

Goldberg Anxiety and Depression Inventory

Age Cohorts	Older
Surveys	Survey 3
Derived Variable	GADS
Definition	18-item, unweighted summed score measuring anxiety and depression based on the Goldberg anxiety and depression inventory (GADS)
Source Items (Index Numbers)	GADS1 to GADS18 (GADS-001 to GADS-018)
Usage Note	The GADS does not add a great deal beyond other measures of psychological well-being collected in the ALSWH surveys. In particular, the hope that the GADS would distinguish between anxiety and depression was not supported.
Statistical Form	Continuous variable
Index Number	GADS-019
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Endorsed	11 February 2004

Background to latent trait analysis

Common factor analysis is not applicable to dichotomous data¹. One reason is that the magnitudes of the correlations are affected by the endorsement proportions (percentage of sample who responded "yes" to the symptom) of dichotomous items². Complex factorial structures can result when factor analysing dichotomous data with differing endorsement proportions, even when items are from a one-dimensional scale².

Latent trait analysis using the program NOHARM³ was used to assess the dimensionality of the psychiatric inventories in the Goldberg et al⁵, Mackinnon et al² and also Clarke et al¹ papers. The latent trait approach was also taken in the current analysis using the program NOHARM87 and the referenced web page contains the program and a manual for the interested reader.³

The method is a robust form of latent trait analysis based on the work of McDonald (1985a, b cited in⁴). In brief, a two-parameter model was used, where for each symptom we can state its position on underlying severity (called 'threshold') and the discriminatory power of the symptom (called 'slope'). The 'slope' has a direct relationship with factor loadings and the later will be presented in the results of this report. The 'threshold' has a direct relationship with the endorsement proportion.

Factor loadings from latent trait analysis can be interpreted in a similar way to loadings obtained from regular factor analysis and can be manipulated by orthogonal or oblique rotations¹. NOHARM fits latent trait models to the matrix of mean cross-products (the diagonal elements are the endorsement proportions for each symptom, off diagonal elements are the proportion endorsing both symptoms) to estimate and transform model parameters. NOHARM can perform exploratory and confirmatory analysis for a user specified model.

Goodness of fit of a solution can be summarised by the root mean square residual, which is the root mean square of the residuals of the proportion of symptom co-occurrence predicted by the model and observed in data. The root mean square residual of a perfectly fitting model is zero and larger values indicate poorer fit. Goodness of fit of a solution can be also summarised by Tanka's Index which ranges from 0 (fit no better than chance) to 1 (perfect fit) with some evidence to suggest values exceeding 0.8 indicate an acceptable fit.¹

Background to the Goldberg anxiety and depression inventory

The Goldberg anxiety and depression symptom inventory^{4,5} is an 18 item self-report symptom inventory with “yes” and “no” response options (see below).

Next are some specific questions about your health and how you have been feeling in the PAST MONTH.

Anxiety Subscale

GADS1	a	Have you felt keyed up or on edge?
GADS2	b	Have you been worrying a lot?
GADS3	c	Have you been irritable?
GADS4	d	Have you had difficulty relaxing?
GADS5	e	Have you been sleeping poorly?
GADS6	f	Have you had headaches or neckaches?
GADS7	g	Have you had any of the following: trembling, tingling, dizzy spells, sweating, diarrhoea or needing to pass urine more often than usual?
GADS8	h	Have you been worried about your health?
GADS9	i	Have you had difficulty falling asleep?

Depression Subscale

GADS10	j	Have you been lacking energy?
GADS11	k	Have you lost interest in things?
GADS12	l	Have you lost confidence in yourself?
GADS13	m	Have you felt hopeless?
GADS14	n	Have you had difficulty concentrating?
GADS15	o	Have you lost weight (due to poor appetite)?
GADS16	p	Have you been waking early?
GADS17	q	Have you felt slowed down?
GADS18	r	Have you tended to feel worse in the mornings?

The inventory was developed by Goldberg et al^{4,5} from 36 items in the Psychiatric Assessment Schedule.⁶ Latent trait analysis was used to establish the existence of two dimensions of symptoms in a sample of people (n=283; with weighting applied to compensate for under sampling of physically ill with low number of psychiatric symptoms) attending a general practice.⁴

Goldberg et al⁵ selected a subset of 18 of these symptoms using data from a sample of 427 (with weighting applied to compensate for under sampling of people without psychiatric diagnoses) to create a brief inventory to detect anxiety and depression. This scale is known by many names (making it difficult to find in the literature) and here will be referred to as the Goldberg anxiety and depression scale⁵ (GADS).

When selecting items for inclusion in the GADS the first step was to choose four core questions that had low threshold and satisfactory slopes for both anxiety and depression. Secondly, five supplementary questions with high thresholds and satisfactory slopes were chosen. A two-step administration of these core and supplementary questions was used. For the anxiety subscale (9 items), four core items were asked and if the response was “yes” to at least two of these, the five supplementary questions were asked. For the depression subscale (9 items), four core items were asked and if the response was “yes” to at least one of these, the five supplementary questions

were asked. Goldberg et al⁵ considered that patients with anxiety scores of five or more or with depression scores of two or more had a 50% chance of having a clinically important disturbance.

The 18-item inventory was validated in an elderly community sample from Canberra and Queanbeyan by Mackinnon et al². The Mackinnon et al² study was examined here because it was the most detailed validation paper found and included an elderly sample. The participants consisted of 411 females and 421 males with an average age of 76 years (SD=4.9). A definitive diagnosis of the presence or absence of depression was available for all participants.

The pattern of discrimination in this Australian sample was different to Goldberg et al's⁴ original findings. In the Australian elderly community sample, two correlated dimensions of anxiety and depression were found with some evidence of a third sleep related dimension.

