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Age differences in depression and anxiety symptoms: a structural equation modelling analysis of data from a general population sample

H. CHRISTENSEN,[1] A. F. JORM, A. J. MACKINNON, A. E. KORTEN, P. A. JACOMB, A. S. HENDERSON AND B. RODGERS

From the NHMRC Psychiatric Epidemiology Research Centre, The Australian National University, Canberra; and Department of Psychological Medicine, Monash University and Mental Health Research Institute of Victoria, Melbourne, Australia

ABSTRACT

Background. There is debate as to whether the elderly are really at lower risk for depressive disorders, or whether endorsement of symptoms is artefactually low. The present paper assesses the effects of age on anxiety and depression, and examines whether age has direct effects on self-report of individual symptoms independent of its effect on the underlying dimensions of anxiety and depression.

Methods. Structural equation modelling was used to assess the structure of the items and their associations with age and a number of demographic variables. The sample of 2622 participants aged between 18 and 79 years from Canberra (Australia) was drawn from the Electoral Roll. Two instruments were used: the anxiety and depression scales of Goldberg *et al.* (1988) and the Personal Disturbance Scale from the DSSI of Bedford *et al.* (1976).

Results. Both scales were found to fit satisfactorily to a two factor model. Age correlated negatively with depression. After controlling for the effects of gender, marital status, education and financial difficulty, direct effects of age were found on items from both instruments, indicating that certain depression items were associated with a differential probability of endorsement in older people, even when the level of depression was equal to that of younger people. Items with direct age effects reflected physical (feeling slowed down; waking early) and psychological (hopeless about the future) components of depression. Direct effects of age on items from both anxiety scales were also found.

Conclusions. The nature of the depression and anxiety experienced by younger and older people may differ qualitatively. Depression may be associated with an increase in somatic symptoms linked to physical changes and to an increase in endorsement of items which reflect the narrowing of opportunities in the long-term.

INTRODUCTION

It has been a common belief that the elderly are particularly at risk for depression (e.g. Klerman, 1983). However, this view was challenged by the results of the Epidemiologic Catchment Area (ECA) studies in the United States which showed that those aged > 65 had the lowest prevalence not only of major depression and dysthymia, but of all mental disorders other than severe cognitive impairment (Regier *et al.* 1993). A number of other population-based studies in several countries, have also reported a low prevalence of depressive disorders in the elderly (Ernst & Angst, 1995). Unfortunately, the large National Survey of Psychiatric Morbidity in Britain and the National Comorbidity Study in the United States excluded the elderly, but their

[1] Address for correspondence: Dr Helen Christensen, NHMRC Psychiatric Epidemiology Research Centre, the Australian National University, Canberra, ACT 0200, Australia.

findings do, nevertheless, indicate a trend towards declining prevalence in the oldest groups studied (Kessler *et al.* 1994; Bebbington *et al.* 1998). The recently published Australian National Survey of Mental Health and Well-Being included older participants and found that they had the lowest prevalence of affective and anxiety disorders (Australian Bureau of Statistics, 1998).

These findings have stimulated discussion about whether the elderly are really at lower risk for depressive disorders, or whether some sort of artefact operates to reduce the observed prevalence (Newmann, 1989; Blazer, 1994; Henderson, 1994; Wittchen *et al.* 1994; Ernst & Angst, 1995; Karel, 1997). One possibility is that the depressed elderly are missed due to a higher refusal rate, higher mortality or a higher rate of institutionalization. However, sampling artefacts have been discounted as insufficient to account for the low prevalence in the elderly (Henderson, 1994; Ernst & Angst, 1995).

Other possible artefacts stem from the structure of the diagnostic criteria for major depressive episode or the standardized interviews used to diagnose mental disorders. The DSM-III diagnostic criteria for major depression require the presence of dysphoric mood or loss of interest and pleasure. It has been suggested that these criteria might be inappropriate for elderly people with depression who are less likely to report dysphoria (Gallo *et al.* 1994; Henderson, 1994). However, even when the dysphoria criterion is ignored, prevalence in the elderly is still low (Henderson, 1994). In a similar vein, Blazer (1994) has argued that the diagnostic criteria are inadequate for the elderly because some experience clinically significant depressive symptoms that are not adequately captured by criteria for major depression and dysthymia. It is also possible that diagnostic interviews such as the Diagnostic Interview Schedule (DIS) and the Composite International Diagnostic Interview (CIDI) provide biased diagnoses in the elderly. It has been shown that symptoms of depression in the elderly may be discounted because they are attributed by the respondent to physical illnesses (Knäuper & Wittchen, 1994). However, even when attributions to physical illnesses are ignored, the prevalence of depressive disorders does not rise appreciably (Heithoff, 1995).

As well as epidemiological studies that examine the prevalence of depressive disorders, there are studies that examine age differences in scores on depressive symptom scales. The results of these studies are complex. Although some scales show a decrease in symptoms in the elderly, others show no age effect or an increase (reviewed by Ernst & Angst, 1995). Ernst & Angst (1995) have argued that scales showing an increase are those that have a larger proportion of somatic items. These items are sensitive to the higher prevalence of physical illnesses in the elderly. Consistent with this possibility, Newmann (1989) pooled data from several studies using the Center for Epidemiologic Studies Depression Scale and found that scores declined from young adulthood to old age, but then rose again in the very elderly. Blazer *et al.* (1991) also found an increase in depressive symptoms from age 65 to 85, but this trend actually reversed once other factors such as physical illness, disability, cognitive impairment, marital status and income were statistically controlled. This finding implies that any increase in depressive symptoms in the very elderly is mediated by other factors. Newmann *et al.* (1996) have proposed a different explanation for the complex results, with depressive symptom scales. They suggest that depressive symptom scales reflect two depressive syndromes, a 'depressive syndrome' which is less common in the elderly and a 'depletion syndrome' which is more common. The depletion syndrome is supposed to be characterized by loneliness, lack of energy and sleep disturbance.

