REVIEW ARTICLE

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Cross-cultural comparison of symptom networks in late-life major depressive disorder: Yoruba Africans and the Spanish Population

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Background: The concept of European psychologisation of depression versus somatisation in non-European populations has been the basis of several studies of cultural psychopathology in the general population. Little is currently known about cross-cultural differences and similarities in late-life depression symptom reporting. We cross-culturally compared symptom reporting in the context of Major Depressive Disorder (MDD) among community-dwelling older adults from Spain and Nigeria.

Methods: We relied on data from two household multistage probability samples comprising 3,715 persons aged 65 years or older in the Spanish and Nigerian populations. All participants underwent assessments for MDD using the World Mental Health Survey version of the Composite International Diagnostic Interview. Cross-cultural comparison of broad somatic and psychological categories as well as relationship and influence of individual symptoms were analysed using the Symptom Network Analysis approach.

Results: Current MDD was diagnosed in 232 and 195 older persons from Spain and Nigeria, respectively. The symptom network of the two samples were invariant in terms of global strength, $S(G_{SPAIN}, G_{NIGERIA})$ = 7.56, P = .06, with psychological and somatic symptoms demonstrating centrality in both countries. However, country-specific relationships and influence of individual symptoms were found in the network structure of both samples, $M(G_{SPAIN}, G_{NIGERIA})$ = 2.95, P < .01.

Conclusion: Broad somatic and psychological symptoms categories contributed to the structural network of older Africans and their peers from the Spanish population.

> Variations in the relationship and influence of individual symptoms suggests that the functional and "communicative" role of individual symptoms may be differentiated by context specific imperatives.
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> **KEYWORDS**
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> ate-life major depression, cross-cultural study, centrality measures, symptom network analysis, clinical intervention targets

One of the best-known examples of cultural variation in psychopathology is the notion of differential somatic symptom reporting by non-European populations.[1] This concept has been the basis of several studies of cultural psychopathology in the general population.[2-9] There is an emerging body of research suggesting that, rather than being an evidence of difficulty in describing experiences in psychological terms, somatisation can sometimes be the predominant mode of symptom presentation depending on context.[5,10]

Preferential symptom reporting of emotional experiences may be shaped by local standards of interpretation of such symptoms as evidence of maladaptation and therefore their reporting as important symptoms.[11] Somatic symptom presentation has also been known to be the preferred way of expressing emotional distress in contexts, globally, where it is perceived as providing more effective access to healthcare.[5,12] In many such contexts, psychological symptoms may be downplayed.

Using data from the World Health Organization (WHO) collaborative study of psychological problems in general health care,[13] Simon and colleagues[4] found that there was no statistical variation in somatic symptom reporting among primary care attendees with Major Depressive Disorder (MDD) across 14 countries drawn from 5 continents. However, compared to centres where clinicians had ongoing relationships with patients, participants in the same study[4] who had no prior therapeutic relationship with clinicians were 2 times more likely to report somatic symptoms. The findings reported by Simon and colleagues[4] have essentially been replicated by more recent studies using advanced statistical techniques to examine the notion of cross-cultural differences in symptom reporting in the context of depression.[3,5,8]

An important gap in the literature examining the phenomenon of cross-cultural differences in symptom reporting in the context of depression is that studies have been based on clinical samples. Interpretation of results of cultural differences in symptom reporting among clinic attendees has an attendant confounding effect of differences in pathways to mental healthcare and help-seeking behaviours across cultures. Notably, there is very little information on cross-cultural patterns of symptom reporting in the context of MDD among community-dwelling older Africans and Europeans. Late-life depression has unique characteristics that differentiate it from depression in other age groups. For example, it has a stronger temporal relationship with contextual factors in the social environment than genetic or early biological factors.[14] Late-life depression is also associated with more complex comorbidities, greater chronicity, enduring disabilities, and stigma.[15-18]

Key points

- Network analysis provides a wide range of strategies to study culture specific manifestations of depression in late-life.
- Symptom structures of late-life depression were similar in Nigerian and Spanish populations according to universal nature of depression.
- Few symptoms were proven to show differential influence in both networks due to context-specific imperatives.

In the present study, we aim to use the Network Analysis (NA) approach to cross-culturally compare symptom reporting in the context of current MDD diagnosed according to criteria in the fourth edition of the Diagnostic and Statistical Manual of Mental disorders (DSM IV)[19] among community dwelling older adults from Spain and Nigeria. The NA approach comes from the conceptualisation of mental disorder as a syndromic constellation of symptoms that reciprocally interact and reinforce each other.[20,21] NA incorporates sophisticated techniques (eg, near-zero correlation shrinking, regularisation-based modelling) to study the complex patterns of symptom interactions (symptom networks), after removing some statistical artefacts due to high multi-dimensionality (multi-collinearity between symptoms). Additionally, influential symptoms (ie, those connected with most symptoms or with stronger connections) can be detected using NA. Those symptoms may play a critical role in disorder pathogenesis and aggravation.[22] Finally, some properties (eg, overall strength, network structure) of networks can be compared between groups of individuals (eg, coming from different cultures).

