$  in people living with HIV/AIDS. This version includes items 1, 5, 6, 7, 8, 10, 11, 12, 14, and 20.

### **Ethical aspects**

The participation in the study was voluntary. We obtained written informed consent from each participant. This study was reviewed and approved by the Research Ethics Boards of both the *Corporación de Lucha contra el Sida* and Queen's University.

### **Statistical analyses**

Descriptive statistics were used to summarise the social and clinical characteristics of the sample. The internal consistency reliability was tested using Cronbach's coefficient. Test-retest reliability was assessed using the intraclass correlation coefficient. Construct validity was established using exploratory factorial analysis and confirmatory factor analysis.

In interpreting the factor pattern, a factor loading  $\geq 0.40$  was considered good. In confirmatory factor analysis, model fit was defined as a comparative fit index and a Tucker-Lewis index of 0.95 while the root mean square error of approximation and the standardized root mean square residual were  $< 0.08$  (36). We further performed an item response theory analysis to establish items with poor fit and to identify the discriminative capacity of the CES-D items (37).

Finally, we examined the construct validity of the scale by comparing social and clinical characteristics of those with 1) CES-D scores  $< 16$  with those with CES-D scores  $\geq 16$ ; 2) CES-D scores  $< 20$  with those with CES-D scores  $\geq 20$ , and 3) those with  $\geq 10$  points in the shorten version vs  $< 10$  points. Group comparisons were conducted using t-tests for continuous variables and contingency table chi-square tests for categorical data and the Mann-Whitney test. All analyses were done with Stata/IC version 12, and R, version 3.3.3.

**Table 1.** Characteristics of people living with HIV/AIDS participating in the study (n=105)

	n	%
Age (years)		
20-29	17	16
30-39	33	31
40-49	40	38
$\geq 50$	15	14
Sex		
Men	76	72
Educational level		
None or primary	38	37
Secondary	38	36
Technical education	14	13
University (incomplete/complete)	13	13
No data	2	2
Employment status		
Work	32	30
Housekeepers	11	10
Other	22	21
Unemployed	37	35
No data	3	3
Marital status		
Single	66	63
Married/common law marriage	26	25
Widow, separated or divorced	11	11
No data	2	2
Life styles		
Current smoker	24	23
Recreational drugs in the last three months (yes)	12	11
Any consumption of alcohol in the last 30 days (yes)	44	42
Tattoos (yes)	28	27
Ever been arrested (yes)	22	21
Regular exercise or any physical activity 3 or more times a week (yes)	43	43
	<b>Median</b>	<b>Interquartile range (Q25-Q75)</b>
CD4 levels (cell/mm <sup>3</sup> )	369	220-555
Viral load (copies/ml)	0	0-1303
CD8 levels (cell/mm <sup>3</sup> )	850	574-1151
CD4/CD8 ratio	0.35	0.23-0.69

## Results

The baseline demographic characteristics of the 105 participants are shown in table 1. Most participants were men (73%) with an average age of 40 years (range: 21-71 years). Participants had low education levels, with 73% not having completed high school. In addition, 63% reported being single and 35% unemployed.

### Exploratory factor analysis and reliability

The Cronbach's alpha coefficients for the CES-D-20 were 0.92 and 0.94 for baseline and second interview, respectively, and these values did not change when excluding an item. The intraclass correlation coefficient was 0.81 (95% CI: 0.72-0.88). Exploratory factorial analysis revealed four factors (table 2). The first factor explained 42.5% of the variance; the second, 9%; the third, 7%, and the fourth, 5%. With the exception of item 2 ("I did not feel like eating, my appetite was poor"), all items loaded distinctly with factor loadings in the range of 0.50-0.80. Five items did not load in the same dimension as in the original scale: items 7, 11, and 20, which are somatic dimensions, item 12, related to positive affect, and item 13, related to interpersonal dimension. The Cronbach's alpha was good for factor 1 but was <0.8 for the other three factors. The exploratory factor analysis for the CES-D-10 revealed that one factor explained 50% of the variance, and the second factor, 11%. The second factor only included item 8; the Cronbach's alpha was 0.89 for the first factor with the nine items.