While age differences in depression have received a lot of attention since the publication of the ECA results, there has been little interest in anxiety, despite the high co-morbidity of anxiety and depressive disorders and the similar age trend in prevalence (Regier *et al.* 1993). Using latent trait analysis, Goldberg *et al.* (1987) found that two correlated dimensions of anxiety and depressive symptoms underlie neurotic disorders. Mackinnon *et al.* (1994) later extended this approach to the elderly. Mackinnon *et al.* (1994) also found correlated dimensions of anxiety and depression, as well as a third, minor, dimension involving sleep disturbance. However, in the elderly, the thresholds and slopes of the items in the latent trait analysis showed a number of differences from the younger sample

studied by Goldberg *et al*. (1987). These results imply that individual symptoms do not relate to the underlying anxiety and depression factors in a consistent way across age groups. In a recent review of the prevalence of anxiety diagnoses in those over 65 years (Krasucki *et al*. 1998) a call was made for more extensive dimensional analysis of anxiety syndromes and symptoms. The authors suggested that anxiety may de-differentiate in later years 'possibly interchanging over time with depression' (p. 95), or increasing with the onset of cognitive decline or cardiovascular illness. It was suggested that three components of anxiety (psychic, somatic and behavioural) may load differentially on anxiety syndromes, and that somatic symptoms may be found to decline with age while other symptoms such as agitation might increase with concurrent cognitive decline.

In the present study, we report a structural equation modelling analysis of depression and anxiety symptoms collected in a large general population sample covering the age range 18–79 years. Structural equation modelling allowed us to test whether correlated anxiety and depression factors underlie the symptoms, to assess the effects of age on the underlying factors, and to see whether age has direct effects on some of the symptoms. If age has a direct effect on a symptom, independent of its effect on the underlying factors, then that symptom can be considered to provide a biased measure. Such measurement bias occurs when age has either a greater or lesser relationship with a symptom than it does with the factors underlying the symptoms. To show the robustness of any age differences, we report separate analyses of two scales designed to measure both depression and anxiety symptoms.

METHOD

Sample

Participants were recruited from the Electoral Roll for Canberra, Australia. Enrolment to vote is compulsory for all Australian citizens aged 18 or over. Interviews were completed with 2725 individuals, representing a response rate of 67% from those who were contactable. The achieved sample was 52% female. The age breakdown was 22% aged 18–29, 23% aged 30–39, 27% aged 40–49, 16% aged 50–59, 8% aged 60–69 and 5% aged 70–80. Compared with the Canberra population, the age group 18–29 was under-represented (22% *v*. 27%) and the age group 40–49 over-represented (27% *v*. 23%), but otherwise the sample closely matched the age distribution in the population. Two thousand six hundred and twenty-two of the respondents who provided complete data on two of the anxiety and depression scales were included in the analysis presented here. Of these, 1262 were male and 1360 were female. Their mean age was 42·41 years (range 18–79).

Table 1. *Percentage responding to items on the Goldberg Anxiety and Depression Scales*

Item	Yes %	No %
Anxiety		
Have you felt keyed up or on edge?	54·6	45·4
Have you been worrying a lot?	46·4	53·6
Have you been irritable?	43·1	56·9
Have you had difficulty relaxing?	47·0	53·0
Have you been sleeping poorly?	43·5	56·5
Have you had headaches or neckaches?	48·3	51·7
Have you had any of the following: trembling, tingling, dizzy spells, sweating, diarrhoea or needing to pass water more often than usual?	29·2	70·8
Have you been worried about your health?	34·5	65·5
Have you had difficulty falling asleep?	30·6	69·4
Depression		
Have you been lacking in energy?	45·2	54·8
Have you lost interest in things?	21·4	78·6
Have you lost confidence in yourself?	18·3	81·7
Have you felt hopeless?	16·4	83·6
Have you had difficulty concentrating?	31·8	68·2
Have you lost weight (due to poor appetite)?	7·6	92·4
Have you been waking early?	39·1	60·9
Have you felt slowed up?	43·2	56·8
Have you tended to feel worse in the mornings?	70·6	29·4

Questionnaire

Participants were asked to complete a questionnaire which covered sociodemographic characteristics, personality, anxiety and depression symptoms, alcohol abuse, life events, social support and childhood experiences. This was done under the supervision of a professional interviewer. The components of the questionnaire relevant to the present paper are the anxiety and depression scales of Goldberg *et al*. (1988) and the Personal Disturbance Scale (sAD) of the Delusions-Symptoms-States Inventory (DSSI) (Bedford *et al*. 1976; Bedford & Deary,

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Table 2. *Percentage responding to items on the DSSI*

Item	Not at all %	A little %	A lot %	Almost unbearably %
Anxiety				
Recently, I have worried about every little thing	44·8	44·9	9·2	1·1
Recently, I have been breathless, or had a pounding of my heart	72·4	22·7	4·5	0·4
Recently, I have been so 'worked up' that I could not sit still	71·2	23·8	4·5	0·5
Recently, for no good reason, I have had feelings of panic	81·1	15·6	2·7	0·6
Recently, I have had a pain, or tense feeling in my neck or head	53·7	32·3	12·4	1·6
Recently, worrying has kept me awake at night	59·6	31·8	7·9	0·7
Recently, I have been so anxious that I couldn't make up my mind about the simplest thing	76·6	19·6	3·4	0·4
Depression				
Recently, I have been so miserable that I have had difficulty with my sleep	68·0	24·4	6·7	0·2
Recently, I have been depressed without knowing why	68·5	25·3	5·3	0·9
Recently, I have gone to bed not caring if I never woke up	89·9	2·3	2·3	0·5
Recently, I have been so low in spirits that I have sat for ages doing absolutely nothing	75·8	19·3	4·3	0·7
Recently, the future has seemed hopeless	74·6	20·2	4·3	0·9
Recently, I have lost interest in just about everything	82·2	14·3	3·0	0·6
Recently, I have been so depressed that I have thought of doing away with myself	93·0	5·8	1·0	0·3