Under the NA approach, first we will compare broad somatic and psychological categories, previously[3] grouped from 12 psychometrically determined symptoms of DSM IV MDD. Secondly, we will describe patterns of relationships at the level of individual symptoms, and thirdly, we will identify symptoms that demonstrate the most distinctive influence on late-life MDD in participants from both countries. Despite the exploratory nature of this study, our main hypothesis was that while there will be cross-cultural invariance in overall symptom networks of both populations (as depression is a culturally universal pathology).,[3,5,9] we could not discard that differences

may be discerned at the level of symptoms relationship and influence in the networks.

1 | METHODS

1.1 | Sample

The present study relied on data from two samples of community-dwelling adults in the Spanish and Nigerian populations who were aged 65 years or older and met DSM IV criteria for current MDD.[19] The Spanish sample comprised participants (N = 2,011, 43.56% men; m = 75.28 years, SD = 7.11) in the Collaborative Research on Ageing in Europe (COURAGE in Europe) project which was conducted between 2011 and 2012.[23] Among them were 232 persons (20.26% men; m = 74.77 years, SD = 6.43) who met criteria for current MDD.[19] The Nigerian data was taken from the Ibadan Study of Ageing (ISA)[24] conducted in 2007 and comprised 1,704 interviewees (43.13% men; m = 76.86 years, SD = 8.50). Among them were 195 older adults (30.11% men; m = 76.84 years, SD = 8.57) who met the same criteria.[19]

1.2 | Procedures

In the COURAGE in Europe and ISA, face-to-face interviews were conducted at the respondents' homes by trained interviewers. The complete depression module of the World Mental Health Survey version of the Composite International Diagnostic Instrument (CIDI)[25] was administered to evaluate the presence of current MDD in the ISA. The version of the CIDI used in the COURAGE in Europe project excepted questions assessing the following depression symptoms: discouragement, self-worth, pleasure, weight, indecision, guilt, and irritability. Nevertheless, diagnosis of MDD in both samples were made based on criteria in the DSM-IV[20] and only symptoms that were present in both interviews were considered for the present study. Symptoms were grouped into broad somatic and psychological categories as determined by previous psychometric analyses of depression symptoms in the context of DSM IV MDD (Table 1).[3]

Ibadan Study of Ageing and COURAGE in Europe data comprising sociodemographic (ie, gender, age, marital status, household income, years of education, place of residence), health, and lifestyle factors were also included in the present study (Table 2).

1.3 | Data analysis

Sociodemographic, health and lifestyle factors were examined using descriptive statistics. Between-group differences were studied by means of χ^2-based tests and unpaired sample t tests. Cramer's V and Cohen's d were used as effect size estimates, respectively. A small effect size is proven by either $0.10 < V < 0.30$ or $0.20 < d < 0.50$;

TABLE 1 Major depression symptoms considered in this study

Label	Symptom	Description
Psychological symptoms		
conc	Concentration difficulty	Diminished ability to concentrate
hope	Hopelessness	Feelings of hopelessness
sad	Sadness[a]	Depressed mood most of the day, nearly every day
self	Lack of self-confidence	Feelings of worthlessness
think	Slow thinking	Diminished ability to think
suic	Suicide behaviour	Recurrent thoughts of death, suicidal ideation or suicidal attempts
Somatic symptoms		
app	Appetite problems	Decrease or increase in appetite nearly everyday
lost_int	Loss of interest[a]	Markedly diminished interest or pleasure in all, or almost all, activities
ener	Low energy or fatigue[a]	Fatigue or loss of energy nearly every day
rest	Restless	Psychomotor agitation
slow	Slowness	Psychomotor retardation
slp	Sleep difficulty	Insomnia or hypersomnia nearly everyday

Note: All the items correspond to DSM symptoms for major depression diagnosis.
Abbreviations: CIDI, Composite International Diagnostic Instrument; DSM, Diagnostic and Statistical Manual of Mental disorders; WMH, World Mental Health.
[a]Screening items in the WMH CIDI interview. At least one of these symptoms should be present to diagnose major depression.

medium effect size is assumed when $0.30 < V < 0.50$ or $0.50 < d < 0.80$; and large effect size was proven by either $V > 0.50$ or $d > 0.80$.

Symptom relationship network calculations relied on NA approach.[20] Under the NA framework, MDD may be understood as a complex and dynamic system with constant interactions between symptoms.[21,26] Each symptom has a distinctive and autonomous causational influence on the disorder status (eg, onset, aggravation, remission) over time, due to its relationships with the rest of symptoms in the network. The NA approach incorporates some sophisticated techniques (eg, near-zero correlation shrinkage techniques and regularisation corrections) to deal with common problems of traditional linear (and non-linear) statistical methods, such as high dimensionality (eg, symptoms may be highly correlated one each other) and the inflation of false positive rates due to very low correlations.

