Use of the Taiwanese Depression Questionnaire and the AD8 Questionnaire for Screening Depression in Older People in Communities

Yi-Chia Wei
Chang Gung Memorial Hospital https://orcid.org/0000-0001-6085-3134
Li-Yuan Huang
Chang Gung Memorial Hospital
Chemin Lin
Chang Gung Memorial Hospital
Yu-Chiau Shyu
Chang Gung Memorial Hospital
Chih-Ken Chen (kenchen@cgmh.org.tw)
Chang Gung Memorial Hospital

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Abstract

Background Depression presents with emotional and somatic symptoms, and sometimes cognitive complaints. On the other hand, depression is one of the important psychiatric symptoms of mild cognitive impairment and dementia.

Methods Residents who were older than 50 years reported their depressive tendency using the Taiwanese Depression Questionnaire (TDQ) and cognitive complaints using the AD8 questionnaire and were assessed using the Mini-International Neuropsychiatric Interview (MINI) and for objective cognitive evaluation using the Mini-Mental State Examination (MMSE).

Results TDQ score (OR 1.154, p = 0.003) and AD8 score (OR 1.769, p = 0.018) were statistically significant in predicting current major depressive disorder (MDD) when adjustment were made for age, sex, sleep quality and cognitive performance. However, in elderly people with age ≥ 65, TDQ score failed to distinguish a diagnosis of current MDD from no such diagnosis (AUC 0.780, p = 0.063). A linear combination of TDQ and AD8 scores provided a new predictive score that successfully separated elderly people with MDD from those without it (AUC 0.875, p = 0.013). Finally, decision-tree learning was used to generate a classification tree for classifying people with and without current MDD. At the first decision level, value less than 29 from the sum of TDQ score and 4 folds of AD8 score 100% excluded people without current MDD.

Conclusions The self-reported response to the TDQ is a feasible way to identify MDD in community-dwelling people. Combining TDQ and AD8 scores further improved detecting depression in older people in communities.

Background

Major depressive disorder (MDD) is an important disease with wide distribution in different age-group and worldwide, with substantial severity and threatening on individuals' socioeconomic role. The prevalence of MDD is 16.2% in life-time and 6.6% annually [1]. Effectively detecting depression has become a crucial goal in public mental health. However, different cultures have various patterns of emotional expression [2]. The Taiwanese Depression Questionnaire (TDQ) is a culturally relevant questionnaire that is used in epidemiological surveys in Taiwan [3]. The TDQ has been used to screen depression in patients with chronic pain [4], in patients with head and neck cancers [5], and in hospital physicians [6] in Taiwan.

Depression in elderly has been more and more prevalent and became an important health issue [7]. The presentations of geriatric depression could be multidomain-involvements, including apathy, poor appetite, mixed with chronic illness and body pain, sleep disturbance, or mimic of cognitive impairment with impaired episodic memory or slow psychomotor speed [8, 9]. Therefore, detection and assessment of geriatric depression could be confusing by the miscellas clinical variability. Data suggest significant differences in the form and quality of clinical presentation of depression in younger and older people, and therefore the atypical presentations of depression in elderly are usually unable to be fully assessed by conventional measures [10, 11]. One of the unique characteristics of late-life depression is the overlap between dementia and depression. Psychomotor retardation and passive refusal to respond appropriately to cognitive tests are typical symptoms of "pseudodementia," which is depression mistaken for dementia [12, 13]. None of the currently used self-report depression rating scales is capable to differentiate dementia from depression in older adults [11]. The suggested neuropsychiatric tests and clinical assessments to detect cognitive impairment in depressed older adults required well-trained evaluator, rather than self-report approach [14]. Moreover, depressed older adults report somatic symptoms, like pain of head and body, constipation or sleep disturbance, more frequently than typical symptoms of sad feeling and dysphoria [11, 15]. In this work, the validity of TDQ screening for depression in older Taiwanese people who live in north Taiwan is tested, and the effectiveness of incorporating self-reported cognitive decline in predicting depression is assessed.