1997). The Goldberg scales consist of nine anxiety and nine depression items (depression and anxiety subscales). The items are coded 0 (no), 1 (yes) with subjects reporting these responses to 'some specific questions about your health and how you have been feeling in the past month'. The items and the percentage endorsing each item are shown in Table 1. The DSSI/sAD consists of 14 items coded 1 (not at all) to 4 (almost unbearably). Seven items assess anxiety and seven items assess depression (anxiety and depression subscales). Participants responded to these symptoms over the past month. The definition of the items, their original allocation to depression and anxiety factors and the percentage of responses in each category are shown in Table 2.

Survey procedure

Persons selected at random from the Electoral Roll were sent a letter informing them about the survey and saying that an interviewer would contact them soon to see if they wanted to participate. If a person agreed to participate, the interviewer visited them at some convenient location, usually the participant's home. To encourage frank responses, the questionnaire had an ID number, but not the participant's name. After completing the questionnaire, the participant sealed it in an envelope and gave it to the interviewer.

Analysis

A multiple indicator, multiple cause model (MIMIC) (Muthén, 1988; Bollen, 1989; Gallo *et al.* 1994) was used to analyse the data from the DSSI and Goldberg Scales. Fig. 1 shows the form of the model as it was applied to the Goldberg scales. The core of the model consists of the two-factor measurement model for the Goldberg scales with nine items loading on each of the anxiety and depression latent factors. Five demographic covariates, namely, age, sex, marital status, educational level and financial status

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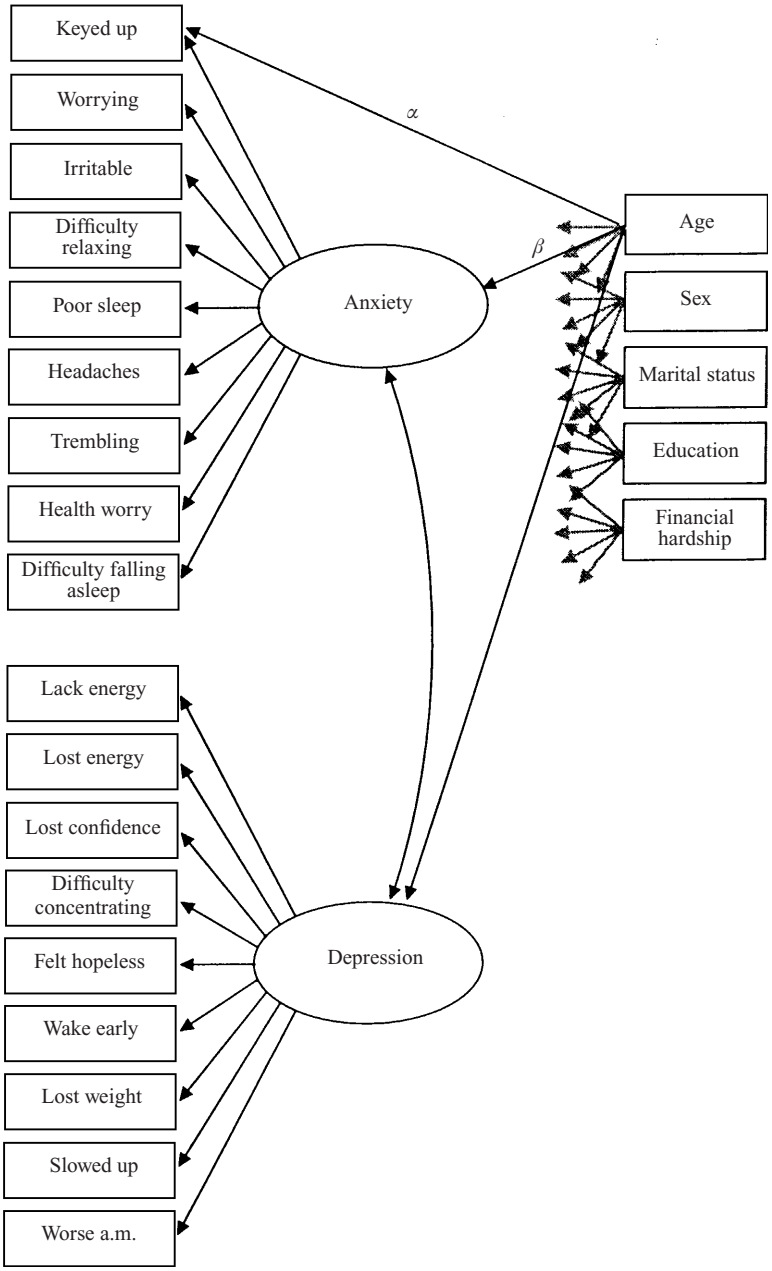

FIG. 1. MIMIC model for simultaneously assessing the effects of demographic variables on anxiety and depression and differential effects on individual items. In the full model, each covariate has a path to the anxiety and depression factors and to each item of both factors. In the diagram, paths from age to the two latent factors are shown (β) as is one path from age to one anxiety item (α). The short arrows on the right from the covariates indicated truncated paths from each covariate to each of the nine anxiety items. If all paths were shown, each covariate would have two paths to the latent factors and 18 paths to each of the items. For clarity, unique variance components of each anxiety and depression item and the free correlations between the covariates are not shown.