Using Fruchterman and Reingold's algorithm,[27] symptom networks can be graphically represented with nodes depicting symptoms and edges reflecting conditional dependence/relationship (ie, association between two symptoms after controlling for all other associations among the symptoms in the network). In this model, the stronger the edge, the higher the relationship correlation between

TABLE 2 Descriptive statistics between study samples

	Samples		Comparison test	Effect size
	COURAGE-Spain	ISA		
n	232	195		
Sex (men)	20.26	30.11	3.69	0.10
Age			19.68**	0.21
65-69	22.41	18.97		
70-74	28.02	31.28		
75-79	30.60	15.90		
80 or more	18.97	33.85		
Marital status			0.13	0.02
Married	38.36	40.51		
Not married	61.64	59.49		
Years of formal education	7.80 (6.23)	1.51 (0.72)	−13.20**	1.43
Household income[a]			97.50**	0.48
1st quartile	48.04	23.08		
2nd quartile	3.92	45.64		
3rd quartile	43.63	26.15		
4th quartile	4.41	5.13		
Urbanicity (urban areas)	84.91	37.95	98.77**	0.49
Functional disability[b]	80.60	30.77	105.87**	0.50
Alcohol intake (currently drinker)	47.43	52.08	0.74	0.05
Smoking (currently smoker)	22.84	33.68	5.64*	0.12
Depression treatment (yes)[c]	20.30	13.85	238.74**	0.75

Note: Percentage of cases are displayed, except with the years of education variable (mean and SD in brackets). The χ^2-based test was used for between-group comparison testing, except for the years of education variable (the t test for independent samples was used). The Cramer's V statistic was used as an effect size estimate (the Cohen's d was used for the years of education variable).

Abbreviations: ADL, activities of daily living index; ISA, Ibadan Study of Ageing.

[a]Household income variable was made by transforming two variables into a common metric: the amount of possessions in the ISA sample and the amount of money earned in the COURAGE-Spain sample.

[b]The index was built upon having difficulty in five activities: bathing, dressing, toileting, arising, and transferring; and eating.

[c]This refers to prescribed pharmacological treatment for depression be reported.

*P < .05.

**P < .01.

these symptoms. Also, nodes placed near the centre are those with higher influence (central) in disorder maintenance.[22]

Network estimation in the present study relied on nested Lasso regressions, with the extended Bayesian information criterion (EBIC) as a model selection index. Penalisation was based on a gamma hyper-parameter (γ = 0.25). Network was weighted and regularised using logistic regression and shrinking small relationships (set to be exactly zero). Holm's correction was used to prevent multiple comparison testing.

Two independent symptom networks (one from the Spanish sample and another from the Nigerian sample) were estimated considering previous psychometric analyses of depression symptoms in the context of DSM IV MDD (Table 1). We next compared properties from both networks by means of the permutation-based network comparison test.[28] This test aims at investigating network invariance (ie, equality in network properties) at three levels: network structure (network as a whole is identical across cohorts), global strength (same overall level of connectivity), and one-to-one edge strength (ie, each specific edge is identical across cohorts). Edge strength invariance should only be tested when a lack of network structure invariance is upheld.

Centrality measures were estimated to investigate the differential role of each symptom within the network in both countries.[22] Three centrality measures were calculated: strength (ie, sum of all the edge weights directed to a single node), betweenness (ie, number of times that node lies on the shortest path between two other nodes), and closeness (ie, average distance from a node to all other ones). Centrality measures from each node were compared to each other by means of the weight difference test. Moreover, network robustness tests were conducted under non-parametric bootstrapping to explore robustness of estimations.[29] All analyses were conducted using R Core Software v 3.5.0,[30] employing the mgm v. 1.2-9,[31] qgraph v. 1.6.5,[32] igraph v. 1.2.5,[33] bootnet v. 1.3,[29] and NetworkComparisonTest v. 2.2.1,[34] packages.

2 | RESULTS

Descriptive statistics are displayed in Table 2. There were more female participants in the Nigerian sample. Participants from Nigeria were also less formally educated, had a lower income, were more likely to be current smokers, and resided in more rural locations. Conversely, Spanish participants were more likely to have received treatment for depression. Symptom distribution between samples is displayed in Table 3. In general terms, a higher proportion of Spanish participants showed psychological symptoms (except suicide behaviour) and Nigerian participants were more likely to show somatic symptoms.

Figure 1 depicts the estimated symptom networks in both samples. The weighted correlation test is displayed in the Supplementary material. The network comparison test revealed that both networks were invariant in terms of global strength, $S(G_{SPAIN}, G_{NIGERIA})$ = 7.56, P = .06 (global strength by country: S_{SPAIN} = 8.06; $S_{NIGERIA}$ = 15.62). However, it found that network structures were different when considering symptom networks, $M(G_{SPAIN}, G_{NIGERIA})$ = 2.95, P < .01 (mean of maximum norm of the matrix of difference scores of all connection strengths from the permuted samples $\bar{M}_{PERM}$ = 1.42). The invariant

edge strength test revealed significantly different correlations between samples in the self-confidence—suicide edge, $E_{SS}(G_{SPAIN}, G_{NIGERIA}) = 0.99$, $P < .05$; and in the appetite—low energy edge,