Methods

The Community Medicine Research Center of Keelung Chang Gung Memorial Hospital runs cohort studies and provides holistic care for residents in northern costal Taiwan. From December 2017 to December 2018, residents were screened using the Taiwanese Depression Questionnaire (TDQ); those who had depressive traits were recruited for a psychiatric diagnostic interview, and non-depressive people were randomly recruited as a control. The TDQ yielded self-rated scores from 0 to 40. The original cut-off TDQ score was 19, such that ≥ 19 points indicated depression and < 19 points indicated non-depression [3]. AD8 is a screening tool for cognitive impairment, which is composed of eight questions, with one point for each question [16]. An AD8 score ≥ 2 suggests cognitive impairment. In this work, residents subjectively reported their impairment with respect to daily cognitive functions. Community residents who were elder than 50 years old and who had completed the TDQ and the Chinese version of the AD8 questionnaire [16] were randomly recruited for a Mini-International Neuropsychiatric Interview (MINI) within three months of answering the TDQ and AD8. MINI is a well validated structured interview for diagnosing psychiatric disorders [17, 18]. The Mini-Mental State Examination (MMSE) was used to evaluate objectively the cognitive performance of the recruited residents. The enrolled residents also underwent a sleeping quality assessment using the Pittsburgh Sleep Quality Index (PSQI) [19] and a quality of life evaluation using the Short Form (36-item) Health Survey (SF-36) [20].

Based on their MINI diagnoses, residents were divided into current MDD and no current MDD groups. The groups were compared with respect to basic demographic data of age, gender, school education year, marital status and annual income. The groups were also compared for TDQ score, AD8 score, MMSE score and suicide risk. The chi square test and Student t-test were used to evaluate differences in nominal and continuous data, respectively.

Correlations between TDQ and AD8, MMSE, PSQI and SF-36 scores were analyzed using Spearman's rho statistics. A logistic regression model was used to evaluate the odds ratio of being diagnosed with MDD using MINI. Various combinations of variables were used in the regression model, including TDQ score only, AD8 score only, a combination of TDQ score, AD8 score, whether elderly (age more than 65), and sex, and a combination of TDQ score, AD8 score, age, sex, PSQI score and MMSE score. The receiver operating characteristic (ROC) curve was used to depict the prediction of the screening tool TDQ to MDD diagnosed using MINI. The predictive value of a linear combination of TDQ and AD8 scores was also tested using the area under the ROC curve (AUC). In the

prediction model, cut-off score was determined by the highest Youden's J statistics [(sensitivity + specificity) − 1] in the model. Since subjective cognitive complaints usually increase with age, the dataset was separated into a subset for age ≥ 65 and a subset for ages 50–65 and ROC curves were obtained for these two groups. Finally, decision tree learning was used to generate a classification tree from the observed demographic data, TDQ score, and AD8 score to concluding MINI-MDD as the target value. Statistical analysis was performed using IBM SPSS Statistics 20 software.

Results

Of 127 community-dwelling residents from the northern coastal area of Taiwan, nine were excluded as subjects for incompletely answering the TDQ, AD8 or MINI. A total of 118 residents were thus enrolled. Based on MINI diagnoses, of those with current MDD 33.3% were widowed and 22.2% were divorced, whereas only 10.7% and 6.8% of those without current MDD ($p < 0.05$) were widowed and divorced, respectively. Both TDQ scores (25.56 ± 10.90 versus 11.05 ± 9.79, $p < 0.001$) and AD8 scores (4.00 ± 2.45 versus 1.94 ± 2.09, $p < 0.01$) were higher in the group with current MDD. A higher percentage risk of suicide was identified in people with current MDD (55.6% versus 0%). The group comparison revealed no difference in age, sex, years of education, income level or cognition status in terms of MMSE score. (Table 1)

Table 1
Basic information and questionnaire scoring of people with and without current MDD by MINI diagnosis