Thresholds from the latent trait analysis for the Mackinnon sample had a smaller range of values than the Goldberg sample, particularly for the anxiety subscale. This suggests that the scales are capable of detecting and discriminating a restricted range of severity of disorders in elderly persons or that the anxiety items tapped into a different construct for elderly persons.² Slopes for the latent trait analysis for the core anxiety items in the Mackinnon sample were within the range of slopes for the other items and not extreme as in the Goldberg sample, suggesting that the core items were no better than the supplementary items at discriminating this dimension. Slopes for the core depression items in the Mackinnon sample were shallower than those in the Goldberg sample but remained above average discriminators of this dimension suggesting that the core items were slightly better than the supplementary items at discriminating this dimension. The two step administration process was sensitive to differences between the slopes and thresholds for the Mackinnon and Goldberg samples and was not recommended.²

For the Mackinnon sample², unweighted sum scores of depression items (items j to r), a total unweighted sum score (with and without the three sleep items, e, i and p) and to a lesser extent unweighted sum score of anxiety items (items a to i) were relatively specific detectors of clinically diagnosed depressive disorders. Diagnostic information on anxiety disorders was not obtained. These three summed scores were recommended for use as a brief, valid and acceptable method of detecting elevated levels of depression and anxiety in elderly persons.²

Source items

The Goldberg anxiety and depression inventory was included in the third survey of the Older cohort of the ALSWH. Core anxiety items were a, b, c and d and core depression items were j, k, l and m. Responses were coded as shown.

Code	Re-code	Response
1	1	Yes
2	0	No

Scale Evaluation

The GADS was included on Survey 3 of the Older cohort. For those who responded to all 18 items, the endorsement proportions (percentage of women who responded "yes" to the symptom) were highly variable and ranged from 7.2% to 61.9% suggesting that erroneous results may be found using standard factor analysis (Table 1). The percentage of women missing an item ranged from 2.2% to 4.1%. Data presented here are from the 7264 women who completed all 18 items (1382 or 16% of women missed at least one of the 18 items). All latent trait analysis was conducted in NOHARM87; all other analysis was conducted in SPSS 11.0

Latent trait analysis

Free, exploratory latent trait analysis using 1, 2 and 3 dimensions was performed (Table 1). Improvements in fit from 1 to 2 dimensions and from 2 to 3 dimensions according to Tanaka's index were not substantial (Table 2). However, there were substantial improvements in fit for root mean square residual from 1 to 2 and from 2 to 3. Accordingly the structures of the 1, 2 and 3 dimension solutions were examined in detail. For the 1, 2 and 3 dimension solutions the items

“headaches or neck aches”, “lost weight/poor appetite” and “waking early” had fairly low loadings (highest loading between 0.3-0.5), these items were not bolded in Table 1. These three items were included with the dimension they loaded most highly with when interpreting solutions and later when creating sum scores. This was because the loadings were not deemed to be extremely low and insignificant and there were no clear guidelines stating a suitable minimum factor loading for latent trait analysis.

Table 1 Goldberg anxiety and depression scale items, endorsement proportions and exploratory factor loadings for 1, 2 and 3 dimensions (n = 7264)

	How you have been feeling in the past month	% Yes	Unrotated			Promax rotation		
			1			3 Dimensions		
			Dimension	2 Dimensions	3 Dimensions	1	2 Dimensions	3 Dimensions
Anxiety Subscale								
a	Have you felt keyed up or on edge?	27.6	0.75	0.67	0.13	1.03	-0.17	0.01
b	Have you been worrying a lot?	24.6	0.76	0.66	0.15	1.04	-0.19	0.03
c	Have you been irritable?	19.0	0.68	0.63	0.08	0.63	0.10	0.02
d	Have you had difficulty relaxing?	25.0	0.79	0.52	0.36	0.69	-0.02	0.29
e	Have you been sleeping poorly?	38.5	0.67	-0.12	1.07	0.06	0.00	0.97
f	Have you had headaches or neckaches?	35.3	0.45	0.36	0.12	-0.03	0.41	0.13
g	Have you had any of the following: trembling, tingling, dizzy spells, sweating, diarrhoea etc?	32.1	0.57	0.53	0.08	0.00	0.54	0.10
h	Have you been worried about your health?	23.7	0.70	0.70	0.03	0.18	0.55	0.03
i	Have you had difficulty falling asleep?	36.0	0.56	-0.14	0.92	0.00	0.01	0.85
Depression Subscale								
j	Have you been lacking energy?	52.6	0.78	0.81	0.01	-0.25	1.05	0.06
k	Have you lost interest in things?	11.9	0.72	0.87	-0.16	0.32	0.57	-0.15
l	Have you lost confidence in yourself?	15.0	0.70	0.89	-0.20	0.29	0.61	-0.18
m	Have you felt hopeless?	8.0	0.78	0.89	-0.12	0.35	0.57	-0.11
n	Have you had difficulty concentrating?	21.4	0.64	0.72	-0.07	0.25	0.50	-0.06
o	Have you lost weight (due to poor appetite)?	7.2	0.46	0.49	-0.03	0.11	0.40	-0.02
p	Have you been waking early?	56.8	0.38	0.04	0.43	0.07	0.05	0.39
q	Have you felt slowed down?	61.9	0.74	0.79	-0.02	-0.29	1.04	0.05
r	Have you tended to feel worse in the mornings?	23.8	0.55	0.50	0.07	-0.14	0.65	0.10

Table 2 Latent trait analysis of Goldberg anxiety and depression scale for 1, 2 and 3 dimensions (n = 7 264)

	1 dimension	2 dimensions	3 dimensions
Root mean squares of residuals	0.012	0.008	0.004
Tanaka index of goodness of fit	0.973	0.988	0.997
Correlation between factors			
1 and 2		0.60	0.76
1 and 3			0.45
2 and 3			0.46

All items had a moderate to high loading on the factor in the one-dimension solution with loadings greater than 0.5 for all items except the three items discussed previously. The two-dimension solution suggest 16 anxiety and depression items as one dimension and 3 sleep related items as another dimension. There was moderate to high correlation between these two factors. The 3 dimension solution suggests 4 anxiety items as one dimension, 11 depression items as another dimension and 3 sleep related items as another dimension. There was high correlation between the depression and anxiety dimension and moderate correlation between these and the sleep related dimension.