TABLE 3 Proportion of individuals showing depressive symptoms across samples

Symptom	Spain sample (n = 232)	Nigeria sample (n = 195)	χ^2 test	Cramer's V
Psychological symptoms				
conc	77.59	68.21	4.30*	0.11
hope	87.07	19.49	192.85**	0.68
sad	98.28	88.72	15.30**	0.20
self	85.34	51.28	55.82**	0.37
think	70.69	72.31	0.07	0.02
suic	41.38	70.26	34.48**	0.29
Somatic symptoms				
app	65.95	97.44	64.50**	0.39
lost_int	93.10	99.49	9.69**	0.16
ener	93.10	92.82	0.00	0.01
rest	81.90	2.05	269.24**	0.80
slow	65.52	83.08	15.90**	0.20
slp	87.50	95.38	7.18*	0.14

Note: app, appetite problems; conc, concentration difficulty; ener, low energy or fatigue; hope, hopelessness; lost_int, lost of interest; rest, restless; sad, sadness; self, lack of self-confidence; slow, slowness; slp, sleep difficulty; suic, suicide behaviour; think, slow thinking.
*$P < .05$.
**$P < .01$.

$E_{AL}(G_{SPAIN}, G_{NIGERIA}) = 2.50$, $P < .01$. In this sense, these two correlations were significant in the Nigerian symptom network (tetrachoric correlation coefficients, $r = .55$, for self-confidence—suicide; and $r = .69$, for appetite—low energy), but shrunk from the Spanish symptom network, due to their low magnitude.

Figure 2 displays the centrality measures in both symptom networks. The most influential (central) symptoms in both networks were psychological (concentration difficulty) and somatic (slowness) symptoms (for all cases, the difference test showed significantly higher strength in comparison to sadness symptom for both samples and suicide symptom for Spanish sample too; $P < .01$). While slow thinking and low energy were distinctive in the symptom network of the Nigerian sample, lack of self-confidence and hopelessness (both psychological symptoms) were the most important symptoms in the network of Spanish participants (difference test with $P < .01$, for all these comparisons).

Network robustness tests revealed that network estimates derived from the real data were not significantly different from those derived from bootstrapped samples, regardless of country (see the Supplementary material). Conversely, stability of centrality measures decreased substantially when dropping people from dataset in both countries.

3 | DISCUSSION

The present study is a cross-cultural comparison of depression symptom networks in two large samples of community dwelling older adults with current MDD drawn from Nigeria and Spain. We
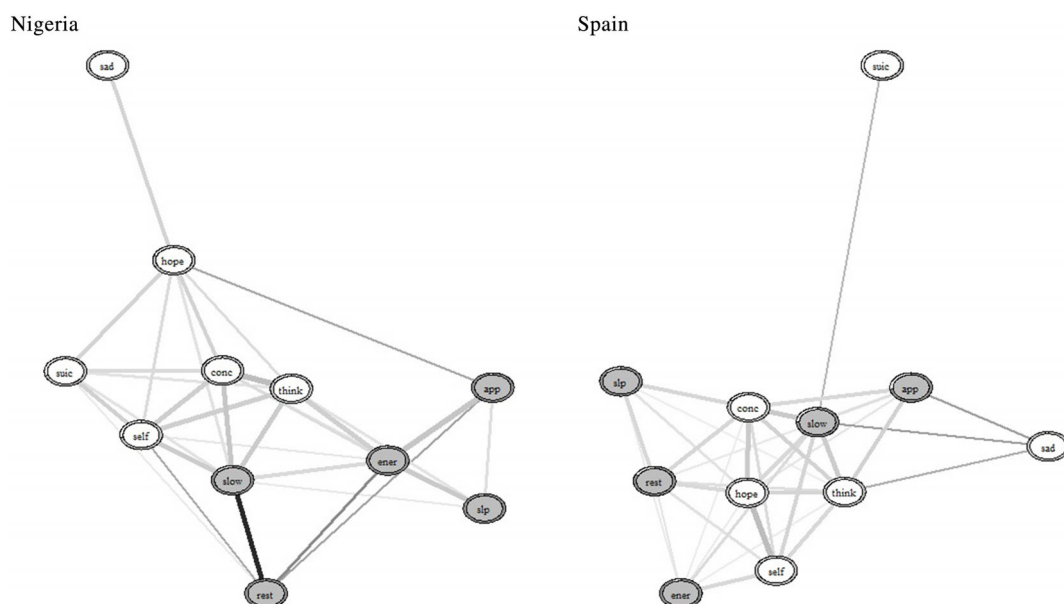