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were included in the model as predictors of the two latent variables. All five covariates were measured directly, that is, they were measured by only one indicator, which is presumed free of measurement error. As a result, this part of the model may be thought of as a multiple regression of the two latent variables against the covariates. In addition to estimating the effect of the covariates on the latent factors, the model allows the effects of age on each of the items to be assessed directly. The differential effects of the covariates (e.g. age) can be assessed by a direct path from the covariate to the item. If, for example, older respondents are more likely to report being 'keyed up' than are younger respondents with the same level of anxiety, a significant positive coefficient (α) on the path from age to 'keyed up' will be observed. The effect can be detected even if, overall, there is a decline in anxiety with age. The latter effect should be evidenced by a negative coefficient (β) on the path from age to anxiety. A significant α coefficient indicates Differential Item Functioning (DIF) or item bias.

The advantages of the MIMIC model are that the effects of the covariates on the latent factors can be measured simultaneously, allowing the effects of age to be assessed while also estimating the effects of other covariates such as sex. The direct effect of age on each of the items can also be assessed simultaneously, thereby estimating the effects of age while controlling for the effects of sex, marital status, education and financial hardship.

The Goldberg and DSSI scales were analysed separately for two reasons. First, this allowed more ready comparison with previous studies which have used only one of these scales. Secondly, the scales involve different ratings (a binary (yes/no) response for Goldberg and a four-point Likert scale for the DSSI). Combining them could have produced nuisance factors.

The MIMIC model as implemented here requires scaled or dichotomous covariates. Questions in the survey not yielding such data were therefore recoded as follows: marital status was classified as being currently married *versus* never married, divorced, separated or widowed. Education was dichotomized to contrast those having no more than secondary education (only primary or secondary schooling) with those with tertiary education. Financial hardship was indicated by the endorsement of 'Yes, often.' in response to a question concerning going without necessities due to lack of money.[1] While seen as desirable, it was not possible to include employment status as a variable due to the small number of respondents who reported being unemployed. Analyses entered age as a continuous measure. Where required for descriptive purposes, four age groups, each spanning approximately 15 years, where formed. Prevalence of each categorization is shown in Table 3.

Analysis proceeded in two phases. First, confirmatory factor models were fitted to the data for the Goldberg and the DSSI scales. These analyses were designed to confirm in our sample the factor structure previously reported for these scales. The two factor solution was tested for the Goldberg scales. One and two factor solutions were tested for the DSSI items following Bedford & Deary (1997). The second phase of the analysis involved the fitting of the MIMIC model described above to the Goldberg and DSSI items.

Maximum likelihood parameter estimates for all models were obtained using AMOS 3.6.1 (Arbuckle, 1997). In addition to the chi-square test, goodness-of-fit was evaluated using the goodness-of-fit index (GFI) (see Jöreskog & Sorböm, 1993), Bentler & Bonett's (1980) non-normed fit index (NNFI) and the root mean square error of approximation (RMSEA) (Browne & Cudeck, 1992). The NNFI indicates how well a model fits, relative to a model specifying no relationships between any of the variables. Values of the GFI and NNFI $> 0{\cdot}90$ are indicative of well-fitting models (see Marsh *et al.* 1988). Work by Rigdon (1996) has demonstrated the utility of the RMSEA as an index of the degree to which a confirmatory structure approximates the data being modelled. Browne & Cudeck (1992) have suggested that values of 0·05 and below indicate a close fit of the model and that values of the RMSEA

[1] The recoding of the dichotomous variables was determined by categorizing responses into groups likely to differ in levels of depression and anxiety, and by the numbers of subjects in the resulting groups. An alternative coding for marital status was also examined. The married and the never married were combined into one category and compared to those divorced, separated, or widowed. When this coding was substituted into the full model, there was very little change. All but one of the covariate coefficients produced the same significant or non-significant association with anxiety or depression, and the direction and size of the specific effects for marital status remained largely unchanged.

Table 3. *Means and standard deviations of Goldberg and the DSSI Anxiety and Depression Scales by age, sex, marital status, education and financial hardship*

	Goldberg		DSSI	
	Anxiety	Depression	Anxiety	Depression
Age group*				
18–34 ($N = 823$)	4·17 (2·75)	2·83 (2·37)	10·36 (3·24)	9·27 (3·09)
35–49 ($N = 1028$)	3·91 (2·76)	2·57 (2·38)	9·97 (2·92)	8·84 (2·74)
50–64 ($N = 563$)	3·31 (2·76)	2·18 (2·31)	9·64 (2·83)	8·52 (2·69)
$\geqslant 65$ ($N = 208$)	2·76 (2·58)	2·03 (1·84)	9·19 (2·08)	8·05 (2·18)
Sex*				
Male ($N = 1262$)	3·32 (2·70)	2·22 (2·20)	9·47 (2·68)	8·55 (2·49)
Female ($N = 1360$)	4·19 (2·78)	2·80 (2·44)	10·40 (3·14)	9·92 (3·08)
Marital status*				
Not married ($N = 827$)	4·05 (2·85)	2·95 (2·47)	10·43 (3·29)	9·52 (3·37)
Married ($N = 1795$)	3·64 (2·74)	2·33 (2·25)	9·74 (2·78)	8·53 (2·48)
Education*				
Primary or secondary ($N = 1803$)	3·90 (2·83)	2·69 (2·40)	10·41 (3·09)	9·01 (2·99)
Tertiary ($N = 819$)	3·48 (2·62)	2·15 (2·16)	9·54 (2·62)	8·48 (2·40)
Financial hardship*				
No ($N = 2394$)	3·61 (2·73)	2·38 (2·26)	9·78 (2·80)	8·67 (2·62)
Yes ($N = 228$)	5·48 (2·70)	4·01 (2·66)	11·87 (3·87)	10·67 (2·83)

* $P < 0·05$ for Goldberg Anxiety, Goldberg Depression, DSSI Anxiety and DSSI Depression.

between 0·05 and 0·08 indicate a reasonable error in approximating a given structure. The pr(RMSEA $\leqslant$ 0·05) indicates the probability that the structure of the model provides an acceptably close fit to the data. Because maximum likelihood estimation assumes multivariate normality, there was concern that standard errors produced under this method may not be accurate. Therefore, following Yung & Bentler (1966), confidence intervals reported here were obtained by bootstrapping using 500 resamplings from the original sample.