The two and three dimension solutions showed somewhat better goodness of fit indices than the one dimension solution and may be preferable on technical grounds. However, the one dimension solution seems most appropriate when looking at the loadings in terms of interpretability and since there were high correlations between dimensions for the higher order solutions

The structure of the original two subscales was not supported by the exploratory analysis. However, a confirmatory two-dimensional analysis was conducted to investigate whether the original anxiety and depression subscales are supported by the ALSWH data. The confirmatory two-dimensional analysis allowed the loading of the 9 anxiety subscale items and 9 depression subscale items onto separate but correlated dimensions (Table 3). All other loadings were constrained to be zero. This solution fitted approximately as well as the one-dimension exploratory analysis, but had only half the number of parameters. The high correlation between the two factors of 0.83 suggests there is little justification for the separation of the anxiety and depression subscales as originally devised by Goldberg et al.^{4, 5}

Derived Variable

Scores

A number of unweighted summed scores were psychometrically evaluated among women who responded to all 18 items: a total score (all 18 items), total score excluding items f, o and p (low loadings), original anxiety and depression subscales and scores based on the factors identified in the 2 and 3 dimensional exploratory analysis.

Table 3 Confirmatory factor loadings for 2 dimension solution for the Goldberg anxiety and depression scale (n = 7264)

Item	Anxiety	Depression
Anxiety Subscale		
a Keyed up on edge	0.78	0
b Worrying a lot	0.79	0
c Irritable	0.70	0
d Difficulty relaxing	0.82	0
e Sleeping poorly	0.69	0
f Headaches or neckaches	0.46	0
g Symptoms	0.58	0
h Worried about health	0.71	0
i Difficulty falling asleep	0.58	0
Depression Subscale		
j Lacking energy	0	0.85
k Lost interest in things	0	0.78
l Lost confidence in self	0	0.76
m Felt hopeless	0	0.84
n Difficulty concentrating	0	0.69
o Lost weight/poor appetite	0	0.49
p Waking early	0	0.39
q Felt slowed down	0	0.80
r Feel worse in mornings	0	0.58
Root mean squares of residuals	0.011	
Tanaka index of goodness of fit	0.976	
Correlation between factors 1 and 2	0.83	

Internal reliability

Cronbach's alpha reliability, distributional properties and correlations with other summed scores and with the SF-36 mental health index⁷ (MH) were calculated for each score (Table 4).

Cronbach's alpha was highest for the total scores (both with and without items f, o and p). Most of the summed scores were moderately right skewed as would be anticipated with symptom inventories. All scores were moderately to highly correlated with one another.

Table 4 Cronbach's alpha, distribution and correlations for various summed scores (n = 7 264)

	All items	Excluding items f, o and p	Anxiety subscale	Depression subscale	Anxiety & depression from 2D ¹	Sleep from 2D1 and 3D ¹	Anxiety from 3D ¹	Depression from 3D ¹
Number of items	18	15	9	9	13	2	4	7
Cronbach's alpha	0.84	0.84	0.77	0.71	0.83	0.64	0.76	0.77
Distributional properties								
Minimum	0	0	0	0	0	0	0	0
Maximum	18	15	9	9	15	3	4	11
Mean	5.20	4.21	2.62	2.59	3.89	1.31	0.96	2.93
Standard Deviation	3.99	3.58	2.41	1.98	3.39	1.11	1.30	2.48
Distribution shape	right skew	right skew	right skew	right skew	right skew	flat	right skew	right skew
Correlations								
All items		0.98						
Anxiety subscale	0.93	0.92						
Depression subscale	0.89	0.87	0.65					
Anxiety & depression from 2D	0.97	0.97	0.87	0.89				
Sleep from 2D and 3D	0.63	0.58	0.66	0.48	0.42			
Anxiety from 3D	0.78	0.80	0.85	0.55	0.80	0.38		
Depression 3D	0.91	0.90	0.75	0.92	0.95	0.37	0.56	
MH score	-0.68	-0.68	-0.63	-0.58	-68	-0.32	-0.64	-0.59

¹ 2D= 2-dimensional, 3D=3-dimensional

GADS-based scores as a screening test for depression

Receiver-operator characteristic (ROC) analysis was used to assess GADS summed scores and the MH score as screening test for depression, anxiety and sleeping problems. There was no “gold standard” for depression, anxiety or sleeping problems in the ALSWH data but a number of proxies were used instead, including MH score dichotomised as “less than 53” and “53 or more” (scores “less than 53” are an indicator of possible clinical depression), self-reported doctor diagnosis of depression or anxiety/nervous disorder in the last 3 years, symptom of anxiety/panic attacks “often or sometimes” in the last 12 months, using medication prescribed or recommended by a doctor for depression, nerves/anxiety/worries or to help you sleep and a sum of five reported sleeping problems (see Table 5 for percentages).