FIGURE 1 Estimated symptom constellations across the study groups. *Note:* Edges depict associations between symptoms (positive partial correlations in grey and negative correlations in black). The thicker the edge, the stronger the connection. Nodes in white depict psychological symptoms and nodes in grey depict somatic symptoms. The colouring of the circle around each node represents the explained variance by its neighbours. Symptoms: app, appetite problems; conc, concentration difficulty; ener, low energy or fatigue; hope, hopelessness; rest, restless; sad, sadness; self, lack of self-confidence; slow, slowness; slp, sleep difficulty; suic, suicide behaviour; think, slow thinking
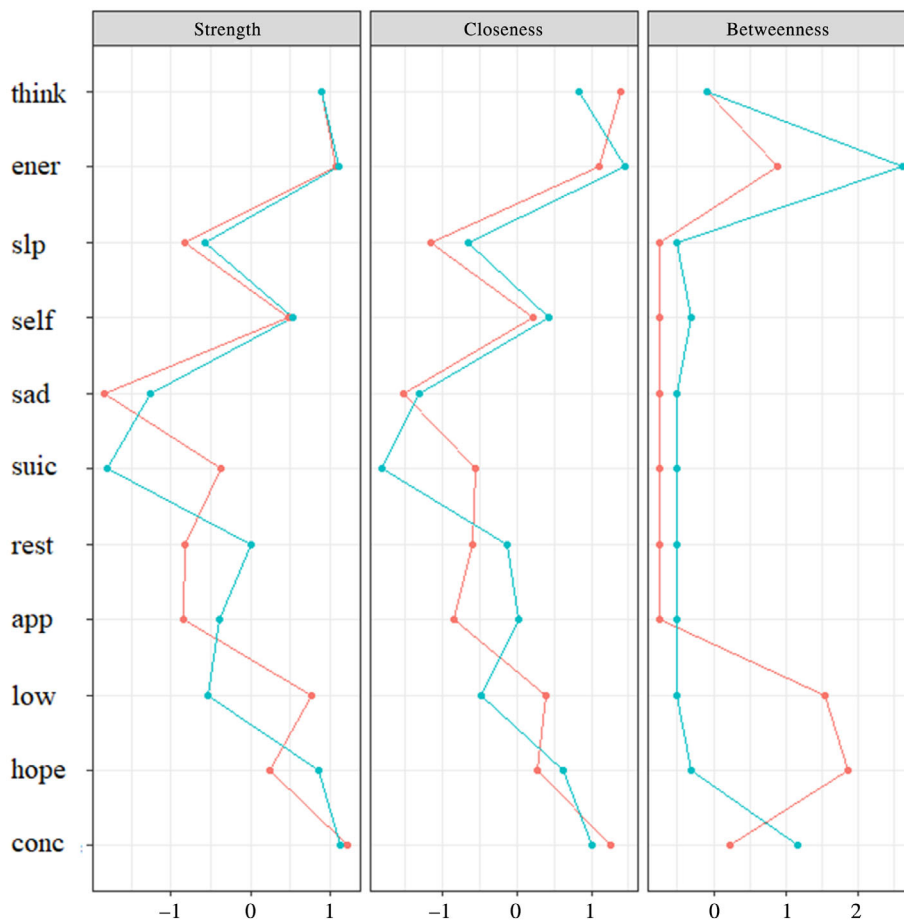
FIGURE 2 Centrality measures between symptom network constellations. *Note:* Red line, Nigerian symptom network estimates; Blue line, Spanish symptom network estimates. Symptoms: app, appetite problems; conc, concentration difficulty; ener, low energy or fatigue; hope, hopelessness; rest, restless; sad, sadness; self, lack of self-confidence; slow, slowness; slp, sleep difficulty; suic, suicide behaviour; think, slow thinking [Colour figure can be viewed at wileyonlinelibrary.com]

found that late-life MDD symptom networks in the two populations were invariant in terms of global strength (similar global magnitude of the relationships between symptoms), with psychological and somatic symptoms demonstrating centrality (ie, equally influential in late-life MDD) in both countries. Variations in network of both countries were found in patterns of relationships at the level of individual symptoms. Moreover, slow thinking and low energy were important in the symptom network of the Nigerian sample, while lack of self-confidence and hopelessness influenced the network derived from Spanish population.

Our findings are in keeping with recent studies showing that the presentation of depression is culturally universal and by no means unique to any one region or cultural context.[3,5,9] However, some culture-specific issues seem to play a relevant role in symptom reporting. In this regard, we found that Spanish older adults reported psychologisation symptoms more frequently than their counterparts did; and Nigerian older adults reported somatisation symptoms more frequently. Additionally, network structures were not similar across samples but showing the same overall connectivity strength.

Our study improves on existing body of work on cross-cultural similarities and nuances in symptom reporting in the context of depression. First, we conducted direct cross-cultural comparison of symptoms reporting in community dwelling older adults with MDD drawn from two large representative samples in Africa and Europe.