RESULTS

Means for the Goldberg and DSSI scales for the subgroups defined by the demographic covariates are shown in Table 3. Lower levels of DSSI and Goldberg Anxiety and Depression were associated significantly with being older, being male, being married, and having a tertiary education qualification. Higher levels of anxiety and depression were associated with reporting financial hardship. Cronbach's alpha was 0·82 for the Goldberg Anxiety Scale and 0·78 for the Depression Scale. No substantial differences in internal consistency were noted when alpha was calculated separately for each age group. For the DSSI, Cronbach's alpha was 0·80 for the anxiety items (range 0·67 to 0·81) and 0·86 for the depression items (range 0·88 to 0·85).

Confirmatory factor analysis

Goldberg scales

The two factor model was fitted to the full sample data. The two factors were permitted to correlate freely. The goodness-of-fit indices indicated only moderate fit ($\chi^2 = 2233·9$, df = 134, $P < 0·0001$; GFI = 0·91; NNFI = 0·83; RMSEA = 0·08, Pr (RMSEA < 0·05) = 0·001). To improve fit, residuals of five pairs of items were permitted to correlate: 'Keyed up' and 'Worrying'; 'Difficulty falling asleep' and 'Poor sleep'; 'Trembling' and 'Health worry'; 'Lack energy' and 'Slowed up'; 'Lost confidence' and 'Felt hopeless' (see Fig. 2). This procedure recognizes that some items, due to similar wording or content, are more closely related than can be accounted for by the underlying factor they measure. Residuals were not permitted to correlate across factors, thus maintaining the essential independence of the items measuring anxiety and depression in the model. The introduction of these parameters resulted in a dramatic improvement in model fit ($\chi^2 = 1040·00$, df = 129, $P < 0·0001$; GFI = 0·96;

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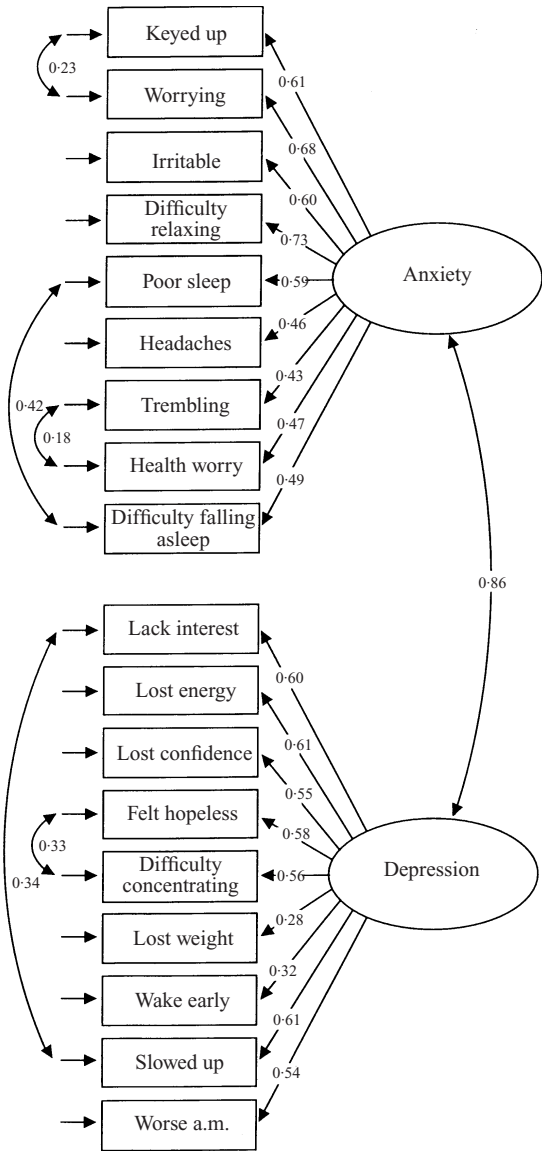

FIG. 2. Confirmatory factor model for the 18-item Goldberg scales showing standardized coefficients for the model fitted to the total sample. (All coefficients are statistically significant.)

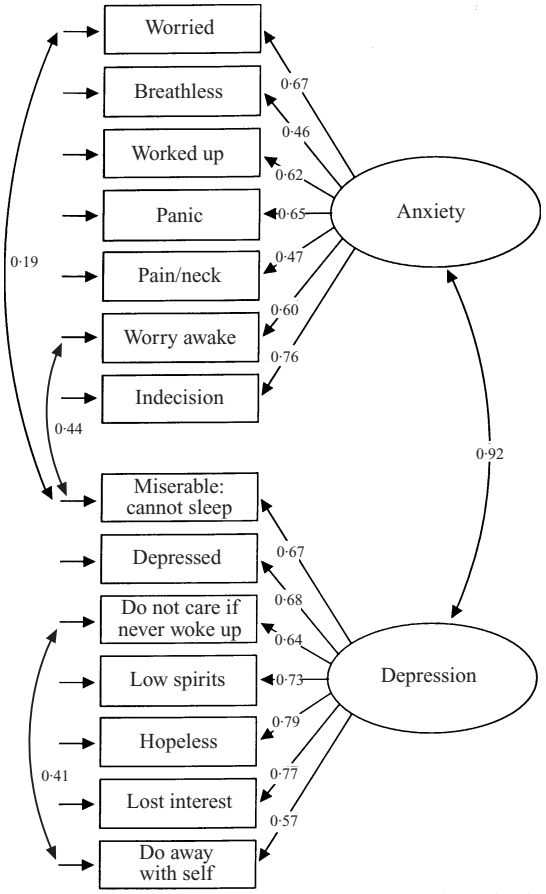

FIG. 3. Confirmatory factor model for the 14-item DSSI scales showing standardized coefficients for the model fitted to the total sample. (All coefficients are statistically significant.)