Table 5 Percent classified as depressed, anxious and with sleep problems (n = 6 917 to 7 153 depending on missing data)

Outcome	Response	Percent
Mental Health Index (MH)	Low MH (less than 53)	7.2
	High MH (53 or more)	
Doctor diagnosed depression (in the last 3 years)	Yes	6.7
	No	
Medication for depression (in the last 4 weeks)	Yes	4.5
	No	
Doctor diagnosed anxiety/nervous disorder (in the last 3 years)	Yes	5.2
	No	
Symptom of anxiety/panic attacks (in the last 12 months)	Sometimes/often	8.1
	Rarely/never	
Medication for nerves/anxiety/worries (in the last 4 weeks)	Yes	6.4
	No	
Number of sleep problems (From items q14a-e: waking up in the early hours of the morning, lying awaking for most of the night, taking a long time to get to sleep, worry keeping you awake at night, sleeping badly at night)	Three to five	11.6
	None to two	
Medication to help you sleep (in the last 4 weeks)	Yes	18.0
	No	

For each of these eight outcomes, sensitivity and specificity were calculated for all possible cut points of the GADS summed scores and MH score and plotted on ROC curves (see Table 6 and Figure 1). The area under each curve is used as an index of performance of the test (GADS summed score or MH score) as a screen for the disorder (proxies for depression, anxiety and sleeping problems from other questions in the survey). An area of 1.0 represents perfect performance, whereas an area of 0.5 represents chance performance. The areas and their 95% confidence intervals are presented in Table 6.

The results of the ROC analysis suggest that in terms of discriminating depression and anxiety (dichotomised MH score, diagnoses, symptoms, medications), MH score and all the GADS sum scores except sleep score from 3-dimensional solution are about equally adequate. The sleep

score from 3-dimensional solution and anxiety subscale are equally adequate at discriminating use of medication to help you sleep and more than 3 sleep problems.

Mackinnon et al² stated that the limited data available about the presentation of psychopathology in later life suggests that the distinctive features of depression and anxiety become less pronounced with rising age. This was supported in the current analysis as there was no justification for splitting the data into the original separate anxiety and depression scales as they were highly correlated ($r=0.65$) suggesting they are measuring the same concept. Furthermore, the summed scores based on the exploratory 3-dimensional solution were also unable to distinguish between depression and anxiety ($r=0.56$).

There is little evidence for any GADS summed score other than the total score with or without items f, o and p (low loaders) excluded as adequate measures of depression. Researchers have suggested that there are also potential problems with using depression scales in groups, such as the elderly, in which physical disorders are present². These problems may be particularly pronounced when asking questions about sleeping problems or other symptoms that could have causes other than psychopathology. In the current analysis all items except “headaches or neckaches”, “lost weight (due to poor appetite)” and “waking early” loaded highly onto the single factor in the exploratory 1-dimensional solution. These three items with low loadings seem to be symptoms that are not necessarily related to psychopathology, particularly in the elderly. However, a summed score with these three items removed was correlated 0.98 with the summed score for all 18 items and had equivalent discriminating abilities in the ROC analysis. This suggests that these three items are causing the total sum score to be a more noisy predictor of depression and anxiety. Findings with the removal of the three sleep-related items (anxiety and depression sum score from 2-dimensional solution) were similar.

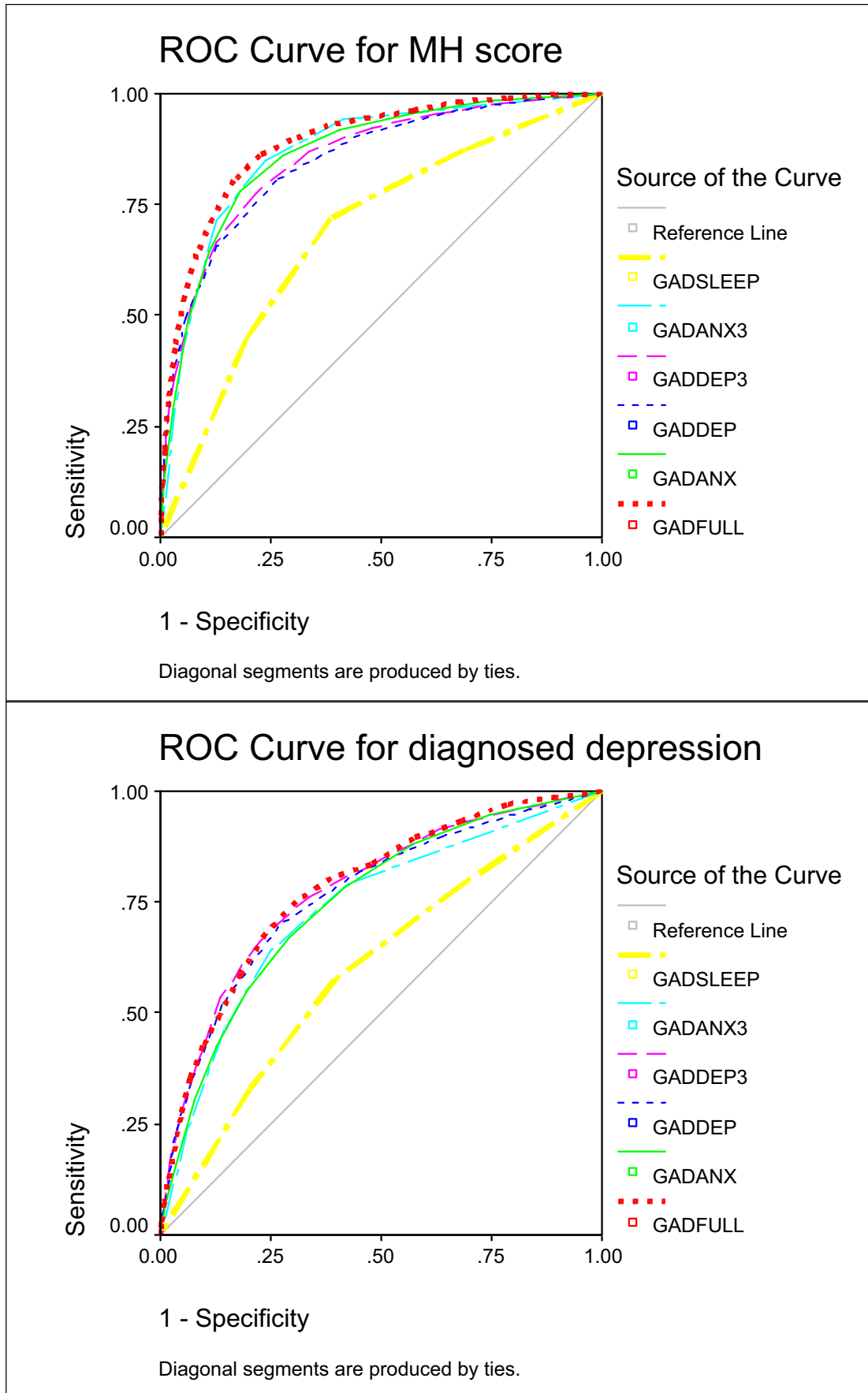
The 18-item GADS summed score is a valid and acceptable method of detecting elevated levels of depression and anxiety in ALSWH Older cohort. However the high correlation ($r=-0.68$) between the 18-item summed score and MH score (continuous) suggests that the inclusion of the GADS in future survey is redundant.

