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Title Page

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Précis: There is evidence of known-groups validity of EQ-5D-5L and ICECAP-O in differentiating depression severity among older adults.

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Abstract

Objectives

This study aimed to assess the known-groups validity of the EQ-5D-5L and the ICECAP-O, two outcome measures used in economic evaluation, among older adults with depressive symptoms in socio-economically deprived areas of Brazil. We also explored the role of education and income on responses to these measures.

Methods

This cross-sectional study used baseline data from PROACTIVE, a cluster randomised controlled trial to evaluate a psychosocial intervention for late life depression among older adults. Participants aged 60 years or over with a Patient Health Questionnaire (PHQ-9) score≥10 were recruited from 20 primary healthcare clinics. Ordered logistic regression models assessed the association between depression severity, income and education and dimension level responses on the EQ-5D-5L and ICECAP-O. Multivariable regression models investigated the ability of EQ-5D-5L and ICECAP-O scores to discriminate between depression severity levels and other characteristics, including education level and household income.

Results

715 participants were included in the study. Depression severity was associated with all EQ-5D-5L and ICECAP-O dimensions, except the ICECAP-O enjoyment attribute. Household income, on the other hand, was only associated with the ICECAP-O security attribute. Higher severity of depressive symptoms (PHQ-9 scores) were also strongly associated with lower (i.e. worse) scores on both measures in all models. Education level and household income showed no association with either EQ-5D-5L or ICECAP-O scores.

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Conclusions

This is the first study that investigated the validity of these two measures among older adults in Brazil. Both EQ-5D-5L and ICECAP-O showed evidence of validity in differentiating depressive symptom severity.

<u>Highlights</u>

EQ-5D measures are one of the most commonly used preference-based measures for valuing health related quality of life. The use of ICECAP capability measures in economic evaluation has been increasing and they are recommended by some regulatory agencies. Previous studies showed evidence of validity of these instruments among populations with depression in high-income countries.

We found evidence of known-groups validity of EQ-5D-5L and ICECAP-O instruments in differentiating depressive symptom severity among older adults from deprived areas of Brazil.

The choice of measure may depend on the purpose of the study, including the perceived need to calculate quality-adjusted life years (QALYs).

Introduction

Depression is the leading worldwide cause of disability, affecting people across all age ranges, but with high prevalence among older adults.[1,2] Alongside other factors, the ageing of the population has contributed to increasing depression rates in low- and middle-income countries (LMICs) where health systems are usually not well prepared to meet demand for mental health care.[3] Hence, depression is often left underdiagnosed and untreated,[4] negatively impacting on the quality of life of individuals.

Economic evaluation guides policy makers in allocating resources by providing evidence on the costs and outcomes of healthcare. Generic instruments have been developed to measure and value health-related quality of life, which can then be combined with life expectancy to estimate quality-adjusted life years (QALYs). QALYs provide a common metric for health outcomes that can be applied across different health conditions and populations.[5,6] QALYs are widely used in economic evaluation, however some concerns have been raised about the ability of some of these instruments to measure improvements in mental health conditions.[7] In patients with depression, studies have shown mixed evidence on the validity of different outcome measures,[8-10] including the EQ-5D, one of the most commonly used questionnaires to estimate QALYs.

Capability instruments have been increasingly used to assess outcomes in economic evaluations in addition, or as an alternative, to QALYs. Regulatory bodies in the UK and the Netherlands recommend the use of such instruments in economic evaluations of social care and chronic care.[11] The ICECAP instruments for adults (ICECAP-A),[12] older adults (ICECAP-O)[13] are designed to measure capability wellbeing, that is people's ability to do and be things in life that matter to them; life attributes such as having enjoyment or independence.[14] Previous research demonstrates that both measures have evidence of construct and content validity and responsiveness among general

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populations of adults and older adults in high income countries (HICs).[15,16] Studies have found a positive association between both ICECAP-A and ICECAP-O and EQ-5D scores,[17,18] but as they measure different concepts (capability wellbeing versus health), one recommendation is to consider them as complementary tools.[16] To date, only a few studies have used ICECAP measures in mental health conditions. Nevertheless, a recent study suggests that the ICECAP-A may be more strongly associated with measures of depression than the EQ-5D,[19] and therefore capability measures are potentially more suitable for valuing outcomes in economic evaluations in this group of patients.

Both EQ-5D and ICECAP provide a summary score allowing every health or capability state identified by the questionnaire to be valued and used in economic analysis. These scores are designed to help decision-makers judge cost-effectiveness of healthcare interventions and set priorities when allocating resources. Scores are derived from population surveys, using techniques such as time trade off to generate a utility score anchored on the dead (0) to perfect health (1) for EQ-5D[20] and best-worst scaling to generate a score ranging from no capability (0) to full capability (1) for ICECAP.[13] Population surveys across countries have illustrated that values may differ between countries and regions.[21,22] The original version of the EQ-5D, the EQ-5D-3L, has preference scores for several countries and regions worldwide,[23] including for the Brazilian population.[24] However, a valuation exercise for the newer five response level version of the EQ-5D, the EQ-5D-5L, has not been conducted in a Brazilian population. To date, official tariff values of ICECAP measures have been derived only from the United Kingdom (UK) population.[13,25]

Age, education and socioeconomic status are associated with EQ-5D scores in HICs[26,27] and LMICs,[28,29] including Brazil.[30] ICECAP scores were also positively associated with income and education in HICs.[17,18,31] Analysis across seven health conditions in four HICs suggested greater

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priority given to patients with depression and more severe health states when using the ICECAP-A rather than the EQ-5D.[32] Very little evidence is available from LMICs on the extent to which variations in EQ-5D and ICECAP scores can be explained by mental health status and sociodemographic characteristics such as education and income. This is important for researchers and policy makers in designing and interpreting studies of interventions that aim to improve mental health in individuals with lower socioeconomic status. Thus, the aim of this study is to assess the known-groups validity of the EQ-5D-5L and ICECAP-O for older adults with depressive symptoms living in socio-economically deprived areas of Guarulhos, Brazil and to explore the independent (and potentially differential) role(s) of education and income in explaining variations in health-related quality of life (HRQoL) and capability scores.