NNFI = 0·92; RMSEA = 0·05, Pr (RMSEA $\leqslant$ 0·05) = 0·14) without any appreciable change in the loadings on items on their respective factors. All items were significantly associated with their respective factor and the loadings ranged from 0·43 to 0·73 for the anxiety factor and between 0·28 and 0·66 for the depression factor. The low loading of 0·28 was for the item 'Lost weight' which was endorsed by only a small percentage of the sample. The correlation between anxiety and depression was 0·86.

DSSI

The two factor model was fitted to the full sample data. The two factors were allowed to correlate freely. The goodness of fit indices indicated a modest to poor fit ($\chi^2 = 1731{\cdot}62$, df = 76, $P < 0{\cdot}0001$; GFI = 0·91; NNFI = 0·88; RMSEA = 0·09, Pr (RMSEA $\leqslant$ 0·05) = 0·000). However, allowing the residuals of three item pairs to correlate ('Recently, I have been so miserable that I have had difficulty with my sleep' and 'Recently, worrying has kept me awake at night'; 'Recently, I have been so miserable that I have had difficulty with my sleep' and 'Recently I have worried about every little thing'; 'Recently, I have gone to bed not

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caring if I never woke up' and 'Recently, I have been so depressed that I have thought of doing away with myself') resulted in a large drop in chi-square and an increase in agreement between all measures of fit ($\chi^2 = 680{\cdot}90$, df = 73, $P < 0{\cdot}0001$; GFI = 0·961; NNFI = 0·952; RMSEA = 0·056, Pr(RMSEA < 0·05) = 0·003). This procedure recognizes the fact that these items were more closely related than can be accounted for by the underlying factors they measure. The resulting model is shown in Fig. 3.

The two latent variables of anxiety and depression correlated very highly (0·92). Given this, a single factor model was fitted. This modification involved fixing the correlation between the scales at 1·0. This equates the two factors and allows a formal test of one factor against a two factor model. However, this model provided a poorer fit than the two factor model (increase in $\chi^2 = 209{\cdot}01$, df = 1, $P < 0{\cdot}0000$, with the same residuals correlated as above.) Consequently, the two factor model was preferred and formed the basis of the MIMIC model described below.

The MIMIC model

The MIMIC model discussed above and shown in Fig. 1 was fitted to the data from the Goldberg and DSSI scales. The aim of the analysis was to determine whether age effects on each of the items were not able to be accounted for by the effect of age on the latent variable (see Fig. 1). The final model for each of the scales was developed by first allowing paths from each covariate to each of the latent variables (for example, paths were allowed from age to each of the anxiety and depression factors). Additional paths representing direct effects from each covariate to each individual item were then tested (for example, paths from age to each item). Because the direct covariate-item paths are measuring a differential effect, at least one path for each latent variable must be constrained to zero in order to serve as a reference point against which the effect of each covariate on the other items is assessed. The item fixed on each subscale was chosen by applying the model to only one item at a time and determining those which had no significant associations with any of the five covariates. This item (or the item with the weakest non-significant associations) was then selected and its paths constrained to zero. This simplified interpreting the parameters in the model. For the Goldberg scale the constrained anxiety item was 'Health worries' and the constrained depression item was 'Worse in the morning'. For the DSSI, the constrained anxiety item was 'Indecision' and the constrained depression item was 'Low spirits'. These items had no significant associations with any covariate. The final fit statistics for the full model for the Goldberg scales were as follows: $\chi^2 = 1003{\cdot}39$, df = 129, $P < 0{\cdot}0001$; GFI = 0·97; NNFI = 0·88; RMSEA = 0·05, pr(RMSEA ⩽ 0·05) = 0·31. The statistics for the DSSI were $\chi^2 = 669{\cdot}53$, df = 73, $P < 0{\cdot}0001$; GFI = 0·97; NNFI = 0·92; RMSEA = 0·056, pr(RMSEA ⩽ 0·05) = 0·006.

Further models which included only the significant direct paths did not substantially affect the remaining paths but did improve fit indices that penalize additional parameter usage. The fit indices for models including only significant paths for the Goldberg were as follows: $\chi^2 = 1056{\cdot}30$, df = 182, $P < 0{\cdot}0001$; GFI = 0·97; NNFI = 0·94; RMSEA = 0·043, Pr(RMSEA ⩽ 0·05) = 1·000). The fit indices for significant paths for the DSSI were ($\chi^2 = 752{\cdot}09$, df = 115, $P < 0{\cdot}0001$; GFI = 0·97; NNFI = 0·94; RMSEA = 0·046, Pr(RMSEA ⩽ 0·05) = 0·982).

Covariates and latent factors

Path coefficients and 95% bootstrap confidence intervals are shown in Tables 4 and 5. For the Goldberg scale, the latent anxiety factor correlated significantly with being female and having financial hardship while for the DSSI, greater anxiety was associated with being younger, being female, being unmarried and reporting financial hardship. Thus, associations between each of the covariates and the latent factors of anxiety were generally stronger on the DSSI than for the Goldberg scales. On both scales, increased depression was associated with being female, unmarried and having financial difficulties. Importantly, for both the DSSI and the Goldberg scales depressive symptoms declined with increasing age. For the DSSI, the standardized regression coefficient was −0·14 and for the Goldberg, the coefficient was −0·15.