Table 6 Area under the curve (95% confidence interval) for receiver-operator characteristic analysis

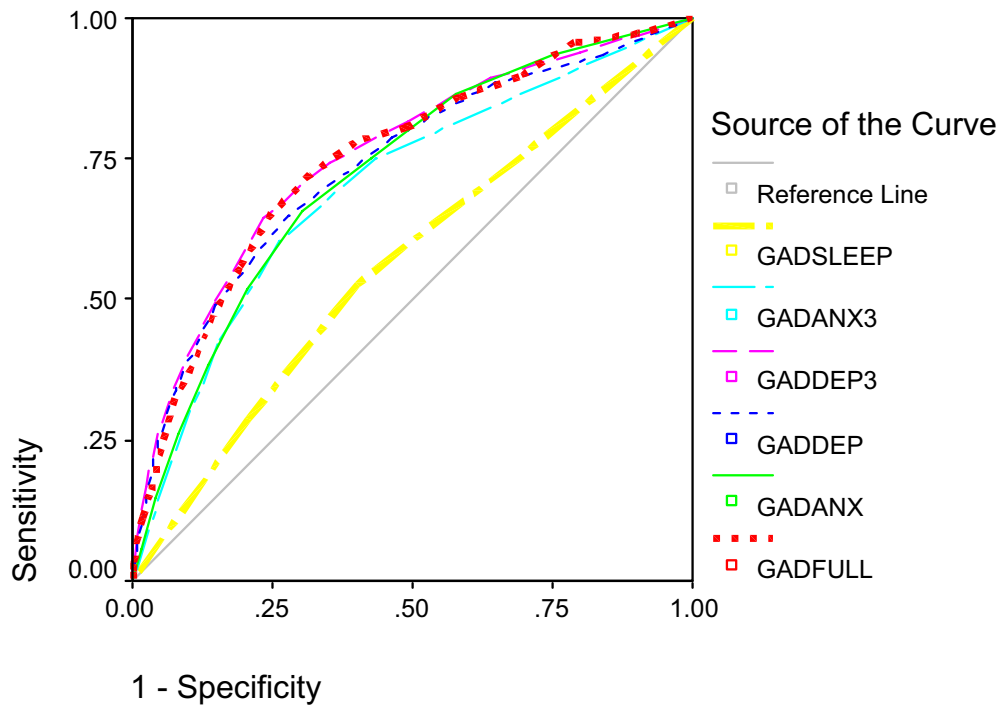
Outcome	MH score (continuous)	GADS Summed score						
		All items ^a	Excluding items f, o & p	Depression subscale ^a	Depression from 3D ^a	Anxiety subscale ^a	Anxiety from 3D ^a	Sleep from 3D ^a
MH score less than 53		0.89 (0.87, 0.90)	0.89 (0.88, 0.91)	0.85 (0.83, 0.87)	0.85 (0.84, 0.87)	0.86 (0.85, 0.88)	0.87 (0.85, 0.88)	0.69 (0.66, 0.71)
Doctor diagnosed depression	0.82 (0.80, 0.84)	0.78 (0.76, 0.80)	0.79 (0.77, 0.81)	0.77 (0.74, 0.79)	0.78 (0.75, 0.80)	0.75 (0.73, 0.77)	0.73 (0.71, 0.76)	0.60 (0.57, 0.63)
Medication for depression	0.79 (0.76, 0.82)	0.75 (0.72, 0.78)	0.76 (0.73, 0.78)	0.74 (0.71, 0.77)	0.75 (0.73, 0.78)	0.72 (0.70, 0.75)	0.70 (0.67, 0.73)	0.56 (0.53, 0.60)
Doctor diagnosed anxiety	0.81 (0.78, 0.83)	0.77 (0.75, 0.80)	0.79 (0.76, 0.81)	0.73 (0.70, 0.76)	0.75 (0.73, 0.78)	0.77 (0.74, 0.79)	0.77 (0.75, 0.80)	0.61 (0.58, 0.64)
Anxiety symptom	0.82 (0.80, 0.84)	0.81 (0.79, 0.83)	0.81 (0.80, 0.83)	0.75 (0.73, 0.77)	0.77 (0.75, 0.79)	0.80 (0.78, 0.82)	0.80 (0.78, 0.82)	0.64 (0.62, 0.66)
Medication for anxiety	0.79 (0.76, 0.82)	0.75 (0.72, 0.77)	0.76 (0.73, 0.78)	0.71 (0.68, 0.73)	0.73 (0.71, 0.76)	0.74 (0.71, 0.76)	0.74 (0.71, 0.76)	0.58 (0.55, 0.61)
Medication to help sleep	0.65 (0.63, 0.67)	0.72 (0.71, 0.73)	0.72 (0.70, 0.73)	0.65 (0.64, 0.67)	0.66 (0.65, 0.68)	0.73 (0.72, 0.75)	0.65 (0.63, 0.66)	0.73 (0.71, 0.74)
Number of sleep problems	0.70 (0.68, 0.72)	0.82 (0.80, 0.83)	0.81 (0.80, 0.83)	0.73 (0.71, 0.75)	0.73 (0.71, 0.75)	0.83 (0.82, 0.85)	0.72 (0.70, 0.74)	0.85 (0.84, 0.86)