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Methods

We used baseline data from a large cluster randomised controlled trial that evaluates the cost-effectiveness of a psychosocial intervention compared to enhanced usual care among elderly people with depression in poor neighbourhoods in Guarulhos, Brazil (PROACTIVE)[33] to address two objectives. First, to assess the known-groups validity of the EQ-5D-5L and in this setting. This type of construct validity evaluates the ability of an instrument to discriminate between two or more groups that are known to differ on the variable of interest.[34] Specifically, we hypothesized that EQ-5D-5L and ICECAP-O scores would be negatively associated with increasing depressive symptoms, measured by the PHQ-9. Second, to examine the relationships of education and income with capability and HRQoL scores.

Dataset and collection

PROACTIVE was conducted in 20 Unidades Básicas de Saúde (UBSs), the primary healthcare clinics, of Guarulhos, the second largest city in São Paulo state. UBSs are the main point of entry to the publicly funded health system, where the registered population receive comprehensive primary care provided by multidisciplinary teams. Each UBS serves over 12,000 people of all ages living in the catchment area. Randomisation was at the level of the UBS and, accounting for clustering effects, the sample size required for the RCT was estimated to be 1,440 individuals with symptoms of depression. Recruitment was planned to be conducted in two waves but, due to the COVID-19 pandemic, the inclusion of participants was interrupted soon after the recruitment of the first wave was completed. This paper is therefore based on the baseline data of 715 participants recruited from 20 UBSs. All individuals aged 60 years or older registered within each UBS were listed in a random order and approached to be screened to participate in PROACTIVE by phone

or face-to-face. Individuals who met the study inclusion criteria and were identified with depression by a score of ≥10 on the 9-item Patient Health Questionnaire (PHQ-9)[35] were invited to participate in the baseline assessment. Baseline assessment was conducted face-to-face at the participants' homes and no more than 28 days after the PHQ-9 screening. A detailed description of the eligibility criteria, recruitment and data collection is provided elsewhere.[33]

Data collected at baseline included sociodemographic characteristics, self-reported hypertension and diabetes and EQ-5D-5L and ICECAP-O instruments. Household income was grouped into four categories based on the Brazilian minimum wage (MW) per month in 2019 (BRL998/USD253 – up to 1 MW, >1 to 2 MW, >2 to 3 MW and >3 MW). Education is presented in years of formal education and grouped according to levels of the Brazilian schooling system (none, 1 to 4 years, 5 to 8 years and more than 8 years). Race was self-reported and the Brazilian Institute of Geography and Statistics race categories were grouped into White or Non-white (Black, Mixed, Asian and Indigenous), as in a previous study conducted among a similar population in Brazil.[36] All data were collected by trained research assistants using tablet computers using Brazilian Portuguese translations of all instruments. Informed consent to participate in the PROACTIVE study was obtained before screening and baseline assessments. The PROACTIVE study was approved by the Ethics Committee of USP Medical School (CEP FMUSP number 2.836.569) and the Guarulhos Health Secretariat.

Patient-reported outcome measures

The PHQ-9 is a widely used brief measure of depressive symptom severity with good evidence of validity,[35,37,38] which has been used in Brazilian populations.[39] It includes questions related to anhedonia, depressed mood, sleep problems, low energy, appetite change, low self-esteem,

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concentration difficulties, psychomotor agitation or retardation and suicidal ideation. PHQ-9 scores range from 0 to 27, with a cut-point of (at least) 10 for clinically significant depression. Severity of depression is categorised according to the PHQ-9 score with cut-points of 10, 15 and 20 for moderate, moderately severe and severe depression respectively.[35]

The EQ-5D-5L measures five dimensions of HRQoL (mobility, self-care, usual activities, pain/discomfort and anxiety/depression) and has five response levels within each dimension.[40] It is, therefore, more sensitive to small changes in depressive symptoms than the original three response level EQ-5D-3L. The Brazilian Portuguese version of the EQ-5D-5L was used. As Brazilian tariffs for this instrument have not been developed and to maintain consistency with the ICECAP-O valuation we used the recommended[41] UK cross-walk value set,[42] to value EQ-5D-5L responses. In the UK value set, negative scores (that is, states worse than death) are possible, with a lower bound of -0.594 for the worst EQ-5D-5L state.

