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PSYCHOMETRIC PROPERTIES OF THE ADAPTATION OF THE INFORMANT QUESTIONNAIRE ON COGNITIVE DECLINE IN THE ELDERLY (IQCODE) IN THE SURVEY OF HEALTH, AGING AND RETIREMENT IN EUROPE (SHARE)

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The growth of dementia cases over the years has promoted methods for efficient early diagnoses such as the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE). Recently, the Survey of Health, Aging and Retirement in Europe (SHARE) made an adaptation of the IQCODE. In this work, we will examine the psychometric properties of this adaptation of the IQCODE. The sample was composed by 1,059 participants. SHARE's adaptation of the scale contained seven items, used two years for changes in mental abilities, and employed a 3-point response scale. We explored confirmatory factor analysis (CFA), coefficient omega estimation and self-report of Alzheimer's diagnoses as criterion. The one-factor structure was supported: $\chi^2(14) = 218.92$, $p < .001$; CFI = .995; SRMR = .028. There was evidence of internal consistency and criterion related validity, and ROC curve indicated acceptable discrimination. SHARE's adaptation of the IQCODE can be used as an appropriate tool for cognitive impairment screening within a large-scale survey framework.

Keywords: Cognition; Dementia assessment; Psychometric study; SHARE; Validity.

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As the baby boom generation ages, the world population's average age increases. This phenomenon has entailed higher prevalence rates of poor age-related health conditions such as dementia (Lourenco et al., 2018). The growth of dementia cases over the years has brought up the need to find effective tools for early diagnoses. One of the options is a two-stage process, with a first screening of symptoms that determines which individuals will require further assessment (Burton et al., 2021a).

There are two types of screening instruments depending on who answers the questions (Young et al., 2011). On the one hand, self-reported cognitive measures, such as the Mini Mental State Examination (MMSE; Folstein et al., 1975), have long been used to detect cognitive decline. These instruments fall under the umbrella of classical neuropsychological tests that measure either global cognition or specific cognitive domains. On the other hand, a complementary approach to assessing early decline relies on using informant-based screening tests. These tests have proved useful when individuals do not want, or are unable, to co-operate (Jorm, 2004).

Among the informant-based screening tests, the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) has become a widely used tool in clinical practice. This scale was originally developed by Jorm and Korten (1988) as a 26-item measure of an informant's perception of a target respondent's cognitive decline. Items ask the informant about the respondent's change in the ability to perform a set of everyday cognitive tasks between present time and 10 years ago. A 16-item version was later developed by Jorm (1994) and is regarded as the preferred instrument to assess early cognitive decline. Answers in both versions of the scale are originally coded in a 5-point Likert scale that ranges from 1 *much improved* to 5 *much worse*.

Psychometric properties of both the IQCODE and its shortened version have been repeatedly examined. Previous studies have mostly focused on reliability, predictive validity, and diagnostic validity. A series of systematic reviews have examined these instruments' accuracy for the detection of dementia in samples from different settings: primary-care settings (Burton et al., 2021b), secondary-care settings (Burton et al., 2021a), and community-dwelling populations (Quinn et al., 2021). In general, the IQCODE displays adequate properties, and the short version performs just as well. There was, however, little research on primary care settings (Burton et al., 2021b). Among the other studies, results indicate that the IQCODE might be useful for a first screening of dementia, as it displays adequate reliability and moderate predictive and criterion-related validity, but ought to be further complemented with other measures (Burton et al., 2021a; Quinn et al., 2021). Most of the studies exploring the adequacy of the IQCODE have done so from a clinical perspective.

In 2016, the 16-item version of the IQCODE was included in the Harmonized Cognitive Assessment Protocol (HCAP), a sub-study within the Health and Retirement Study (Langa et al., 2020). Most recently, in 2020, the Survey of Health, Aging and Retirement in Europe (SHARE) also included an adaptation of the IQCODE in their assessment protocol (Bergmann & Börsch-Supan, 2021). In this way, the use of this diagnostic tool has transcended clinical practice and has started being used as a research instrument.