^a These test result variables had at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

Figure 1 ROC curves for depression, anxiety and sleep outcomes by GADS sum scores

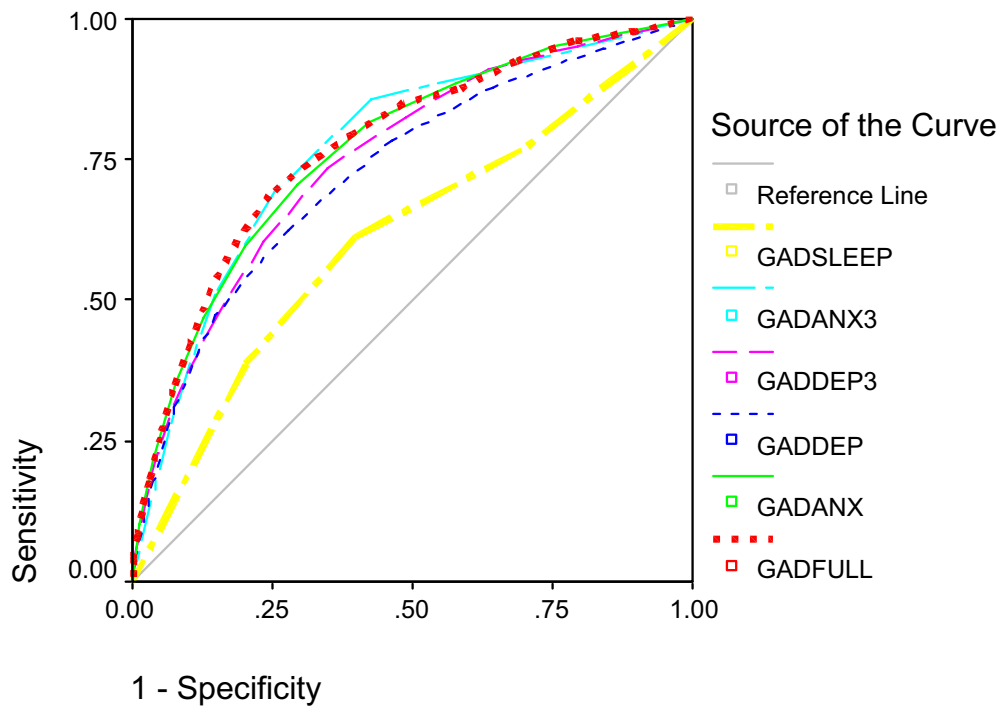


ROC Curve for depression medication



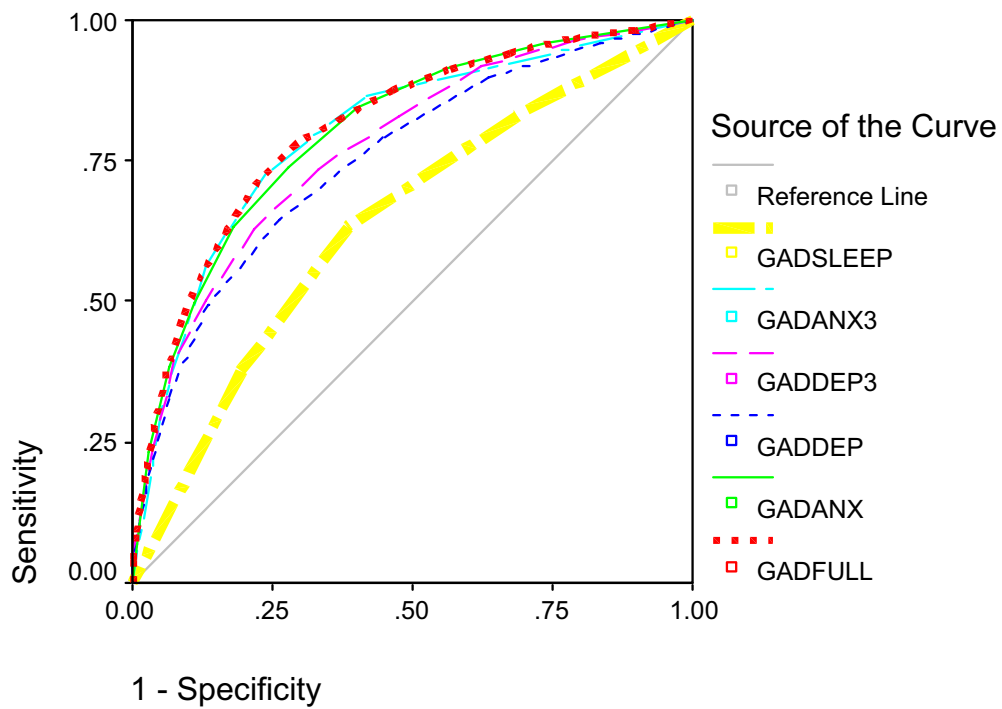
Diagonal segments are produced by ties.