Variables	Current MDD	No current MDD	*p*
Number	9	109	
Age	63.22 ± 2.68	64.94 ± 5.12	.322
Sex (female)	8 (88.9%)	65 (59.6%)	.150
Years of school education	7.78 ± 3.63	10.19 ± 4.30	.108
Marital status			.025*
Married	4 (44.4%)	85 (82.5%)	
Divorced	2 (22.2%)	7 (6.8%)	
Widowed	3 (33.3%)	11 (10.7%)	
Annual income level (10^3 USD)			.729
< 10	3 (33.3%)	29 (29.3%)	
10–30	3 (33.3%)	39 (39.4%)	
30–60	1 (11.1%)	22 (22.2%)	
> 60	1 (11.1%)	4 (4.0%)	
Concealed	1 (11.1%)	5 (5.1%)	
TDQ score			
TDQ ≥ 19	8 (88.9%)	24 (22.0%)	< .001*
Total	25.56 ± 10.90	11.05 ± 9.79	< .001*
MINI-suicide:			< .001*
High risk	5 (55.6%)	0 (0.0%)	
Low risk	3 (33.3%)	7 (6.4%)	
No risk	1 (11.1%)	102 (93.65)	
AD8 score	4.00 ± 2.45	1.94 ± 2.09	.006*
MMSE score	27.56 ± 1.59	28.12 ± 2.05	.427

* Statistic significant at 0.05 level. MINI, Mini-International Neuropsychiatric Interview. MDD, Major depressive disorder. TDQ, Taiwanese Depression Questionnaire. MMSE, Mini-mental state examination.

Spearman's rho statistics were used to evaluate correlations among TDQ, age, years of education, income level, AD8 score, MMSE score, PSQI score and SF-36 score. Statistics revealed a weak correlation between TDQ and AD8 scores with a correlation coefficient of 0.386 at a significance of $p < 0.01$ (Table 2). Depressive tendency slightly increased with subjective cognitive complaints. The depressive score on the TDQ was also moderately correlated with sleep quality in terms of PSQI (correlation coefficient 0.561, $p < 0.001$), quality of life with respect to general health (correlation coefficient − 0.564, $p < 0.001$), vitality (correlation coefficient − 0.688, $p < 0.001$) and mental health, per the SF-36 questionnaire (correlation coefficient − 0.603, $p < 0.001$). These results suggest that sleeping quality and quality of life worsen as depressive traits increase.

Table 2
Correlation analysis by Spearman's rho statistics

		TDQ	Age	Education year	Annual income	AD8	MMSE	PQSI	SF-36						
									PF	RP	BP	GH	VT	SF	RE
TDQ		1.000													
Age		− .064	1.000												
Education year		− .026	− .273**	1.000											
Annual income		− .239*	.016	.345**	1.000										
AD8		.386**	− .124	− .080	− .066	1.000									
MMSE		− .076	− .324**	.443**	.109	− .107	1.000								
PSQI		.561**	.030	.118	− .134	.391**	− .032	1.000							
SF-36	PF	− .389**	.014	.209	.137	− .321**	.172	− .325**	1.000						
	RP	− .402**	.046	.100	.147	− .385**	.047	− .313**	.623**	1.000					
	BP	− .311**	− .082	.103	.038	− .276**	.117	− .297**	.550**	.575**	1.000				
	GH	− .546**	− .018	.179	.279**	− .335**	.216*	− .474**	.465**	.468**	.551**	1.000			
	VT	− .688**	− .013	.093	.124	− .374**	.117	− .482**	.490**	.424**	.365**	.585**	1.000		
	SF	− .413**	.155	− .145	− .020	− .194**	− .054	− .387**	.461**	.391**	.390**	.389**	.450**	1.000	
	RE	− .465**	.124	.042	− .014	− .369**	.070	− .384**	.394**	.539**	.271**	.334**	.425**	.292**	1.000
	MH	− .603**	.133	− .015	.122	− .391**	.020	− .424**	.378**	.397**	.199**	.496**	.703**	.413**	.460**

Correlations between variables were analyzed by Spearman's rank correlation coefficient (Spearman's rho, ρ). * Correlation was significant at 0.05 level (2-taile Correlation was significant at 0.01 level (2-tailed). TDQ, Taiwanese Depression Questionnaire. MMSE, Mini-mental state examination. PQSI, Pittsburgh Sleep Quality Index. SF-36, Short Form (36-item) Health Survey. PF, physical functioning. RP, physical role functioning. BP, body pain. GH, general health. VT, vitality. social role functioning. RE, emotional role functioning. MH, mental health.