Regarding the implementation of the IQCODE in the SHARE assessment battery, some adjustments were done to shorten administration time (Bergmann & Börsch-Supan, 2021). Time and resource constraints are well known in large-scale surveys such as SHARE (Eisinga et al., 2013). SHARE's general survey takes about 90 minutes to complete, which is an important factor to consider when it comes to survey fatigue (O'Reilly-Shah, 2017). Moreover, individuals were asked to leave the room while the informant answered the questions, so this further required a reduction in completion time (Bergmann & Börsch-Supan, 2021). As a result, SHARE's adaptation of the IQCODE contained seven items from the 16-item IQCODE, namely Items 1, 2, 3, 5, 10, 13, and 14. The response scale shifted from a 5-point Likert scale to a 3-point one, and the time frame to compare the individual's ability was reduced to two years instead of 10.

The use of the IQCODE has been extended to research practice in the latter years. With SHARE's new adaptation of the tool, the need to assess whether this new version of the IQCODE is still adequate as an informant-based measure of early cognitive decline has arisen. The aim of this study is to provide evidence of the psychometric properties of SHARE's adaptation of the IQCODE. For this, we will examine factor structure, reliability, and criterion-related validity. Moreover, as the use of the scale has a marked clinical tradition, a second aim of the study is to examine the cut-off value of this new adaptation of the IQCODE.

METHOD

Participants and Procedure

Data comes from the 8th wave of the Survey of Health, Aging and Retirement in Europe (SHARE; Börsch-Supan, 2022).[1] SHARE is a longitudinal panel design aimed at individuals aged 50 and over that, at

the moment, has published eight waves of public data. Sampling for the initial panel recruitment is done through a four-step sampling procedure in order to guarantee the sample is representative in all countries. First, each country specifies the sampling frame and procedure to be used. Then, the sample is drawn and processed within each country to produce a gross sample file. Thirdly, SHARE's central management team validates it, and finally sample data is uploaded onto the software system. Further details about sampling are available in Bethmann et al. (2018) and in Börsch-Supan et al. (2013).

For this study, we selected the 1,137 respondents who were not able to answer the questions related to their cognitive state. Only in this case, the IQCODE was administered to an informant. From these, 78 cases did not answer the IQCODE and were thus dismissed. The final sample was composed by 1,059 participants that informed about the cognitive state of the target respondents. Regarding respondents, their average age was 79.26 years old (*SD* = 10.53); 510 (48.2%) were female and 549 (51.8%) were male.

Instruments

SHARE's adaptation of the 16-item Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE; Jorm, 1994) was used. This adaptation used seven items from the 16-item version, namely items 1, 2, 3, 5, 10, 13, and 14. Further changes were a shift of the time frame referred to for change in cognitive ability of two years instead of 10, and a 3-point response scale instead of a 5-point one. Responses were coded as 1 (*improved*), 2 (*not much changed*), and 3 (*gotten worse*). Item content of the original 16-item version of the IQCODE are displayed in Table 1.

Additionally, the respondent was asked whether he or she had been diagnosed with Alzheimer's disease, dementia, or senility. Answers were coded as 0 (*no*) or 1 (yes) and this measure was used for criterion-related validity and sensitivity/specificity analyses.

TABLE 1
Item content of the 16-item IQCODE

1	Remembering things about family and friends (e.g., occupations, birthdays, addresses)
2	Remembering things that have happened recently
3	Recalling conversations a few days later
4	Remembering his/her address and telephone number
5	Remembering what day and month it is
6	Remembering where things are usually kept
7	Remembering where to find things which have been put in a different place from usual
8	Knowing how to work familiar machines around the house
9	Learning to use a new gadget or machine around the house
10	Learning new things in general
11	Following a story in a book or on TV
12	Making decisions on everyday matters
13	Handling money for shopping
14	Handling financial matters, for example, the pension, dealing with the bank
15	Handling other everyday arithmetic problems (e.g., knowing how much food to buy, knowing how long between visits from family or friends)
16	Using his/her intelligence to understand what's going on and to reason things through

Statistical Analyses

To examine the factor structure of the scale, we employed confirmatory factor analysis (CFA) to test whether one factor of cognitive decline also fits the data as with other versions of the IQCODE. Model fit was assessed with the recommended indices (Kline, 2015): the chi-square statistic (χ^2), the comparative fit index (CFI), the root-mean-square error of approximation (RMSEA), and the standardized root-mean-square residual (SRMR). Adequate fit was considered with CFI values of at least .90 and RMSEA and SRMR values of at most .08 (Marsh et al., 2004). To treat the categorical nature of the data, we estimated the models using the weighted least squares mean and variance (WLSMV) corrected method.