**Table 2.** Rotated factor loadings for 20- and 10-item CES-D scale versions (pattern matrix)

Item	CES-D 20				CES-D 10	
	Factor I	Factor II	Factor III	Factor IV	Factor I	Factor II
1. I was bothered by things that do not usually bother me. (S) Me molestaron cosas que usualmente no me molestan			0.62*		0.56	
2. I did not feel like eating; my appetite was poor. (S) No me sentía con ganas de comer; tenía mal apetito.	0.35					
3. I felt that I could not shake off the blues even with the help of my family and friends. (D) Me sentía que no podía quitarme de encima la tristeza, aun con la ayuda de mi familia o amigos.	0.80*					
4. I felt that I was just as good as other people. (P) Sentía que yo era tan bueno(a) como cualquier otra persona.				0.85*		
5. I had trouble keeping my mind on what I was doing. (S) Tenía dificultad en concentrarme en lo que estaba haciendo.			0.50*		0.70	
6. I felt depressed. (D) Me sentía deprimido(a).	0.85*				0.83	
7. I felt that everything I did was an effort. (S) Sentía que todo lo que hacía era un esfuerzo.	0.65				0.78	
8. I felt hopeful about the future. (P) Me sentía optimista sobre el futuro.				0.50*		0.82
9. I thought my life had been a failure. (D) Pensé que mi vida había sido un fracaso.	0.69*					
10. I felt fearful. (D) Me sentía con miedo.	0.79*				0.80	
11. My sleep was restless. (S) Mi sueño era inquieto.	0.75				0.78	
12. I was happy. (P) Estaba contento(a).	0.68				0.56	
13. I talked less than usual. (I) Hablaba menos de lo usual.			0.79			
14. I felt lonely. (D) Me sentía solo(a).	0.62*				0.72	
15. People were unfriendly. (I) La gente no era amistosa.		0.80*				
16. I enjoyed life. (P) Disfrutaba de la vida.				0.64*		
17. I had crying spells. (D) Pasaba ratos llorando.	0.61*					
18. I felt sad. (D) Me sentía triste.	0.75*					
19. I felt that people disliked me. (I) Sentía que no le caía bien a la gente		0.75*				
20. I could not get going. (S) No tenía ganas de hacer nada.	0.55	0.50			0.72	
Cronbach's alpha	0.93	0.75	0.64	0.64	0.88	

(S): Somatic; (D): Depressed; (P): Positive, and (I) Interpersonal, as per original scale method: Principal-component factors; Rotation: Orthogonal varimax. Kaiser-Meyer-Olkin measure of sampling adequacy was 0.8630.

\* Highest factor loading consistent with the highest factor loading in the original structure

**Table 3.** Confirmatory factor analysis of the CES-D 20 and CES-D 10 scales

Model	Original 20-CES-D factor solution	Factor solution of table 2	Factor solution of table 2 without item 2	CES-D 10 one factor	Excluding item 8
CFI	0.827	0.84	0.85	0.95	0.96
TLI	0.799	0.81	0.83	0.94	0.95
SRMR	0.08	0.08	0.08	0.05	0.05
RMSEA	0.10	0.09	0.10	0.08	0.07

CFI Comparative fit index; TLI: Tucker-Lewis index; SRMR: Standardised root mean square residual; RMSEA: Root mean square error of approximation

### **Confirmatory factor analysis**

Table 3 summarizes the model fit of statistics for different factor solutions. The best fit was obtained with the CES-D-10 scale, either with or without item 8. The factor solution of the CES-D-20 of table 2 and the original scale factor solution did not meet the criteria for goodness to fit of the model (table 3).

### **Item response analysis**

Four of the items of the CES-D-20 failed the test of fit (item-fit statistics for a multidimensional model). Poorly fitting items should be expected with the significance  $<0.05$ , to diagnose where the functional form of the item response theory analysis model was incorrectly specified: 3 ( $p=0.040$ ), 6 ( $p=0.038$ ), 9 ( $p=0.036$ ) and 13 ( $p=0.050$ ). In the CES-D-10 scale, only item 5 failed to demonstrate unacceptable fit ( $p=0.007$ ). Items 4, 8, and 13 in the CES-D-20 and item 8 in the CES-D-10 did not show acceptable discrimination values (how well items identify patients at different levels of depression).

### **Correlates of depression**

Of the participants, 54.3% (95% CI: 44.6-64.0) had CES-D scores of  $\geq 16$ , 44.8% (95% CI: 35.1-54.4) had CES-D scores of  $\geq 20$  with the 20 item scale, and 53.3% (95% CI: 43.6-63.0) had CES-D scores of  $\geq 10$  with the 10-item scale. The relationships between the exposure and the presence of depressive symptoms were consistent across the different cut-off points used (table 4). A score over the cut-off points (either  $\geq 16$  or  $\geq 20$  in the CES-D-20, or  $\geq 10$  in the CES-D-10) was more frequent among women, housewives, the unemployed, and among those with dissatisfaction regarding housing and those who did not exercise. When using the cut-off point of  $\geq 16$ , we found an association with smoking which did not occur when using the other two cut-off points (table 4). A higher viral load and lower  $CD_4$  levels were found in those with possible depression and this was consistent with all three CES-D versions (table 5).