Previous studies have been mostly based on clinical samples. Interpretation of the results of studies in which participants were those who presented themselves to primary care or outpatient clinics have often been confounded by the observation that cross-cultural variations in broad symptom presentation may also reflect patterns of help-seeking.[5,12]

Second, many previous studies have focused solely on broad somatic and psychological symptom categories. Such broad categorisation does not allow for the disaggregation of cross-cultural nuances in the influence of individual symptoms in the overall presentation of MDD. We thus analysed, using the NA approach, individual symptoms as well as broad somatic and psychological categories derived according to previously published psychometric analyses of depression symptoms in the context of DSM IV MDD.[3] This methodology allowed us to discern cross-cultural nuances in the relationship between individual symptoms and identified symptoms that were most salient in maintaining the disorder in both populations. The third area in which our study improves on the literature is that, rather than rely on depression symptoms derived from patients self-reported, we have used symptoms obtained from the WHO CIDI. This methodology eliminates cross-cultural variations in symptom reporting that is due to interview techniques. For example, some previous studies have observed that compared to self-reported patient questionnaires,

diagnostic interviews that allows the interviewer to ask further questions may elicit more symptoms in the broad psychological categories, as opposed to more somatic symptoms when using patient self-reports.[35]

It is well feasible that, due to culture-specific experiences across the lifespan, there are true cultural variations in emotional expression in the general non-psychiatric population.[36,37] However, as reflected in the present findings, it would seem that in the context of psychopathology, differential reporting of symptoms in terms of broad categories such as more or less somatisation and psychologisation may be less pronounced in terms of how symptoms are connected each other.

In consonance with our hypothesis, we found differences at the level of individual symptoms, wherein slow thinking and low energy were important in the symptom network of the Nigerian sample while lack of self-confidence and hopelessness influenced the network from Spain. We note that even though we were able to identify these symptoms as having unique influences on late-life MDD in both populations using statistical techniques, we currently are unable to provide clear proposition as to their functional role as well as possible reasons for their influence on the disorder in the two populations. A closer look at our data revealed that low energy (Nigeria) and slowness (both in Nigeria and Spain) were important representative symptoms of the broad somatic categories in the two populations, while slow thinking (Nigeria) and lack of self-confidence and hopelessness (Spain) were key symptoms in the broad psychological categories. This observation is in keeping with the main finding of the present study suggesting that symptoms in the broad somatic and psychological categories were important in both populations. On the other hand, symptoms with distinctive influences on MDD may serve as targets for culturally sensitive interventions for older persons with the disorder in the respective populations.[22]

A key limitation of our study is that in instances of opposing DSM IV depression symptoms, such as weight loss and weight gain, we have chosen to drop the atypical depression symptom. As it is unlikely for the same patient to endorse both weight gain and weight loss in the same interview, the strategy to drop atypical symptoms was found to be the most expedient in statistical and conceptual terms. We also note that loss of interest was removed from analysis due to its low variability across samples (ie, the symptom was present in most study participants). Nevertheless, the observation that loss of interest was endorsed by the majority of participants with MDD regardless of country contexts indicate that the symptom may be crucial in late-life MDD regardless of country and culture. Given that we have investigated the phenomenon of cross-cultural differences in symptoms reporting using two cohorts from diverse social and economic contexts, we were not surprised by our finding of heterogeneity in the study sample in terms of several demographic, health, and lifestyle factors. Nevertheless, future studies should strive to include more homogeneous samples in order to reduce the influence of confounding factors. In terms of network estimation, it is worth noting that our sample is somewhat limited, leading to decreased power either to detect measure differences, lack of invariance, or significant correlations. For that reason, this study aspires to be a starting point to approach NA to cross-cultural psychiatry and further research should include larger sample size. On the other hand, the participant selection strategy (ie, participants fulfilling diagnostic criteria for MDD) may bias network estimation due to Berkson's bias. However, our focus was on clinical sample from both countries as meaningful unit of analysis on a community basis. In addition, the structure of the World Mental Health (WMH) CIDI interview (based on skip questions) led to missing data on secondary symptoms when interviewee did not manifest key symptoms. Further studies should include participants over the continuum of MDD in terms of severity as a way to minimise the impact of such bias. Finally, some depressive symptoms were not included in this study due to the CIDI version used to assess depression in the Spanish cohort. Although the key symptoms for depression diagnosis were considered, future studies should comprise a more exhaustive set of depressive symptoms to paint a more accurate picture of symptom networks and cultural aspects.

In conclusion, the network structures of late-life MDD symptoms in community-dwelling Yoruba Africans and the Spanish populations were similar in terms of global strength, when considering broad categories of somatic and psychological symptoms. However, the functional and 'communicative' role of individual symptoms may be differentiated by context specific imperatives. Reliability of statistical differences in the relationship and influence of individual depression symptoms requires confirmation in future studies comparing older Africans and Europeans with and without MDD. Such studies will justify their uniqueness in the process of late-life MDD in the two populations. If the distinctive role of individual symptoms in driving the disorder is confirmed, such symptoms could serve as important targets for culturally sensitive interventions in the respective populations.

It was timely to investigate the question of whether there are cross-cultural differences in symptom reporting using Africans with late-life MDD as the study model. This is as rapid social and epidemiological transitions in Africa have resulted in a more complex social configuration of the continent, a situation that may have consequences for the mental health of older Africans.[38,39] In turn, emerging complexities in social configurations in African societies may produce unique patterns of psychopathology, especially among the older population who may lack the requisite resources to adapt to the changes.