We also estimated internal consistency, using coefficient omega (McDonald, 1999), as it has been proved to overcome the problems encountered when using coefficient alpha (Deng & Chan, 2017). Criterion-related validity was tested comparing the mean score of the IQCODE between individuals who reported an Alzheimer's diagnosis and those who did not, and receiver operating characteristic (ROC) curves were used to assess the diagnostic validity of the tool and the most optimal cut-off point. Analyses were done in MPlus 8.7 (Muthén & Muthén, 1998/2017) and R (R Core Team, 2023).

RESULTS

Factor Structure

A CFA model was established according to the theoretical one-factor structure of the scale. The model fitted the data adequately: $\chi^2(14) = 218.92$, $p < .001$; CFI = .99; RMSEA = .118 [.104, .132]; SRMR = .028. The RMSEA does not meet the criteria, but this is common in models with relatively few degrees of freedom (Kenny et al., 2015). Item loadings are displayed in Figure 1; all were statistically significant and extremely high.

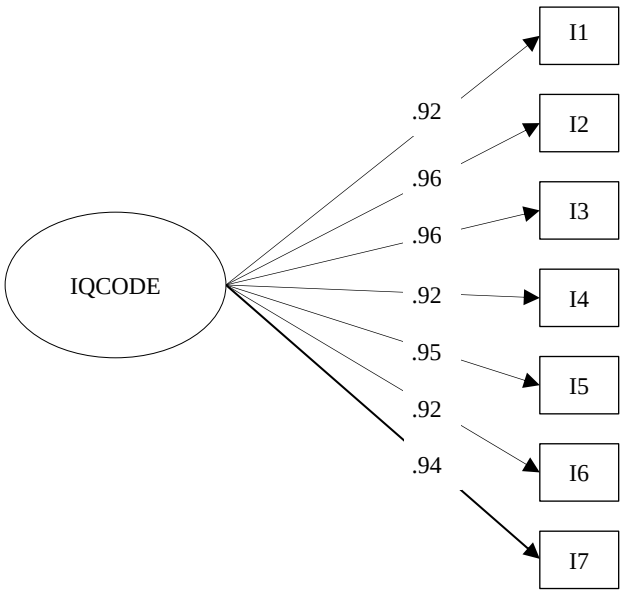

FIGURE 1
Standardized factor loadings for the one-factor model of the IQCODE

Reliability

Omega coefficient for the unidimensional model of informants' perception of cognitive decline was .94, which indicates excellent reliability of the scale in terms of internal consistency.

Criterion-Related Validity

To study criterion-related validity, a *t*-test was computed to examine differences in informants' perception of cognitive loss between those informants of respondents that had been diagnosed with Alzheimer's disease or other dementia and informants of respondents who had not. The results of the *t*-test were: $t(1009.04) = 20.61$, $p < .001$, $d = 1.16$. The mean score of informants of respondents with dementia was 2.89 ($SD = 0.23$), while informants of respondents who had not been diagnosed with dementia presented an average score of 2.46 ($SD = 0.44$). Therefore, results indicated that there was a significantly higher score of the informants' perception of cognitive impairment among those individuals whose respondent had a diagnosis of dementia and the effect size is large.

Diagnostic Validity

To assess diagnostic validity, a ROC curve was computed with the mean IQCODE score, using the respondents' report of dementia diagnosis as the binary classifier. The curve is represented in Figure 2. The area under the curve was 77.33%, which indicates acceptable discrimination (Hosmer et al., 2013). We employed Youden's (1950) index to establish the optimal cut-off point. The IQCODE cut-off score that maximized this index was 2.80 points. This corresponded to a sensitivity of .838 and a specificity of .641.