Direct effects of age on individual items

Three items showed decreased endorsement in older individuals on the Goldberg anxiety

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Table 4. *Standardized path coefficients* (95% *bootstrap confidence intervals*) *for covariates on Goldberg factors and items*

Item	Age	Sex	Marital status	Education	Financial hardship
Anxiety factor	−0·08 (−0·16, 0·01)	**0·08 (0·01, 0·17)**	−0·07 (−0·15, 0·01)	−0·05 (−0·13, 0·03)	**0·21 (0·13, 0·29)**
Keyed up	−0·02 (−0·08, 0·04)	0·03 (−0·04, 0·09)	0·05 (−0·00, 0·11)	**0·06 (0·00, 0·11)**	−0·05 (−0·11, 0·02)
Worrying	**−0·07 (−0·13, −0·01)**	**0·06 (−0·01, 0·11)**	0·03 (−0·03, 0·08)	0·03 (−0·02, 0·08)	−0·00 (−0·06, 0·06)
Irritable	**−0·11 (−0·17, −0·05)**	0·02 (−0·05, 0·06)	**0·14 (0·09, 0·20)**	0·02 (−0·03, 0·07)	−0·01 (−0·07, 0·05)
Difficulty relaxing	−0·03 (−0·10, 0·03)	0·04 (−0·04, 0·09)	**0·09 (0·03, 0·16)**	0·05 (−0·02, 0·11)	−0·04 (−0·11, 0·02)
Sleeping poorly	0·04 (−0·02, 0·09)	0·000 (−0·06, 0·05)	0·02 (−0·03, 0·07)	−0·01 (−0·07, 0·04)	−0·03 (−0·09, 0·04)
Headaches	**−0·11 (−0·16, −0·06)**	**0·15 (0·10, 0·19)**	0·04 (0·00, 0·10)	−0·03 (−0·07, 0·02)	0·01 (−0·04, 0·05)
Trembling	0·01 (−0·04, 0·05)	**0·05 (0·01, 0·10)**	−0·02 (−0·06, 0·03)	−0·03 (−0·08, 0·01)	−0·00 (−0·06, 0·04)
Healthy worry	—	—	—	—	—
Difficulty falling asleep	−0·02 (−0·06, 0·04)	0·02 (−0·04, 0·07)	**−0·06 (−0·10, −0·01)**	−0·03 (−0·08, 0·02)	0·01 (−0·05, 0·07)
Depression factor	**−0·15 (−0·23, −0·07)**	**0·14 (0·07, 0·22)**	**−0·10 (−0·18, −0·03)**	−0·05 (−0·12, 0·02)	**0·17 (0·09–0·25)**
Lacking energy	−0·01 (−0·06, 0·05)	0·05 (−0·00, 0·09)	**0·05 (0·00, 0·10)**	−0·01 (−0·06, 0·04)	0·00 (−0·05, 0·05)
Lost interest	−0·02 (−0·07, 0·03)	**−0·08 (−0·14, −0·04)**	0·02 (−0·03, 0·08)	−0·03 (−0·09, 0·01)	−0·01 (−0·07, 0·04)
Lost confidence	0·04 (−0·02, 0·09)	0·04 (−0·01, 0·09)	−0·00 (−0·06, 0·05)	−0·01 (−0·06, 0·04)	0·01 (−0·04, 0·07)
Felt hopeless	−0·01 (−0·06, 0·04)	−0·01 (−0·05, 0·04)	−0·04 (−0·08. 0·02)	−0·02 (−0·07, 0·03)	**0·05 (−0·00, 0·11)**
Difficulty concentrating	0·01 (−0·05, 0·06)	**−0·07 (−0·12, −0·02)**	0·01 (−0·04, 0·08)	−0·01 (−0·06, 0·04)	−0·01 (−0·07, 0·04)
Lost weight	**−0·05 (0·09, 0·00)**	−0·01 (−0·05, 0·03)	**−0·08 (−0·13, −0·03)**	**−0·04 (−0·08, 0·00)**	**0·07 (0·02, 0·13)**
Waking early	**0·13 (0·09, 0·18)**	**−0·08 (−0·12, −0·04)**	0·01 (−0·03, 0·06)	−0·03 (−0·07, 0·02)	−0·01 (−0·06, 0·04)
Felt slowed up	**0·17 (0·12, 0·22)**	0·01 (−0·04, 0·05)	0·03 (−0·02, 0·08)	−0·02 (−0·07, 0·03)	0·02 (−0·03, 0·07)
Feel worse a.m.	—	—	—	—	—

Significant effects are indicated in bold type.

subscale: 'worry a lot'; 'irritability'; 'headaches or neckaches'. Three items of the DSSI anxiety subscale showed differential effects of age, with age being associated negatively with two items ('Worked up' and 'Pains in head and neck') and positively with 'Breathlessness'. For depression, there were significant direct age effects to the following items on the Goldberg scales: 'Wake early' and 'Slowed down' (with these increasing with age) and 'Lost weight' (which decreased with age). Age had direct positive effects on five depression items on the DSSI: 'Feeling so miserable this interfered with sleep', 'Feelings of not caring if never woke up', 'Hopelessness', 'Loss of interest', and 'Suicidal thoughts'.