ICECAP-O measures capability wellbeing (i.e. wellbeing associated with people's ability to do and be things in life that matter to them) in older adults based on five domains (attachment, security, role, enjoyment and control), each with four levels of response.[14] Therefore, unlike the EQ-5D-5L, the ICECAP-O has no questions which ask directly about depression, although poor mental health might plausibly have a detrimental impact on all five capabilities measured by the ICECAP-O. The ICECAP-O was translated into Brazilian Portuguese by the research team for the purposes of this study and then back-translated to English by a Brazilian researcher independent of the study to confirm the translation's accuracy. The translated version is available from the authors on request. As Brazilian tariffs for the ICECAP-O have not been developed, UK tariff values were used in the analysis.[13]

Analysis

We used descriptive statistics including histograms to present the distributions of the EQ-5D-5L and ICECAP-O scores. We explored the association between categories of severity of depression, income and education status and dimension level responses to the EQ-5D-5L and ICECAP-O questionnaires using ordered logistic multivariable regression. We used multivariable regression analyses to investigate the ability of the EQ-5D-5L and ICECAP-O scores to identify differences in the severity of depressive symptoms (PHQ-9 scores), examining also the extent to which education and income were independently associated with capability and HRQoL scores. Specifically, we fitted two linear ordinary least squares (OLS) models: (1) including age, gender, comorbidities, marital status, living alone, race and PHQ-9 score as explanatory variables; (2) model 1 plus education and household income as explanatory variables. These regressions were run using EQ-5D-5L scores and, separately, ICECAP-O scores as the outcome variable. For each outcome we also investigated first-order interactions between PHQ-9 score and each of education and household income (presented in supplemental tables). All analyses were performed using Stata/SE 14.2, and for the regression models we emphasise the estimates and standard errors (SEs)/95% confidence intervals (CIs) more than the (2-sided and precise) p-values that are also presented.

Results

The recruitment was conducted between May 2019 and February 2020, when 8,147 individuals from 20 UBSs were pre-checked for potential eligibility. Those who were contactable and who potentially met eligibility criteria were invited to participate in the screening assessment. Of 3,356 older adults who completed the assessment, 1,020 scored 10 or more on the PHQ-9 and were invited to the baseline assessment. Of these, 305 individuals were excluded as they did not meet trial eligibility criteria (e.g. full-time job, vision or hearing problems, suicidal risk), declined to participate in the study or the UBS had reached recruitment capacity. Individuals who were excluded had a similar gender and age group profile as those who were included, with weak evidence of slightly lower PHQ-9 scores (15.58 versus 16.19; p=0.054). Thus, a total of 715 older adults with depressive symptoms were included in the analysis. Participants were mainly female (74%), aged less than 80 years, with four years or less of formal education and a household income of less than twice the MW (Table 1). Most participants had moderate (43%) or moderately severe (31%) depressive symptoms. Only 122 (17%) participants were receiving treatment for depression (either medication or therapy) at baseline.

The distribution of EQ-5D-5L and ICECAP-O scores had a negative skew (Figure 1). The wide dispersion of EQ-5D-5L scores was particularly evident; 6% of participants reported health states valued less than zero (i.e. worse than death). There is also a 'gap' in the distribution of EQ-5D-5L scores between the minority of patients (2%) who report no problems on any dimension (i.e. EQ-5D-5L score = 1) and the remainder who report problems on one or more dimension.

On the EQ-5D-5L (Figure 2), very few (9%) of all respondents stated that they had "no pain or discomfort", whereas a higher proportion (25%) responded that they were "not anxious or depressed". Most (71%) stated that they had no problems with self-care (i.e. washing or dressing).

The lowest levels of capability were reported on the 'enjoyment' attribute of the ICECAP-O (Figure 2). Overall, only 19% of participants reported "a lot" or "full" capability on this dimension. Many participants also reported a lot of concern when thinking about the future (the 'security' dimension). In contrast, the majority (55%) reported "a lot" or "full" capability on the 'attachment' dimension.

The ordered logistic regression models (Table 2) showed that more severe depression (based on PHQ-9 scores) was associated with more reported problems on all EQ-5D-5L dimensions. Participants who reported more severe depression also reported lower capability on all ICECAP-O attributes, except 'enjoyment'. As expected, the EQ-5D-5L 'anxiety/depression' dimension was strongly associated with moderately severe (OR=2.005, 95% CI: 1.398, 2.876) and severe cases (OR=5.054, 95% CI: 3.382, 7.553). There is evidence that higher household income (>3 MW) was associated with greater feelings of security when thinking about the future on the ICECAP-O (OR=1.882, 95% CI: 1.131, 3.129) (Table 2). Neither education level nor household income were strongly associated with any other domain of either outcome measure.

There is evidence of known-groups validity for both EQ-5D-5L and ICECAP-O (Tables 3 and 4 respectively). Increasing severity of depressive symptoms (higher PHQ-9 scores) was associated with lower (worse) EQ-5D-5L and ICECAP-O scores in all model specifications. A one-point deterioration (increase) in PHQ-9 was associated with a 0.019 decrease (95% CI: -0.024, -0.015) in EQ-5D-5L and 0.012 decrease (95% CI: -0.015, -0.009) in ICECAP-O scores. There was evidence that individuals in the oldest age group (80+ years) and those with self-reported hypertension had lower EQ-5D-5L scores in regression models adjusting for each other (Table 3, model 1). Age, gender, marital status, living alone, race and hypertension were not associated with ICECAP-O scores (Table 4, model 1). Only self-reported diabetes was (weakly) associated with a

decrease in ICECAP-O scores. There was no evidence that either education or household income had an independent association with either EQ-5D-5L or ICECAP-O scores (Tables 3 and 4, model 2). Similarly, there was no strong evidence for the two interactions investigated for either outcome (Supplemental Table 1 and 2, models 3a and 3b); indeed, even for the one with the lowest p-value (0.093 for education and PHQ-9 for ICECAP-O) there was no clear pattern amongst the coefficients (Supplemental Table 2, model 3a).