ROC Curve for diagnosed anxiety

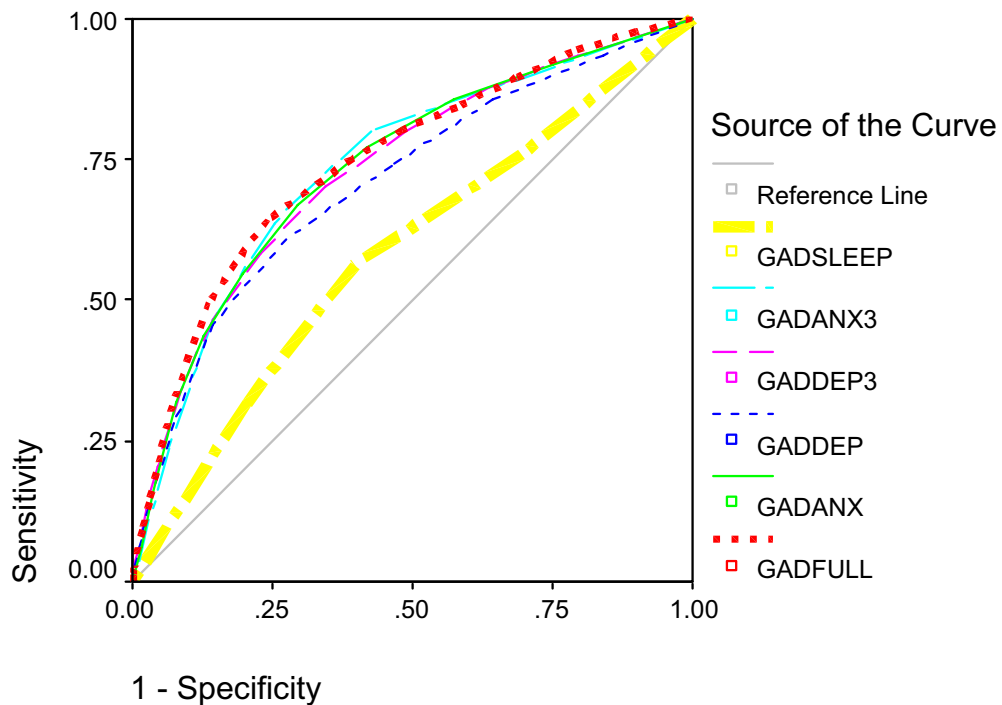


Diagonal segments are produced by ties.