In the logistic regression model for the MINI diagnosis of current MDD, AD8 and TDQ scores were both included as variables. TDQ score alone and AD8 score alone had 1.127 ($p = 0.001$) and 1.463 ($p = 0.012$) folds of odds of indicating current depression in MINI respectively (Table 3, models 1 and 2). Accounting for whether someone is elderly (age ≥ 65) and their sex, TDQ score significantly influenced the diagnosis of depression (Table 3, model 3). When sleep quality in terms of PSQI and objective cognitive assessment in terms of MMSE are considered along with old age and sex, both TDQ and AD8 scores significantly affected the likelihood of a depressive disorder (odds ratios OR 1.154, $p = 0.003$ and OR 1.769, $p = 0.018$, Table 3, model 4).

Table 3
Logistic regression model to determine MINI diagnosis of current MDD

	Model 1				Model 2				Model 3				Model 4			
	B	SE	p	OR	B	SE	p	OR	B	SE	p	OR	B	SE	p	C
TDQ	.119	.036	.001*	1.127					.109	.038	.004*	1.115	.143	.048	.003*	1
AD8					.381	.151	.012*	1.463	.399	.205	.051	1.490	.570	.241	.018*	1
Sex									2.001	1.230	.104	7.397	2.436	1.456	.094	1
Age ≥ 65									.207	.854	.809	1.229	.066	1.123	.953	1
MMSE													− .086	.234	.714	.9
PSQI													− .068	.125	.584	.9

* Statistic significant at 0.05 level. MINI, Mini-International Neuropsychiatric Interview. MDD, Major depressive disorder. TDQ, Taiwanese Depression Question MMSE, Mini-mental state examination. SE, standard error. OR, odds ratio.

The ROC curve was used to evaluate the performance of self-reported questionnaires in predicting a diagnosis of major depression. The AUC was 0.835 for the TDQ score ($p = 0.001$) and 0.751 for the AD8 score ($p = 0.013$). An AUC over 0.5 was regarded as indicating that target values could be effectively classified. When using the linear combination of TDQ and AD8, the sum of TDQ score and four times the AD8 score predicted a MINI diagnosis of major depression with an AUC of 0.887 ($p < 0.001$) (Fig. 3-A). Calculating Youden's J statistics as [(sensitivity + specificity) − 1] yielded the best cutoffs of TDQ for

predicting MDD, which were identical to that originally proposed for clinical use: a TDQ score of 19 with a sensitivity 0.889, a specificity of 0.780, a positive predictive value of 88.9% and a negative predictive value of 77.3%. A linearly combined TDQ and AD8 score of ≥ 31 was feasibly predicted MDD diagnosis by MINI for community-dwelling people, with a sensitivity of 1.000, a specificity of 0.789, a positive predictive value of 100% and a negative predictive value of 77.1%.

Owing to the possibility of atypical presentations, such as subjective cognitive complaints in elderly people with major depression, enrollees were separated into groups of age ≥ 65 and age 50–65, to examine whether age influenced likelihood of major depression. In the elderly group (Fig, 3-B), prediction by TDQ score or AD8 score alone was unsatisfactory, yielding AUCs of only 0.780 ($p = 0.063$) and 0.627 ($p = 0.398$) respectively, and failing to reach statistical significance. The sum of the TDQ score and four times the AD8 score, however, offered much improved predictive performance, with an AUC of 0.875 ($p = 0.013$). In the group with age 50–65 (Fig. 1-C), the TDQ score, AD8 score and their linear combination were less predictive, but the linear combination remained the strongest predictor; the AUC values were 0.892 ($p = 0.004$), 0.804 ($p = 0.026$), and 0.918 ($p = 0.002$) respectively.