Discussion

Principal findings

In our sample of older adults with depressive symptoms, both EQ-5D-5L and ICECAP-O measures demonstrated evidence of validity for differentiating between participants with moderate to severe depressive symptoms. We observed a high prevalence of health problems beyond mental health, especially related to 'pain/discomfort,' and wellbeing problems including inability among many to enjoy life and be free from concerns about the future. Apart from 'enjoyment and pleasure', all EQ-5D dimensions and ICECAP attributes were associated with depression severity. Self-reported HRQoL and capabilities were not associated with education and household income status.

Strengths and weaknesses

This is the first study to compare these measures in a LMIC population. As ICECAP-O was developed and validated in a HIC and its use is still predominantly in HICs, previous findings might not be transferable to populations living in different socioeconomic conditions.

Our sample is relatively large and evenly distributed across PHQ-9, education and income categories, thus we have good statistical power to explore associations. However, the sample size in the regression models decreased due to the number of missing values for household income; information people do not always feel comfortable sharing. The questionnaires were administered by independent research assistants and all questions were read to participants, allowing the inclusion of the individuals with low literacy level. However, as these questionnaires are usually self-administered, the chosen format may also limit the generalisability to other settings. Another limitation of our sample is the lack of healthy population as a control group.

The cross-sectional nature of this study also imposes some limitations, as we are unable to explore other aspects of validity of the measures (e.g. responsiveness to change). Due to the COVID-19 pandemic, the intervention could not be delivered as planned and the follow-up assessments were conducted mostly by phone. Moreover, some responses may have been influenced due to social isolation and other uncertainties associated with the pandemic. Thus, comparison between a baseline and follow-up measures was not performed. The lack of Brazilian tariffs might also affect the generalisability of our findings. To date, the only two South American countries who have validated EQ-5D-5L tariffs are Peru[43] and Uruguay.[44] Values for the Brazilian population for both EQ-5D-5L and ICECAP-O measures are needed to better represent local values for HRQoL and capabilities.

Comparison with other studies

We found that more severe depressive symptoms were associated with worse EQ-5D-5L and ICECAP-O scores, suggesting that both are potentially able to discriminate across levels of depression in LMIC settings. Previous work in younger adults with depression in a high income setting also observed that the ICECAP-A measure was able to discriminate between depression severity groups.[19] In a longitudinal study in older adults in a high income setting, the ICECAP-O was more strongly associated with changes in mental health than the older, shorter, version of the EQ-5D, the EQ-5D-3L.[45]

We observed similar levels of 'attachment', but much lower levels of 'enjoyment' than reported by Mitchell et al.[19] among younger adults (ICECAP-A) with depression in a HIC. It is uncertain whether this might be due to the more constrained socioeconomic circumstances in this LMIC setting, different age groups, or different cultural interpretations of 'enjoyment and pleasure'. Another study using ICECAP-O measure reported much higher capability levels in all attributes

compared to our findings, although in an, on average, older population mostly without depression.[46] Moreover, evidence from other countries suggests that capability is much lower in the population we studied (mean 0.634, standard deviation (SD) 0.198), when comparing to an older adult population in Hungary (mean 0.83, SD 0.15)[18] and Australia (mean 0.80, SD 0.17).[47]

Similar to other work,[18] we observed no clear independent relationship between education and income categories and ICECAP-O scores. On the other hand, EQ-5D-5L is commonly associated with both socioeconomic characteristics,[29] but this association was not observed in our sample. In other literature, associations were found in other measures, such as ICECAP-A[17,18,31] and EQ-5D-3L in a general sample of adults in Brazil.[30,36] We did not find evidence to support previous work that capability is lower in the lowest income groups.[18] Our analysis of dimension level data suggests an association only with the thinking about the future (security) attribute of ICECAP-O. Finally, ICECAP-O scores, unlike EQ-5D, were not associated with advancing age. Previous work has found an association between capability scores and age.[48] One interpretation of our findings is that depressive symptoms drive the lower capability scores in our sample which was selected from poor neighbourhoods in Guarulhos, overwhelming other factors (e.g. age, education, income) which may be associated with capability in a more diverse general population.

Implications

Although both EQ-5D and ICECAP are associated with PHQ-9 scores and have been advocated for use in economic evaluation, they measure different constructs and there may be circumstances where it is appropriate to use both measures.[49,50] Arguably, the EQ-5D might be more appropriate in studies that aim to improve depressive symptoms by improving physical function, whereas the ICECAP-O might be more suitable for evaluating interventions, like the one evaluated in the PROACTIVE study, which specifically aims to tackle mental health problems by encouraging

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activities that are enjoyed and meaningful to participants. Ultimately, any choice between the two measures may depend on the perceived need to calculate a QALY to aid policy makers and the attributes that researchers and patients themselves feel are most important and likely to be effected by the intervention.

Conclusions

We found that EQ-5D-5L and ICECAP-O instruments showed known-groups validity in differentiating depression severity among older adults living in a deprived area of Brazil. No strong evidence of the association between education level and income for both measures was found. There is a need for local value sets to better represent the Brazilian population values and confirm these findings.