### **Discussion**

The adaptation and use of the CES-D scale were felt to be an important tool in the clinical assessment of people living with HIV/AIDS, a population with special social and clinical characteristics that differ from those of the general adult population in Colombia. Ours is the first study in Colombian people living with HIV/AIDS examining the validity and reliability of both the 20 item and the 10 item versions of the CES-D scale.

The application of this scale in our sample was straightforward and subjects were eager to answer all questions, which resulted in no missing data.

The long scale demonstrated high internal reliability suggesting that the 20 items measured the same underlying construct: depressive symptoms. It also showed a high construct validity as it correlated with known established

**Table 4.** General characteristics of participants according to CES-D scores

	CES-D (20 items) scores <16			CES-D (20 items) scores ≥16			CES-D (20 items) scores <20			CES-D (20 items) scores ≥20			CES-D (10 items) scores <10			CES-D (10 items) scores ≥10		
	%	%	p-value	%	%	p-value	%	%	p-value	%	%	p-value	%	%	p-value	%	%	p-value
Gender																		
Female	24	76	0.006	31	69	0.002	28	72	0.015	24	76	0.006	31	69	0.002	28	72	0.015
Male	54	46		64	36		54	46		54	46		54	46		54	46	
Educational level																		
None or primary	39	61	0.640	45	55	0.510	37	63	0.306	37	63	0.306	37	63	0.306	37	63	0.306
Secondary	53	47		61	39		50	50		50	50		50	50		50	50	
Technical education	43	57		57	43		64	36		64	36		64	36		64	36	
University	54	46		62	38		54	46		54	46		54	46		54	46	
Employment status																		
Work	53	47	<0.001	63	38	0.002	66	34	0.002	66	34	0.002	66	34	0.002	66	34	0.002
Housekeepers	9	91		18	82		9	91		9	91		9	91		9	91	
Unemployed	32	68		43	57		35	65		35	65		35	65		35	65	
Other	82	18		82	18		64	36		64	36		64	36		64	36	
Marital status																		
Single	45	55	0.593	55	45	0.791	45	55	0.419	45	55	0.419	45	55	0.419	45	55	0.419
Married /common law marriage/	54	46		58	42		58	42		58	42		58	42		58	42	
Widow/separated or divorced	36	64		45	55		36	64		36	64		36	64		36	64	
Dependent children																		
Yes	43	57	0.392	52	48	0.590	43	57	0.288	43	57	0.288	43	57	0.288	43	57	0.288
No	51	49		57	43		53	47		53	47		53	47		53	47	
Currently lives with:																		
Alone	64	36	0.535	64	36	0.598	45	55	0.759	45	55	0.759	45	55	0.759	45	55	0.759
Relatives	43	57		52	48		46	54		46	54		46	54		46	54	
Spouse or partner and/or sons	52	48		62	38		57	43		57	43		57	43		57	43	
Friends/other	38	63		38	62		38	63		38	63		38	63		38	63	
You are satisfied with the place where you live now																		
Yes	53	47	0.04	61	39	0.035	53	47	0.085	53	47	0.085	53	47	0.085	53	47	0.085
No	30	70		37	63		33	67		33	67		33	67		33	67	
Currently lives in:																		
Own house/apartment	43	57	0.58	55	45	0.565	45	55	0.579	45	55	0.579	45	55	0.579	45	55	0.579
House/apartment in rent	54	46		56	44		49	51		49	51		49	51		49	51	
Other	33	67		33	67		67	33		67	33		67	33		67	33	
Sexual orientation																		
Heterosexual	43	57	0.509	52	48	0.825	43	57	0.525	43	57	0.525	43	57	0.525	43	57	0.525
MSM	55	45		59	41		55	45		55	45		55	45		55	45	
Bisexual	42	58		50	50		50	50		50	50		50	50		50	50	
Have you ever been arrested																		
Yes	41	59	0.546	59	41	0.616	50	50	0.797	50	50	0.797	50	50	0.797	50	50	0.797
No	48	52		53	47		47	53		47	53		47	53		47	53	
Regular exercise																		
Yes	60	40	0.025	70	30	0.013	60	40	0.039	60	40	0.039	60	40	0.039	60	40	0.039
No	38	62		45	55		40	60		40	60		40	60		40	60	
Tobacco																		
Never	43	57	0.032	50	50	0.252	46	54	0.576	46	54	0.576	46	54	0.576	46	54	0.576
Former smoker	70	30		70	30		57	43		57	43		57	43		57	43	
Current smoker	33	67		50	50		42	58		42	58		42	58		42	58	
Recreative drugs in the last 3 months																		
Yes	50	50	0.772	67	33	0.346	58	42	0.447	58	42	0.447	58	42	0.447	58	42	0.447
No	46	54		52	48		47	53		47	53		47	53		47	53	
How often do you drink alcohol																		
Never	44	56	0.126	51	49	0.238	42	58	0.270	42	58	0.270	42	58	0.270	42	58	0.270
<4/5 drinks monthly	60	40		67	33		60	40		60	40		60	40		60	40	
>4/5 drinks more than once a month	29	71		43	57		43	57		43	57		43	57		43	57	
Sexually active																		
Yes	48	52	0.655	56	44	0.602	47	53	0.842	47	53	0.842	47	53	0.842	47	53	0.842
No	44	56		51	49		49	51		49	51		49	51		49	51	
Condom usage																		
Not every time	25	75	0.156	25	75	0.055	25	75	0.186	25	75	0.186	25	75	0.186	25	75	0.186
Every time	52	48		61	39		50	50		50	50		50	50		50	50	