ETHICS STATEMENT

The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. Protocol for the COURAGE in Europe project was approved by the La Princesa University Hospital Ethics Committee, Madrid, and the Parc Sanitari Joan de Deu Ethics Committee, Barcelona, while the ISA was approved by the University of Ibadan and University College Hospital Ibadan joint ethics committee.

CONFLICT OF INTEREST

The authors declare that they do not have any conflict of interests to report.

DATA AVAILABILITY STATEMENT

Authors do not have permission to share data. Details on additional analyses and results are available upon corresponding author request.

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REFERENCES

1. Kleinman A. Neurasthenia and depression: a study of somatization and culture in China. *Cult Med Psychiatry*. 1982;6(2):117-190. https://doi.org/10.1007/bf00051427.
2. Ryder AG, Chentsova-Dutton YE. Depression in cultural context: "Chinese somatization," revisited. *Psychiatr Clin N Am*. 2012;35(1):15-36. https://doi.org/10.1016/j.psc.2011.11.006.
3. Ryder AG, Yang J, Zhu X, et al. The cultural shaping of depression: somatic symptoms in China, psychological symptoms in North America? *J Abnorm Psychol*. 2008;117(2):300-313. https://doi.org/10.1037/0021-843X.117.2.300.
4. Simon GE, VonKorff M, Piccinelli M, Fullerton C, Ormel J. An international study of the relation between somatic symptoms and depression. *N Engl J Med*. 1999;341(18):1329-1335. https://doi.org/10.1056/NEJM199910283411801.
5. Dere J, Sun J, Zhao Y, et al. Beyond "somatization" and "psychologization": symptom-level variation in depressed Han Chinese and Euro-Canadian outpatients. *Front Psychol*. 2013;4(June):1-13. https://doi.org/10.3389/fpsyg.2013.00377.
6. Parker G, Cheah YC, Roy K. Do the Chinese somatize depression? A cross-cultural study. *Soc Psychiatry Psychiatr Epidemiol*. 2001;36(6):287-293. https://doi.org/10.1007/s001270170046.
7. Zhou X, Dere J, Zhu X, Yao S, Chentsova-Dutton YE, Ryder AG. Anxiety symptom presentations in Han Chinese and Euro-Canadian outpatients: is distress always somatized in China? *J Affect Disord*. 2011;135(1-3):111-114. https://doi.org/10.1016/j.jad.2011.06.049.
8. Zhou X, Min S, Sun J, et al. Extending a structural model of somatization to South Koreans: cultural values, somatization tendency, and the presentation of depressive symptoms. *J Affect Disord*. 2015;176:151-154. https://doi.org/10.1016/j.jad.2015.01.040.
9. Zhou X, Peng Y, Zhu X, et al. From culture to symptom: testing a structural model of "Chinese somatization.". *Transcult Psychiatry*. 2016;53(1):3-23. https://doi.org/10.1177/1363461515589708.
10. Kirmayer LJ, Robbins JM. Three forms of somatization in primary care: prevalence, co-occurrence, and sociodemographic characteristics. *J Nerv Ment Dis*. 1991;179(11):647-655. https://doi.org/10.1097/00005053-199111000-00001.
11. Moleiro C. Culture and psychopathology: new perspectives on research, practice, and clinical training in a globalized world. *Front Psychiatry*. 2018;9(AUG): Article 366. https://doi.org/10.3389/fpsyt.2018.00366.
12. Yen S, Robins CJ, Lin N. A cross-cultural comparison of depressive symptom manifestation: China and the United States. *J Consult Clin Psychol*. 2000;68(6):993-999. https://doi.org/10.1037/0022-006X.68.6.993.
13. Sartorius N, Ustun TB, Costa JAS, et al. An international study of psychological problems in primary care: preliminary report from the World Health Organization Collaborative project on "psychological problems in general health care.". *Arch Gen Psychiatry*. 1993;50(10):819-824. https://doi.org/10.1001/archpsyc.1993.01820220075008.
14. Vink D, Aartsen MJ, Schoevers RA. Risk factors for anxiety and depression in the elderly: a review. *J Affect Disord*. 2008;106(1-2):29-44. https://doi.org/10.1016/j.jad.2007.06.005.
15. Haigh EAP, Bogucki OE, Sigmon ST, Blazer DG. Depression among older adults: a 20-year update on five common myths and misconceptions. *Am J Geriatr Psychiatry*. 2018;26(1):107-122. https://doi.org/10.1016/j.jagp.2017.06.011.
16. Gitlin LN, Szanton SL, Huang J, Roth DL. Factors mediating the effects of a depression intervention on functional disability in older African Americans. *J Am Geriatr Soc*. 2014;62(12):2280-2287. https://doi.org/10.1111/jgs.13156.
17. Fauth EB, Gerstorf D, Ram N, Malmberg B. Changes in depressive symptoms in the context of disablement processes: role of demographic characteristics, cognitive function, health, and social support. *J Gerontol Ser B Psychol Sci Soc Sci*. 2012;67 B(2):167-177. https://doi.org/10.1093/geronb/gbr078.
18. de la Torre-Luque A, de la Fuente J, Sanchez-Niubo A, et al. Stability of clinically relevant depression symptoms in old-age across 11 cohorts: a multi-state study. *Acta Psychiatr Scand*. 2019;140(6):541-551. https://doi.org/10.1111/acps.13107.
19. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders (4th Ed., Text Rev.)*. 4th ed. Washington, DC: Author; 2000.
20. Borsboom D, Cramer AOJ. Network analysis: an integrative approach to the structure of psychopathology. *Annu Rev Clin Psychol*. 2013;9:91-121. https://doi.org/10.1146/annurev-clinpsy-050212-185608.
21. Schmittmann VD, Cramer AOJ, Waldorp LJ, Epskamp S, Kievit RA, Borsboom D. Deconstructing the construct: a network perspective on psychological phenomena. *New Ideas Psychol*. 2013;31(1):43-53. https://doi.org/10.1016/j.newideapsych.2011.02.007.
22. McNally RJ. Can network analysis transform psychopathology? *Behav Res Ther*. 2016;86:95-104. https://doi.org/10.1016/j.brat.2016.06.006.
23. Miret M, Caballero FF, Chatterji S, et al. Health and happiness: cross-sectional household surveys in Finland, Poland and Spain. *Bull World Health Org*. 2014;92(10):716-725. https://doi.org/10.2471/BLT.13.129254.
24. Gureje O, Kola L, Afolabi E. Epidemiology of major depressive disorder in elderly Nigerians in the Ibadan Study of Ageing: a community-based survey. *Lancet*. 2007;370:957-964. https://doi.org/10.1016/S0140-6736(07)61446-9.
25. Kessler RC, Üstün TB. The World Mental Health (WMH) Survey Initiative version of the World Health Organization (WHO) Composite