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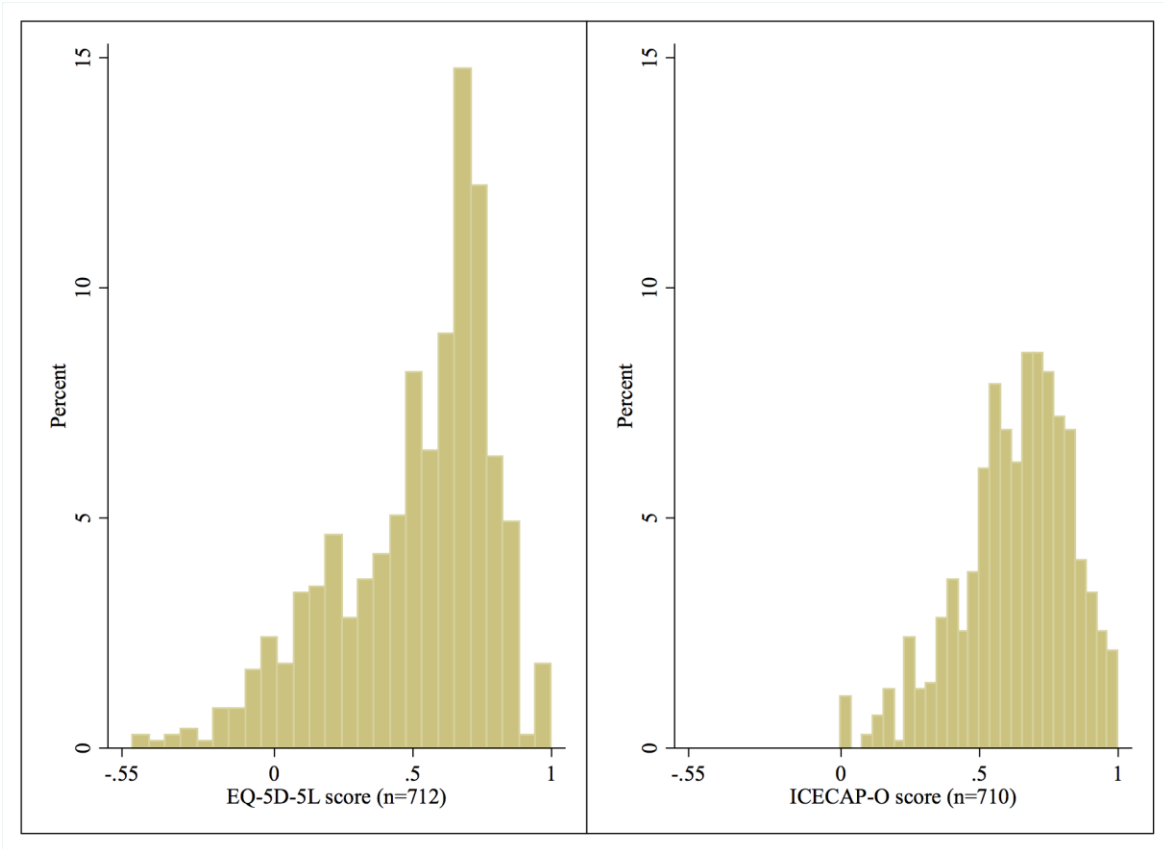
Figure 1: Distributions of ICECAP-O and EQ-5D-5L scores.
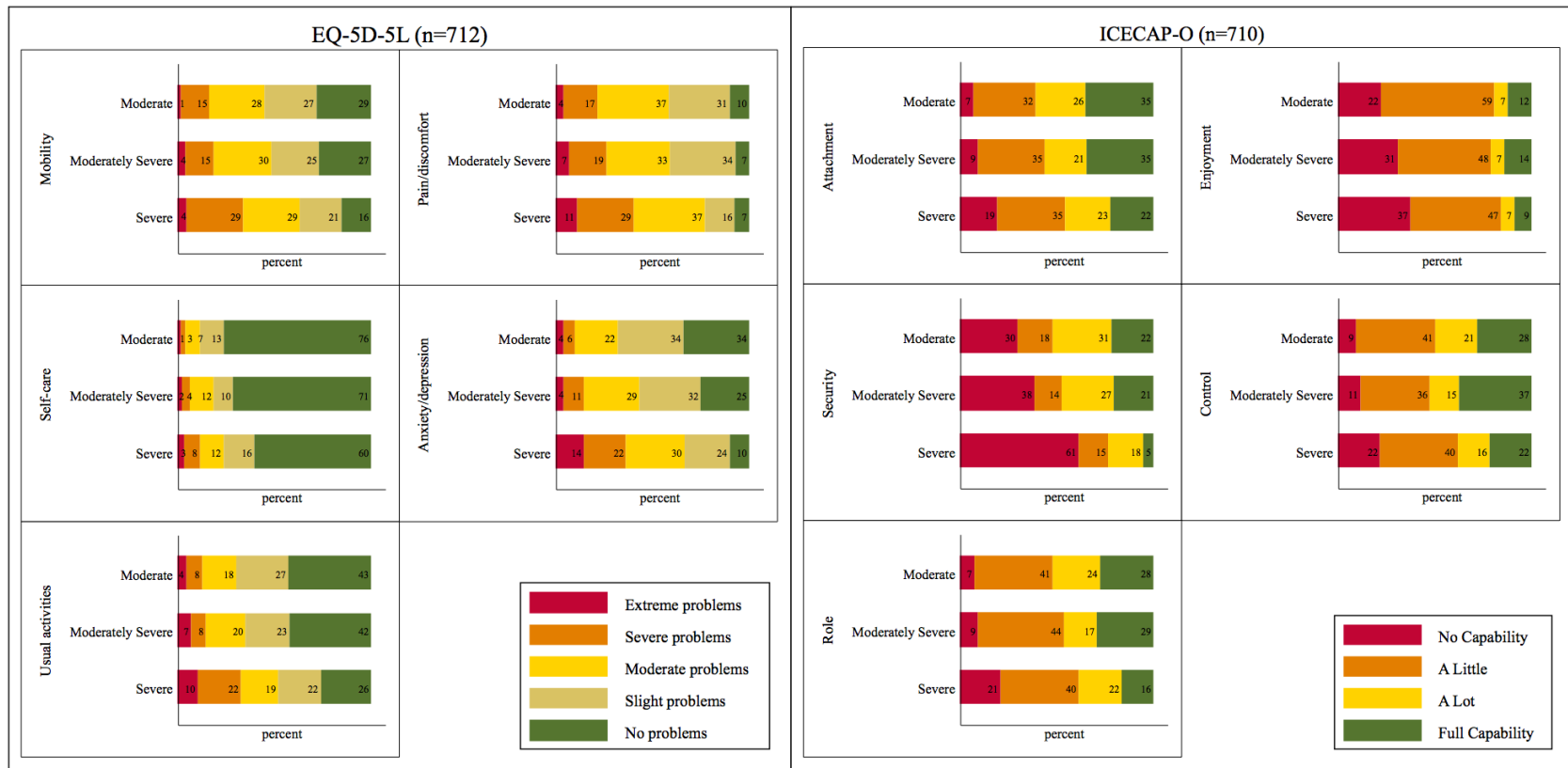
Figure 2: Response distributions on ICECAP-O attributes and EQ-5D-5L dimensions across depressive symptom (PHQ-9) categories.