**Table 5.** Immunology and virology distributions by CES-D scores

	CES-D (20 items) scores <16	CES-D (20 items) scores ≥ 16		CES-D (20 items) scores <20	CES-D (20 items) scores ≥20		CES-D (10 items) scores <10	CES-D (10 items) scores ≥10	
	Median (range IQ)	Median (range IQ)	p	Median (range IQ)	Median (range IQ)	p	Median (range IQ)	Median (range IQ)	p
Age	39.5 (30-46)	40 (34-45)	0.5914	39 (30-46)	41 (34-46)	0.5551	39 (30-45)	41 (34-47)	0.1476
CD <sub>4</sub>	425 (319-591)	324.5 (189-458)	0.0206	423 (304-589)	316 (189-434)	0.0229	434 (322-589)	316 (189-440)	0.0137
Viral load	0 (0-675564)	58.5 (0-21412)	0.0373	0 (0-328)	114 (0-21412)	0.0221	0 (0-66)	95 (0-21412)	0.0066
CD8	925 (678-1162)	766.5 (537-1113)	0.0835	918 (636-1289)	755 (537-1078)	0.0497	939 (652-1289)	778 (540-1107)	0.0772
CD <sub>4</sub> /CD <sub>8</sub> ratio	0.489 (0.287-0.657)	0.323 (0.213-0.712)	0.1922	0.457 (0.280-0.657)	0.327 (0.213-0.712)	0.3285	0.518 (0.280-0.657)	0.327 (0.213-0.712)	0.1824

factors for depression, such as gender, low socio-economic status, and smoking. However, our factor analysis showed that 5 of the 20 items did not load in the original scale factor loadings. Similar findings have been reported in previous validation studies in which the original four dimensions in the CES-D scale did not hold for people living with HIV/AIDS (37). Our factor analysis failed to confirm the model fit in the factor solution of the 20 item version, and the item response theory analysis established that four items did not meet the criteria for a good fit. Thus, the usefulness of the total score of the CES-D in people living with HIV/AIDS should be approached with caution. In contrast, the CES-D-10 appeared to work better in our sample population as it showed high internal consistency and a valid factorial structure. The usefulness of this shorter CES-D scale has also been found by other studies (38).

It has been documented that the CES-D scale has a factorial structure that behaves inconsistently in different populations including people living with HIV/AIDS (25,31,37). Some authors have found a different factorial structure when using the oblique rotation (24). We found that the oblique rotation was no better than that obtained with varimax (data not shown). In a clinical sample of 350 people living with HIV/AIDS, Gay, *et al.* (37) found that items 2, 4, 8, 11, and 16, which are mostly related to positive affect, were problematic and caused the scale to lose validity. In our study, we found that item 8 was also problematic. Some authors have even recommended to fully exclude positive affect items from the CES-D (31,39). Furthermore, we found four different items with poor fit: items 3, 6, 9, and 13, which mainly relate to depressive state and seem to load differently according to other reports (40). Since the CES-D-10 scale did not include items 3, 9 and 13, this may explain why in our population it held its validity.