To classify people with and without major depression, a basic machine learning algorithm with decision tree learning was used to analyze the effects of such variables as age, sex, education year, level of annual income, marital status, TDQ score, AD8 score, and the sum of TDQ and four times the AD8 score. The model thus obtained had two levels and four nodes. The linear combination of TDQ score + 4*AD8 score was at level 1, and a value of less than 29 at node 1 indicated no current MDD while a value of over 29 at node 2 indicated current MDD. The second level came from node 2 by sex; the female gender at node 3 favored current MDD whereas the male gender favored no current MDD (Fig. 2).

Discussion

This study is a cross-sectional study that was carried out by the Community Medicine Research Center of Keelung Chang Gung Memorial Hospital, which ran a cohort study in northern costal Taiwan. Using self-reported responses to questionnaires on depression (TDQ) and subjective cognitive complaints (AD8), this work seeks to screen people with major depression. At total of 118 community residents were recruited after comprehensive psychiatric assessment using MINI identified nine people with current MDD. According to group analysis, correlation analysis, logistic regression modeling, AUC of ROC curves, and a decision tree model, TDQ score was useful in distinguishing people with current MDD from those without. Based on the ROC curve and decision tree models, a new score equal to a linear combination of the TDQ and AD8 scores outperformed TDQ score alone.

The limitations of the study included the small number of people with current major depression, which might have led to biased statistical results. Second, the recruitment of community-dwelling people and their visits to hospital for complete psychiatric evaluation required their cooperation. Those willing to undergo that evaluation might have been more active and had a greater ability to move than the others. People with major depression might have had less motivation and therefore have been more likely to refuse to participate. Consequently, the number of people with MDD could be under-estimated. Finally, grouping the enrolled people by age group to generate ROC curves further reduced the statistical power of the determinations made based on those groups.

Depression is a multifactorial disease that links to socioeconomic function, culture and interpersonal relationships. Comparisons of patients with and without current MDD demonstrated that their percentages married differed (Table 1). Marital disruption, including divorce and widowhood, precipitate depression [21, 22] and this fact may explain the high percentage of non-married people with current MDD. Other objective criteria like demographic characteristics, education, and financial status did not precipitate major depression. However, in the decision tree model, under the node of score summation of TDQ + 4*AD8 (Fig. 2), female gender favored the identification of depression in people with a score greater than 29 points. Although the between-group comparison failed to reveal a significant difference in sex ratio ($p = 0.150$, Table 1), people with MDD were more likely to be female (eight of nine) than those without MDD. The statistical insignificance of the chi-square statistics might be explained by small number of cases in the MDD group; the clinical significance of female gender in predicting MDD at the decision tree is logical because depression is 1.7 times as prevalent in females than males (5.5 to 3.2%) [23].

Depression is commonly concomitant with cognitive complaints, as determined in our earlier study of subjective cognitive decline [24]. TDQ is a self-reporting depressive questionnaire on somatic and emotional aspects. AD8 is a self-reporting questionnaire that covers various cognitive domains in daily life. Correlation tests in Table 2 revealed a correlation between TDQ and AD8 scores but not a strong one. Therefore, depression complaints and subjective cognitive complaints should be considered together, and collinearity was not a problem in the regression model. In logistic regression (Table 3), model 4 reveals that TDQ and AD8 scores both predicted MINI-current MDD; according to the ROC curve in Fig. 1-A, AUC was improved by combining TDQ and AD8 scores in a new predictive score. Therefore, co-considering depressive and cognitive complaints is a feasible means of improving the identification of major depression.