Table 1: Characteristics of the (first wave) PROACTIVE participants (n=715)

Variable	Descriptive statistic n (%)
Gender	
Male	185 (25.9)
Female	530 (74.1)
Age group (years)	
60-69	440 (61.5)
70-79	214 (29.9)
80+	61 (8.5)
Education	
None	137 (19.2)
1-4 years	353 (49.5)
5-8 years	141 (19.8)
>8 years	82 (11.5)
Missing	[2 (0.3)]
Household income	
Up to 1 MW*	258 (43.1)
>1-2 MW*	180 (30.1)
>2-3 MW*	85 (14.2)
>3 MW*	75 (12.5)
Missing	[117 (16.4)]
Marital status	
Divorced, widowed, single	335 (48.3)
In a partnership	358 (51.7)
Missing	[22 (3.1)]
Living alone	
No	595 (85.5)
Yes	101 (14.5)
Missing	[19 (2.7)]
Race	
White	265 (37.6)
Non-white[a]	439 (62.4))
Missing	[11 (1.5)]
Has hypertension	
No	173 (24.2)
Yes	542 (75.8)
Has diabetes	

No	421 (58.9)
Yes	294 (41.1)
Receives depression treatment	
No	588 (82.8)
Yes	122 (17.2)
Missing	[5 (0.7)]
Depression severity (PHQ-9)	
Moderate (10-14)	306 (42.8)
Moderately severe (15-19)	220 (30.8)
Severe (20+)	189 (26.4)
PHQ-9 score, mean (SD*)	16.19 (4.6)
ICECAP-O score	
Mean (SD)	0.634 (0.198)
Missing	[5 (0.7)]
EQ-5D-5L score	
Mean (SD)	0.506 (0.281)
Missing	[3 (0.4)]

* MW: minimum wage; SD: standard deviation. [a]Non-white: Black (n=105); Mixed (n=303); Asian (n=12) and Indigenous (n=19).

Table 2: Ordered logistic regressions of EQ-5D-5L dimension and ICECAP-O attribute on depression severity (PHQ-9), education and household income categories adjusted for gender, age, marital status, living alone, race and comorbidities.

EQ-5D-5L dimension OR (95% CI) (n=561)					
	Mobility	Self-care	Usual activities	Pain/Discomfort	Anxiety/Depression
Depression severity (ref. moderate)					
Moderately severe	0.956 (0.670, 1.366)	1.191 (0.765, 1.852)	1.144 (0.797, 1.642)	1.342 (0.935, 1.927)	2.005 (1.398, 2.876)
Severe	1.578 (1.079, 2.310)	2.123 (1.356, 3.324)	2.053 (1.400, 3.010)	2.370 (1.609, 3.489)	5.054 (3.382, 7.553)
p-value[a]	0.019	0.001	<0.001	<0.001	<0.001
Education level (ref. None)					
1-4 years	0.951 (0.624, 1.450)	1.258 (0.764, 2.073)	0.961 (0.630, 1.468)	0.791 (0.521, 1.201)	0.984 (0.641, 1.509)
5-8 years	0.933 (0.559, 1.558)	0.871 (0.458, 1.658)	0.704 (0.421, 1.178)	0.821 (0.492, 1.369)	0.955 (0.573, 1.589)
>8 years	0.848 (0.467, 1.539)	1.379 (0.673, 2.824)	0.989 (0.545, 1.794)	1.111 (0.620, 1.991)	1.110 (0.611, 2.014)
p-value[a]	0.586	0.603	0.716	0.706	0.765
Household income (ref. up to 1 MW*)					
>1-2 MW*	0.901 (0.621, 1.308)	1.218 (0.785, 1.890)	1.293 (0.889, 1.880)	0.804 (0.555, 1.166)	1.206 (0.832, 1.747)
>2-3 MW*	1.362 (0.859, 2.158)	0.665 (0.363, 1.221)	0.791 (0.488, 1.282)	0.782 (0.487, 1.255)	0.706 (0.438, 1.140)
>3 MW*	0.948 (0.570, 1.576)	0.968 (0.527, 1.779)	1.208 (0.738, 1.976)	1.234 (0.737, 2.068)	1.128 (0.684, 1.858)
p-value[a]	0.759	0.478	0.925	0.469	0.829
ICECAP-O attribute OR* (95% CI*) (n=559)					
	Attachment	Security	Role	Enjoyment	Control
Depression severity (ref. moderate)					
Moderately severe	0.822 (0.572, 1.183)	0.735 (0.512, 1.054)	1.012 (0.702, 1.459)	0.958 (0.655, 1.401)	1.162 (0.808, 1.672)
Severe	0.504 (0.342, 0.741)	0.286 (0.190, 0.429)	0.538 (0.365, 0.794)	0.702 (0.469, 1.051)	0.571 (0.387, 0.842)
p-value[a]	0.001	<0.001	0.002	0.085	0.005
Education level (ref. None)					