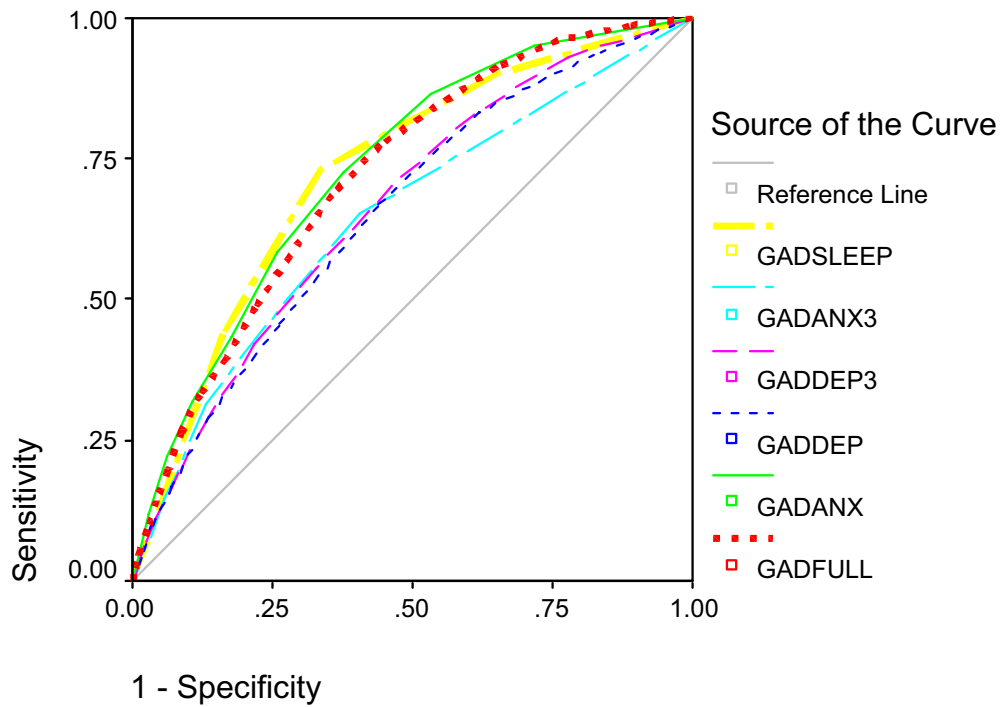
ROC Curve for anxiety symptom



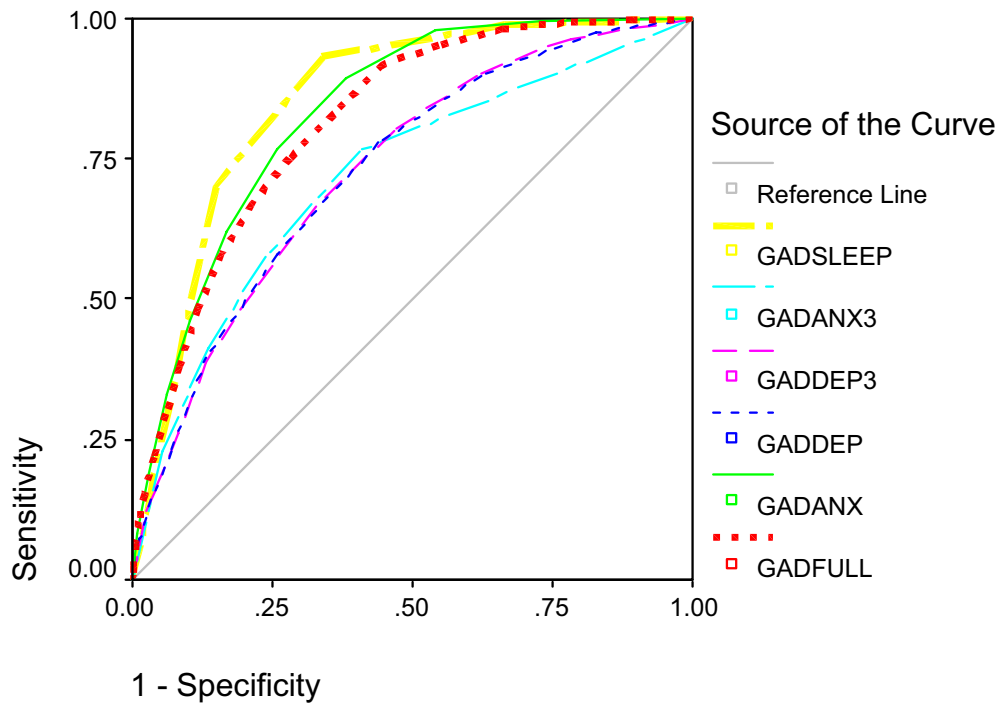
ROC Curve for anxiety medication



ROC Curve for sleep medication



ROC Curve number of sleep symptoms



Missing items

Table 7 presents the frequencies for the number of items missing for all women who participated in the longer version of the third survey for the Older cohort. Mean item substitution for up to two items resulted in 95% of participants being assigned a GADS total score. The GADS total score has a mean of 5.36, SD of 4.02 and range of 0-18. Figure 2 is a histogram of the GADS total sum score with mean item substitution for up to two items.

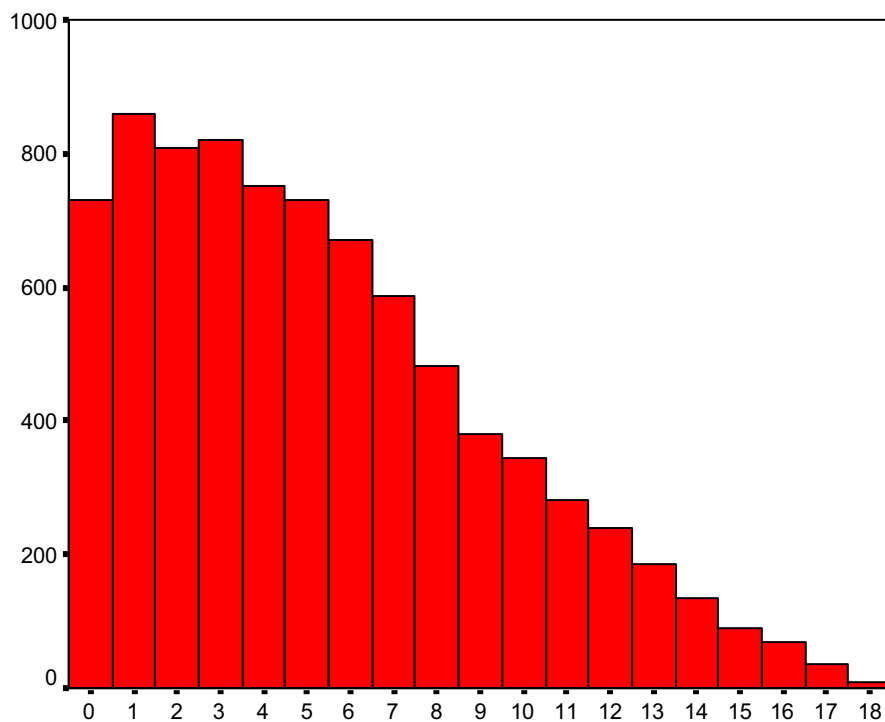
Recommendation for usage

The 18-item GADS summed score is a valid and acceptable method of detecting elevated levels of depression and anxiety in ALSWH Older cohort. However, it is important to note that sum score is right skewed and this needs to be taken into consideration during statistical analysis.

Table 7 Number of missing items (n = 8 646).

Number of items missing	Frequency	Percent	Cumulative percent
0	7264	84.0	84.0
1	747	8.6	92.7
2	199	2.3	95.0
3	91	1.1	96.0
4	68	0.8	96.8
5	37	0.4	97.2
6	40	0.5	97.7
7	22	0.3	97.9
8	13	0.2	98.1
9	18	0.2	98.3
10	8	0.1	98.4
11	10	0.1	98.5
12	16	0.2	98.7
13	12	0.1	98.8
14	8	0.1	98.9
15	12	0.1	99.1
16	4	0.1	99.1
17	7	0.1	99.2
18	70	0.8	100.0

Figure 2 Histogram of GADS total score



The SAS code deriving the GADS summed score at Survey 3 is:

```
/*recode no from 2 to 0 */
array gad(18)
o3q30a o3q30b o3q30c o3q30d o3q30e o3q30f o3q30g o3q30h o3q30i
o3q30j o3q30k o3q30l o3q30m o3q30n o3q30o o3q30p o3q30q o3q30r;

do a= 1 to 18;
if gad(a)=2 then gad(a)=0 ;
else gad(a)=gad(a) ;
end;

sumgad = sum(of gad{*});
meangad = mean(of gad{*});
missgad = nmiss(of gad{*});

/* create sum score */
if missgad in (0,1,2) then o3gad = sumgad + (missgad * meangad) ;
else if 3<=missgad<=18 then o3gad = . ;
```

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