It has been suggested that the somatic symptoms among HIV positive participants are difficult to interpret as they may overlap with medication side effects or with the effects of HIV infection itself (30). Other studies have found that those items are more likely to load in different factors (41). In fact, four of the items that did not load in the same factor as the original scale in our sample were related to somatic symptoms (items 2, 7, 11, and 20). Interestingly, items 7, 11, and 20 loaded well on the CES-D-10 scale. Even shorter versions of the scale have been found to be valid in general populations (22). One version has seven items of which five are also included in the CES-D-10 that we studied. Thus, it is possible that somatic symptoms are not as problematic in populations of people living with HIV/AIDS in Colombia.

There was a high frequency of depressive symptoms in our sample and we found that social factors such as gender, housing satisfaction, unemployment, as well as smoking, were associated with more depressive



symptoms in our sample. In addition, 60% of the women had high levels of depressive symptoms, which is consistent with a disproportionate prevalence of depression found in females living with HIV/AIDS in other studies (14,42,43) which suggest that the combination of depression with poverty, interpersonal violence, and the burden of caring for themselves and others creates numerous social challenges for women living with HIV (14,44,45).

In this regard, it is conceivable that the 'caregiver' role that many Colombian women play (household tasks and raising children) can result in a high burden of stressful experiences (46,47). The coexistence of depression and smoking is well established in people living with HIV (48,49) which calls for interventions to address both conditions simultaneously. Studies have documented the association between disease severity as measured by CD<sub>4</sub> counts and depressive symptoms (14,50) an aspect that was also evidenced in the small sample of people living with HIV/AIDS under study.

We have not validated the CES-D against gold standards for the diagnosis of depressive disorders. A previous study in Colombia found that the 20-point cut-off in the CES-D scale was better for depression in the general population; future studies in the country should consider confirming the factor structure and fit of the CES-D-20 scale with a more advanced item response theory analysis (51) and assess the accuracy of the full and shortened versions of this scale in people living with HIV/AIDS. Oversampling of women and transgender populations should be considered in those previous studies since one of them showed differences in item functions in those populations (37). Our sample size limited the possibility of assessing differences in item responses in such populations.

The CES-D scale has been extensively used worldwide and will likely continue to be used in future assessments of depressive symptoms in people living with HIV/AIDS. The subjective nature of this scale for the assessment of depressive symptoms may have resulted in an underestimation of the prevalence of depression due to social desirability bias. However, we believe that overestimation is more likely to occur than lack of validity in people living with HIV/AIDS given the lack of fit of some of the items reported. However, even with such overestimation, the CES-D-10 scale can be a valid tool for the screening of depression and its use may effectively help select people living with HIV/AIDS who need a more detailed assessment and, eventually, treatment for depression.

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**Appendix:** Spanish version of the CES-D scale used in the study

**Instrucciones:** Las siguientes son preguntas relacionadas con su estado de ánimo. Hay una lista de maneras en la que usted pudo haberse sentido o comportado en la **última semana**. Por favor, indique con qué frecuencia se sintió de esta manera.

Durante la semana pasada...	Raramente o ninguna vez (<1 día)	Una parte o un poco de tiempo (1-2 días)	Ocasionalmente o una cantidad moderada de tiempo (3-4 días)	La mayoría o todo el tiempo (5-7 días)
1. Me molestaron cosas que usualmente no me molestan.				
2. No me sentía con ganas de comer; tenía mal apetito.				
3. Me sentía que no podía quitarme de encima la tristeza, aun con la ayuda de mi familia o amigos.				
4. Sentía que yo era tan bueno(a) como cualquier otra persona.				
5. Tenía dificultades en concentrarme en lo que estaba haciendo.				
6. Me sentía deprimido(a).				
7. Sentía que todo lo que hacía era un esfuerzo.				
8. Me sentía optimista sobre el futuro.				
9. Pensé que mi vida había sido un fracaso.				
10. Me sentía con miedo.				
11. Mi sueño era inquieto.				
12. Estaba contento(a).				
13. Hablaba menos de lo usual.				
14. Me sentía solo(a).				
15. La gente no era amistosa.				
16. Disfrutaba de la vida.				
17. Pasaba ratos llorando.				
18. Me sentía triste.				
19. Sentía que no le caía bien a la gente.				
20. No tenía ganas de hacer nada.				