1-4 years	1.019 (0.663, 1.566)	0.683 (0.438, 1.063)	1.112 (0.720, 1.717)	1.258 (0.801, 1.976)	0.886 (0.581, 1.352)
5-8 years	1.342 (0.797, 2.259)	0.968 (0.573, 1.636)	0.920 (0.547, 1.548)	1.109 (0.641, 1.919)	1.066 (0.635, 1.791)
>8 years	0.922 (0.510, 1.670)	1.045 (0.573, 1.903)	1.262 (0.694, 2.294)	1.088 (0.578, 2.048)	1.000 (0.545, 1.837)
p-value[a]	0.973	0.615	0.592	0.901	0.848
Household income (ref. up to 1MW*)					
>1-2 MW	0.996 (0.682, 1.453)	1.083 (0.735, 1.598)	0.775 (0.527, 1.140)	1.454 (0.976, 2.166)	0.983 (0.673, 1.437)
>2-3 MW	0.827 (0.519, 1.317)	1.356 (0.844, 2.178)	0.698 (0.433, 1.124)	1.227 (0.755, 1.992)	1.387 (0.859, 2.240)
>3 MW	1.302 (0.777, 2.183)	1.882 (1.131, 3.129)	0.878 (0.529, 1.458)	1.350 (0.793, 2.297)	0.918 (0.552, 1.528)
p-value[a]	0.466	0.010	0.546	0.393	0.916

* CI: confidence interval; MW: minimum wage; OR: odds ratio. [a] Orthogonal polynomial contrasts, linear.

Table 3: OLS regression of EQ-5D-5L scores on gender, age, marital status, living alone, race, comorbidities and PHQ-9 scores (model 1); and adding the main effects of education and income (model 2).

Explanatory variable	Model 1 (n=668)		Model 2 (n=561)	
	coefficient (SE*)	*p-value*[a]	coefficient (SE*)	*p-value*[a]
Female gender	-0.041 (0.024)	0.093	-0.023 (0.026)	0.377
Age group (ref. 60-69 years)		0.002		0.025
70-79	0.011 (0.023)		0.005 (0.027)	
80+	-0.116 (0.038)		-0.098 (0.043)	
Marital status (ref. Divorced, widowed, single)		0.527		0.285
In a partnership	0.015 (0.023)		0.028 (0.026)	
Living alone	0.006 (0.032)	0.851	0.024 (0.034)	0.474
Race (ref. Non-white)		0.814		0.958
White	0.005 (0.021)		0.001 (0.023)	
Having hypertension	-0.056 (0.024)	0.021	-0.045 (0.027)	0.101
Having diabetes	-0.006 (0.021)	0.786	-0.013 (0.023)	0.587
PHQ-9 score	-0.019 (0.002)	<0.001	-0.020 (0.002)	<0.001
Education level (ref. None)				0.497
1-4 years			0.010 (0.031)	
5-8 years			0.044 (0.038)	
>8 years			0.020 (0.044)	
Income (ref. <1 MW*)				0.963
>1-2 MW*			0.020 (0.028)	
>2-3 MW*			0.033 (0.035)	
>3 MW*			-0.006 (0.037)	

   * MW: minimum wage; SE: standard error. [a] Orthogonal polynomial contrasts, linear.

Table 4: OLS regression of ICECAP-O scores on gender, age, marital status, living alone, race, comorbidities and PHQ-9 scores (model 1); and adding the main effects of education and income (model 2).

Explanatory variable	Model 1 (n=666)		Model 2 (n=559)	
	coefficient (SE*)	*p-value*[a]	coefficient (SE*)	*p-value*[a]
Female gender	-0.010 (0.017)	0.562	-0.006 (0.019)	0.738
Age group (ref. 60-69 years)		0.254		0.507
70-79	-0.006 (0.017)		-0.010 (0.019)	
80+	-0.031 (0.027)		-0.021 (0.031)	
Marital status (ref. Divorced, widowed, single)		0.476		0.340
In a partnership	-0.012 (0.017)		-0.018 (0.019)	
Living alone	-0.027 (0.023)	0.236	-0.017 (0.024)	0.496
Race (ref. Non-white)		0.736		0.945
White	-0.005 (0.015)		0.001 (0.017)	
Having hypertension	0.003 (0.017)	0.859	0.012 (0.020)	0.543
Having diabetes	-0.030 (0.015)	0.045	-0.034 (0.017)	0.043
PHQ-9 score	-0.012 (0.002)	<0.001	-0.012 (0.002)	<0.001
Education level (ref. None)				0.283
1-4 years			0.008 (0.022)	
5-8 years			0.029 (0.027)	
>8 years			0.029 (0.032)	
Income (ref. <1 MW*)				0.150
>1-2 MW*			0.007 (0.020)	
>2-3 MW*			0.025 (0.025)	
>3 MW*			0.035 (0.027)	

* MW: minimum wage; SE: standard error. [a] Orthogonal polynomial contrasts, linear.