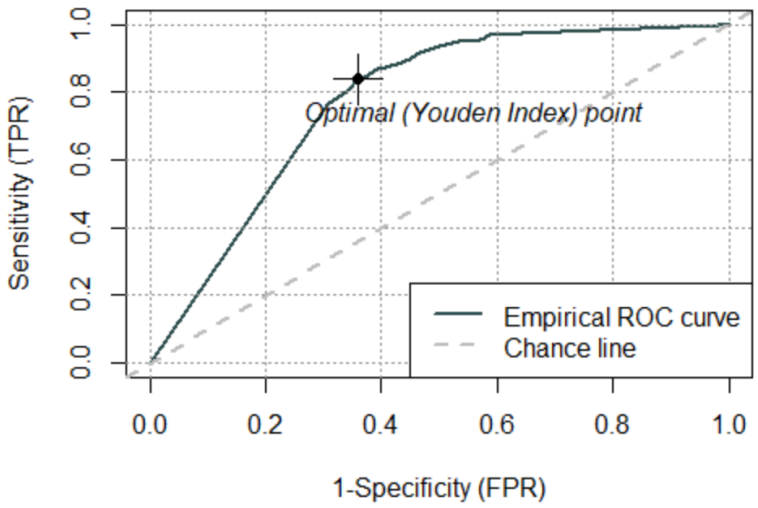

FIGURE 2
ROC curve

DISCUSSION

SHARE's adaptation of the IQCODE was first employed during SHARE Wave 8 data collection in 2020 and will be administered during Wave 9 too. The modified scale contains seven items from the 16 included in the short-IQCODE (Jorm, 1994), shifts the time frame for cognitive change to two years and uses a 3-point response scale. These changes, together with the potential use of the scale in research, lead to the need of analyzing the psychometric properties of this new version of the IQCODE.

Although the original IQCODE (Jorm & Korten, 1988) was originally developed for clinical practice, the inclusion of the 16-item version in large-scale surveys such as HCAP (Langa et al., 2020) illustrates the potential of this instrument as a research tool. In this line, for SHARE-IQCODE, we aimed at establishing factor structure, reliability, and criterion-related validity. We further investigated the diagnostic validity of the scale and the most optimal cut-off score, as this instrument might be used for dementia screening in the population.

Regarding factor structure, we estimated a one-factor CFA of informant's perception of a respondent's cognitive decline. Although the value of the RMSEA was high, this has been previously acknowledged with simple models with a relatively small number of items and few degrees of freedom (Kenny et al., 2015). In this situation, authors (Shi et al., 2020) recommend to assess fit using CFI and SRMR. Results of both fit indices indicated an excellent fit of the model to the data. Moreover, all factor loadings were large and statistically significant. Therefore, a one-factor of informant's perception of cognitive impairment was confirmed as the structure for the SHARE-IQCODE. Compared to the 16-item version, SHARE-IQCODE seems to display a unidimensional structure too (Reichenheim et al., 2015; Truong et al., 2021).

The scale's reliability in terms of internal consistency was excellent, indicating high congruence of the responses to different items. High internal consistency has been repeatedly observed for the 16-item version of the IQCODE as well, with estimates around .90 - .95 (Foroughan et al., 2019; Othman et al., 2015; Truong et al., 2021), as was the case for the SHARE-IQCODE. Criterion-related validity also showed scores to the SHARE-IQCODE to discern among those that were cognitively impaired, as per their report of a dementia diagnosis, and those that were not. Finally, diagnostic validity was examined using a ROC curve, which indicated acceptable discrimination (Hosmer et al., 2013) of cognitively impaired individuals, as per their report of a dementia diagnosis, according to informant's responses to the items of the scale. Regarding previous studies examining the diagnostic validity of the 16-item version of the IQCODE, results were similar, with values of area under the curve around 80% (Jorm, 2004; Sanchez & Lourenço, 2013).

The cut-off score that maximized true positive rates and true negative rates was 2.80 points. This score could be used for a first screening of cognitive impairment using SHARE-IQCODE. However, as indicated by results, discrimination is not excellent and hence we would only advise the scale's use as a first approximation to dementia detection in the frame of a two-stage process, as proposed by some authors (Burton et al., 2021a).

Apart from the limited use of the scale as a screening test, there are some additional considerations that should be made from this study. First, the variable used to classify individuals as cognitively impaired or not in the ROC curve analysis does not come from an official medical record but from individuals' self-reported diagnostic status. Therefore, it is possible that individuals did not answer truthfully because of dementia-related self-stigma (Gajardo et al., 2021; Nguyen & Li, 2020). Moreover, the scale was only administered to informants of respondents that were not able to answer neuropsychological tests, so results could be biased by an over-coverage of impaired individuals.

Nonetheless, this work is novel in providing evidence about the psychometric quality of a newly adapted scale that has been, is being, and will be, administered in a large-scale survey targeted at the older

population of Europe and Israel. Therefore, the main strength of this research relies in settling the adequacy of the SHARE-IQCODE instrument for its use in future research.

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Note

1. The data used for this article can be accessed at the SHARE Research Data Center to the entire research community free of charge (www.share-project.org). Data are available from the authors upon reasonable request and with permission of the SHARE Project.

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