International Diagnostic Interview (CIDI). *Int J Methods Psychiatr Res*. 2004;13(2):93-121.

26. Borsboom D, Robinaugh DJ, Rhemtulla M, Cramer AOJ. Robustness and replicability of psychopathology networks. *World Psychiatry*. 2018;17(2):143-144. https://doi.org/10.1002/wps.20515.

27. Fruchterman TMJ, Reingold EM. Graph drawing by force-directed placement. *Softw Pract Exp*. 1991;21(11):1129-1164. https://doi.org/10.1002/spe.4380211102.

28. Borkulo C Van, Boschloo L, Amsterdam VU, Kossakowski J, Tio P. Comparing network structures on three aspects: a permutation test. 2017). doi:https://doi.org/10.13140/RG.2.2.29455.38569

29. Epskamp S, Borsboom D, Fried EI. Estimating psychological networks and their accuracy: a tutorial paper. *Behav Res Methods*. 2018;50(1): 195-212. https://doi.org/10.3758/s13428-017-0862-1.

30. R Core Team. R: a language and environment for statistical computing. *R Foundation for Statistical Computing*. Vienna, Austria; 2017. https://www.r-project.org/.

31. Haslbeck JMB, Waldorp LJ. mgm: estimating Time-Varying Mixed Graphical. *J Stat Softw*. 2019;10(2):1-49.

32. Epskamp S, Cramer AOJ, Waldorp LJ, Schmittmann VD, Borsboom D. Qgraph: network visualizations of relationships in psychometric data. *J Stat Softw*. 2012;48. https://doi.org/10.18637/jss.v048.i04.

33. Csardi G, Nepusz T. The igraph software package for complex network research. *Int J Complex Syst*. 2006;1695 http://igraph.sf.net.

34. van Borkulo CD. A tutorial on R package NetworkComparisonTest (NCT). *Symptom Netw Model Depress Res Methodol Explor Clin Appl*. 2018; https://www.researchgate.net/publication/317493228_A_tutorial_on_R_package_NetworkComparisonTest_NCT.

35. Sayar K, Kirmayer LJ, Taillefer SS. Predictors of somatic symptoms in depressive disorder. *Gen Hosp Psychiatry*. 2003;25(2):108-114. https://doi.org/10.1016/S0163-8343(02)00277-3.

36. Kim HS, Sasaki JY. Cultural neuroscience: biology of the mind in cultural contexts. *Annu Rev Psychol*. 2014;65(1):487-514. https://doi.org/10.1146/annurev-psych-010213-115040.

37. Kirmayer LJ, Robbins JM, Dworkind M, Yaffe MJ. Somatization and the recognition of depression and anxiety in primary care. *Am J Psychiatry*. 1993;150(5):734-741. https://doi.org/10.1176/ajp.150.5.734.

38. Leigh-Hunt N, Bagguley D, Bash K, et al. An overview of systematic reviews on the public health consequences of social isolation and loneliness. *Public Health*. 2017;152:157-171. https://doi.org/10.1016/j.puhe.2017.07.035.

39. The Academy of Medical Sciences. *Challenges and Priorities for Global Mental Health in the Sustainable Development Goals (SDG) Era*. London: Academy of Medical Sciences; 2018. https://acmedsci.ac.uk/file-download/48863619.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.