Supplemental Table 1: OLS regression of EQ-5D-5L scores on gender, age, marital status, living alone, race, comorbidities, PHQ-9 scores, the main effects of education and income and the interaction between the PHQ-9 score and education (model 3a) and interaction between the PHQ-9 score and income (model 3b).

Explanatory variable	Model 3a (n=561)		Model 3b (n=561)	
	coefficient (SE*)	*p-value*[a]	coefficient (SE*)	*p-value*[a]
Female gender	-0.024 (0.026)	0.364	-0.021 (0.026)	0.426
Age group (ref. 60-69 years)		0.032		0.026
70-79	0.005 (0.027)		0.010 (0.027)	
80+	-0.094 (0.044)		-0.097 (0.043)	
Marital status (ref. Divorced, widowed, single)		0.301		0.230
In a partnership	0.027 (0.026)		0.032 (0.026)	
Living alone	0.023 (0.034)	0.493	0.027 (0.034)	0.426
Race (ref. Non-white)		0.965		0.966
White	0.001 (0.023)		0.001 (0.023)	
Having hypertension	-0.047 (0.028)	0.088	-0.043 (0.027)	0.115
Having diabetes	-0.011 (0.024)	0.644	-0.012 (0.023)	0.615
PHQ-9 score	-0.026 (0.005)	<0.001	-0.019 (0.004)	<0.001
Education level (ref. None)		0.618		0.472
1-4 years	-0.123 (0.108)		0.005 (0.031)	
5-8 years	-0.035 (0.132)		0.042 (0.038)	
>8 years	-0.108 (0.151)		0.021 (0.044)	
Income (ref. <1 MW*)		0.956		0.133
>1-2 MW*	0.022 (0.028)		0.131 (0.098)	
>2-3 MW*	0.036 (0.035)		0.084 (0.132)	
>3 MW*	-0.007 (0.037)		-0.192 (0.130)	
Education level (ref. None) × PHQ-9 score		0.471		
1-4 years	0.008 (0.006)			
5-8 years	0.005 (0.008)			
>8 years	0.008 (0.009)			
Income (ref. <1 MW*) × PHQ-9 score				0.113
>1-2 MW*			-0.007 (0.006)	
>2-3 MW*			-0.003 (0.008)	
>3 MW*			0.012 (0.008)	

* MW: minimum wage; SE: standard error. [a] Orthogonal polynomial contrasts, linear.

Supplemental Table 2: OLS regression of ICECAP-O scores on gender, age, marital status, living alone, race, comorbidities, PHQ-9 scores, the main effects of education and income and the interaction between the PHQ-9 score and education (model 3a) and interaction between the PHQ-9 score and income (model 3b).

Explanatory variable	Model 3a (n=559)		Model 3b (n=559)	
	coefficient (SE*)	*p-value[a]*	coefficient (SE*)	*p-value[a]*
Female gender	-0.008 (0.019)	0.674	-0.008 (0.019)	0.680
Age group (ref. 60-69 years)		0.569		0.518
70-79	-0.010 (0.019)		-0.010 (0.019)	
80+	-0.018 (0.031)		-0.020 (0.031)	
Marital status (ref. Divorced, widowed, single)		0.326		0.331
In a partnership	-0.018 (0.019)		-0.018 (0.019)	
Living alone	-0.017 (0.024)	0.482	-0.016 (0.024)	0.505
Race (ref. Non-white)		0.986		0.936
White	0.000 (0.016)		0.001 (0.017)	
Having hypertension	0.011 (0.020)	0.589	0.013 (0.020)	0.518
Having diabetes	-0.031 (0.017)	0.062	-0.034 (0.017)	0.044
PHQ-9 score	-0.017 (0.004)	<0.001	-0.015 (0.003)	<0.001
Education level (ref. None)		0.484		0.253
1-4 years	-0.131 (0.077)		0.010 (0.022)	
5-8 years	0.036 (0.094)		0.032 (0.027)	
>8 years	-0.134 (0.109)		0.031 (0.032)	
Income (ref. <1 MW*)		0.162		0.945
>1-2 MW*	0.007 (0.020)		-0.067 (0.070)	
>2-3 MW*	0.026 (0.025)		-0.039 (0.095)	
>3 MW*	0.034 (0.027)		-0.016 (0.094)	
Education level (ref. None) × PHQ-9 score		0.286		
1-4 years	0.009 (0.005)			
5-8 years	0.000 (0.005)			
>8 years	0.010 (0.006)			
Income (ref. <1 MW*) × PHQ-9 score				0.626
>1-2 MW*			0.004 (0.004)	
>2-3 MW*			0.004 (0.006)	
>3 MW*			0.003 (0.006)	

* MW: minimum wage; SE: standard error. [a] Orthogonal polynomial contrasts, linear.