The complex relationship between cognitive impairment and depressive disorder has a long history; debates have addressed prodromal depression in later dementia [25], depression as a risk factor of dementia [26], depression's mimicking dementia, called pseudodementia [27], and depression as a psychiatric symptom of various types of dementia [28, 29]. One of the most important indicators of cognitive decline is a self-sensation of cognition dysfunction [30]. In a systematic review, subjective cognitive impairment and depressive presentations were found to have reciprocal effects, and were frequently accompanied by anxiety and stress [31]. The severity of depression has been correlated with the degree of cognitive complaints [32]. Among various factors that mediate cognitive symptoms in depression, such as duration of current depression episode and presence of disability [33], age is important. Late-life depression (age ≥ 60) presents more memory impairment, worse verbal learning, and slower motor speed than depression in younger individuals [34]. Notably, atypical presentations of depression in the elderly were considered in the development of the Geriatric Depression Scale (GDS). In 1982, Yesavage noted that psychomotor retardation and passive refusal lead to mistaken identification of depression as dementia. Depression in the elderly is usually accompanied by experiences of memory or cognitive decline, and somatic symptoms of depression are commonly confused with other age-related somatic symptoms. The high frequency of cognitive complaints in cases of geriatric depression may be misleading but also useful in identifying depression in the elderly [35]. Since the features of depression in the elderly are distinct, geriatric depression represents a subfield of affective disorders [8].

In this work, integrating subjective cognitive survey with a traditional depression survey showed provided additive value in identifying depression in elderly people aged over 65 years. Neither TDQ nor AD8 score alone sufficed to identify depression in elderly, but a linear combination of AD8 and TDQ scores as a new predictor significantly improved the ROC curve (Fig. 1-B). The TDQ was originally developed to suit Taiwan's cultural traits and forms of emotional expression [3], but did not consider the effect of age on presentations of depression. Given the special characteristics of geriatric depression, cognitive complaints, AD8 and the culture-specific questionnaire TDQ were used in screening for depression; doing so improved the AUC in ROC curves; and the linear combination of TDQ and AD8 was critical in implementing the classification decision tree. A decision tree is basic machine learning model and is suitable for solving multifactorial diagnostic problems with hierarchical variables [36, 37]. In the model herein, multiple variables were considered, but the linear combination TDQ + 4*AD8 was the best for identifying depression in community-dwelling older people. The cut-off value of TDQ + 4*AD8 was 29/30 in the decision tree model and 30/31 in the ROC curve based on Youden's J statistics; the closeness of these cutoffs indicate the consistency of this variable in predicting depression.

Conclusions

The TDQ can feasibly be used for screening for major depression in community-dwelling people. Incorporating subjective cognitive complaints using the AD8 questionnaire further improved the identification of depression in the elderly. A decision tree model that comprehensively weighted influencing factors was developed to identify depression.

List Of Abbreviations

MDD, Major depressive disorder. TDQ, Taiwanese Depression Questionnaire. MINI, Mini-International Neuropsychiatric Interview. MMSE, Mini-Mental State Examination. PSQI, Pittsburgh Sleep Quality Index. SF-36, Short Form (36-item) Health Survey. ROC, receiver operating characteristic. AUC, area under the curve.

Declarations

Ethics approval and consent to participate: This study was approved by the Institutional Review Board of Chang Gung Memorial Hospital, under approval no. 201600270B0 and no. 201600580B0. All the participants had been well informed about the study and had signed written consents before entering the study.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: YCW analyzed the dataset and drafted the manuscript. LYH and YCS contributed to study conception and data analysis. CKC contributed to study conception and design, acquisition of data, analysis and interpretation of data, and critical revision of manuscript. All authors have read and approved the manuscript

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Figures

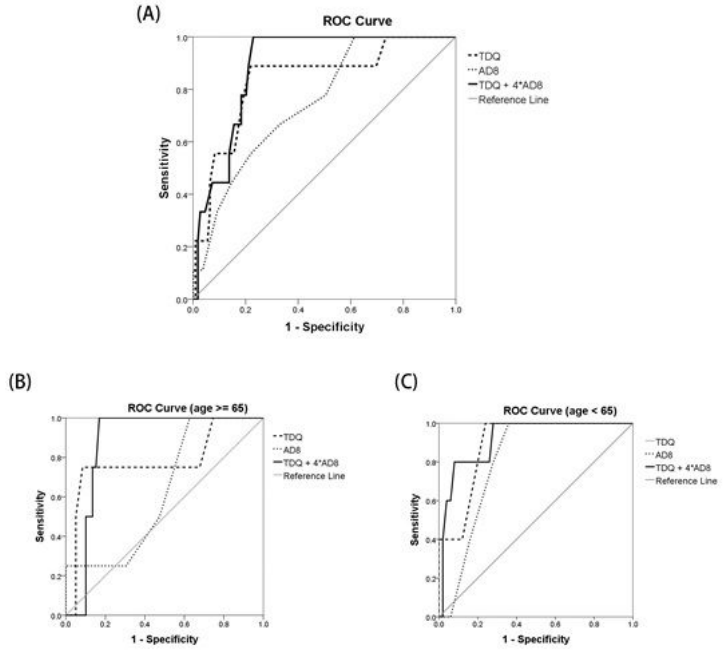

Figure 1

Receiver operating characteristic (ROC) curves to test area under curve (AUC) in predicting MINI diagnosis of current MDD (A) Among all the enrolled residents, the AUC to examine MINI-MDD were 0.835 ($p = 0.001$) by TDQ score, 0.751 ($p = 0.013$) by AD8 score and 0.887 ($p < 0.001$) by the linear combination of TDQ score plus 4 folds of AD8 score. (B) In elderly people with age ≥ 65, by only-TDQ or only-AD8 scores failed to distinguish with/without current MDD in MINI (AUC: TDQ 0.780, $p = 0.063$; AD8 0.627, $p = 0.398$). However, using the linear combination of TDQ and AD8 successfully districted elderly people with presence of MDD from those without depressive status (AUC 0.875, $p = 0.013$). (C) In people aged from 50 to 65 years old, the AUC of ROC curves to detect current MDD were 0.892 ($p = 0.004$) of TDQ score, 0.804 ($p = 0.026$) of AD8 score and 0.918 ($p = 0.002$) of the linear combination of TDQ+4*AD8. The linear combination of TDQ and AD8 scores in distinguishing current MDD in MINI performed better than sole TDQ or AD8. Especially in elderly people, when TDQ and AD8 failed to predict MDD diagnosis, the linear combination had good performance with statistical significance.

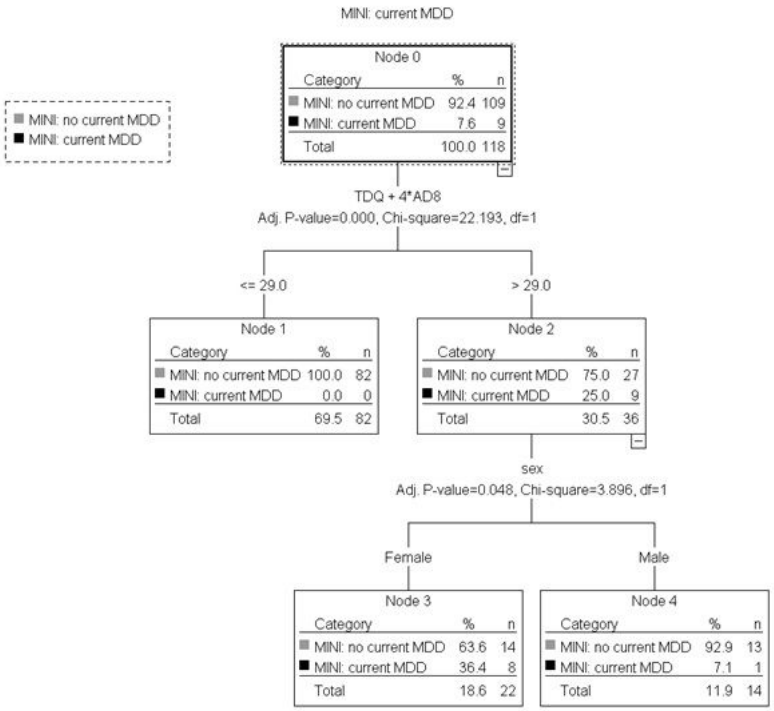

Figure 2

Classification tree to determine MINI diagnosis of current MDD. The linear combination of TDQ and AD8 scores was the key node in the decision tree classifier for current status of MDD. Female gender was the other key classifier at the second node of decision tree.