Effects of sex, marital status, education and financial hardship

At the same level of anxiety as men on the latent factor of the Goldberg scales, women were more likely to 'worry a lot', have head or neckaches, and trembling or other somatic symptoms, but were less likely to endorse items such as loss of interest, difficulty concentrating and to wake early. Direct effects (of the type represented by α in Fig. 1) of sex were found for four anxiety

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Table 5. *Standardized path coefficients* (95% *bootstrap confidence intervals*) *for covariates on DSSI factors and items*

Item	Age	Sex	Marital status	Education	Financial hardship
Anxiety factor	**−0·11 (−0·16, −0·06)**	**0·11 (0·06, 0·15)**	**−0·07 (−0·12, −0·01)**	−0·05 (−0·09, 0·01)	**0·17 (0·11, 0·25)**
Worried	0·03 (−0·01, 0·07)	**0·06 (0·03, 0·10)**	0·03 (−0·00, 0·07)	−0·03 (−0·06, 0·01)	0·00 (−0·05, 0·04)
Breathless	**0·09 (0·05, 0·13)**	−0·02 (−0·06, 0·01)	−0·02 (−0·06, 0·03)	**−0·05 (−0·08, −0·00)**	−0·00 (−0·05, 0·04)
Worked up	**−0·04 (−0·08, 0·00)**	**−0·05 (−0·08, −0·01)**	−0·02 (−0·06, 0·03)	−0·01 (−0·05, 0·03)	0·4 (−0·02, 0·09)
Panic	0·02 (−0·02, 0·06)	**0·04 (−0·00, 0·07)**	**−0·04 (−0·08, 0·00)**	0·00 (−0·04, 0·04)	−0·04 (−0·09, 0·01)
Pain	**−0·04 (−0·08, −0·01)**	**0·12 (0·08, 0·15)**	0·02 (−0·02, 0·05)	−0·01 (−0·05, 0·03)	**0·06 (0·01, 0·10)**
Worry awake	0·02 (−0·01, 0·06)	0·01 (−0·03, 0·05)	−0·00 (−0·04, 0·04)	0·00 (−0·03, 0·04)	0·03 (−0·02, 0·08)
Indecision	—	—	—	—	—
Depression factor	**−0·14 (−0·19, −0·09)**	**0·06 (0·01, 0·11)**	**−0·16 (−0·11, −0·01)**	**−0·07 (−0·21, −0·10)**	**0·20 (0·13, 0·27)**
Miserable, cannot sleep	**0·06 (0·02, 0·10)**	**0·06 (0·02, 0·10)**	**0·05 (0·01, 0·10)**	−0·03 (−0·06, 0·01)	0·00 (−0·05, 0·05)
Depressed	−0·01 (−0·05, 0·03)	**0·05 (0·02, 0·09)**	**0·05 (0·01, 0·09)**	0·01 (−0·03, 0·05)	**−0·05 (−0·11, −0·01)**
Do not care if never woke	**0·07 (0·03, 0·11)**	−0·01 (−0·05, −0·02)	−0·00 (−0·05, 0·04)	0·00 (−0·03, 0·04)	−0·01 (−0·07, 0·04)
Low spirits	—	—	—	—	—
Hopeless	**0·06 (0·02, 0·10)**	−0·02 (−0·06, 0·02)	−0·00 (−0·05, 0·04)	0·03 (−0·00, 0·08)	0·02 (−0·03, 0·07)
Lost interest	**0·06 (0·03, 0·10)**	−0·01 (−0·05, 0·02)	**0·06 (0·02, 0·10)**	0·00 (−0·04, 0·03)	**−0·05 (−0·11, −0·01)**
Do away with self	**0·06 (0·01, 0·09)**	−0·02 (−0·05, 0·02)	0·02 (−0·02, 0·07)	0·03 (−0·00, 0·07)	−0·03 (−0·09, 0·03)

Significant effects are indicated in bold type.

items of the DSSI scale: 'worried', 'worked up', 'panic' and 'pain', and two depression items: 'miserable' and 'depressed'. Direct effects of marital status, financial difficulty and education for the Goldberg and DSSI scales are shown in Tables 4 and 5.

DISCUSSION

Structural equation modelling was used to test whether correlated anxiety and depression factors underlie the symptoms on two scales used to measure depression and anxiety, to assess the effects of age on the underlying factors and to see whether age has direct effects on some of the symptoms. The two scales were used to examine the robustness of the direct effects of age.

Confirmatory factor analyses

Both scales were found to fit well to the two factor model with anxiety and depression as separate yet highly correlated latent factors. However, the Goldberg items identified more distinctly the anxiety and depression factors than did the DSSI items. The analyses reported here are consistent with the latent trait analyses undertaken on medical patients (Goldberg, 1987) and the elderly (Mackinnon *et al*. 1994). The high correlation of anxiety and depression for the DSSI, and the need to correlate residuals across factors suggests that some of the DSSI depression items may correlate as well with both anxiety and depression latent factors, findings which are consistent with Bedford & Deary's (1997) recent exploratory and confirmatory factor analysis of the sAD scale. They reported

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that the sAD scale as a whole 'had coherence as a general psychological scale' (p. 503). The model which best fitted the structure of the scale on their psychiatric sample was one where item variance was contributed by general psychiatric disturbance in addition to anxiety- or depression-specific variance. In these analyses, as in those reported in this study, residual variances were permitted to correlate for the two sleep items in order to fit the scale satisfactorily, and the 'miserable, can't sleep' item loaded highly on both the anxiety and depression factors, suggesting that problems with fit may be due to the structure of the items rather than the samples used.

Age effects and age specific effects for anxiety

Age was found to correlate negatively with the factor of anxiety on the DSSI scale, but not the Goldberg scale, although there was a trend for the latter in the same direction. Direct effects of age were found for breathlessness, feeling worked up and reports of physical symptoms such as pain and tension in head or neck. A similar set of direct age effects were found for the Goldberg scale, with older age being associated with a reduction in headaches, worrying and irritability. These findings were rather surprising, since it may have been expected that sleep difficulties would have been positively associated with age, and that symptoms of physical disorder such as aches and pains would increase with age. These findings, which are not dissimilar across the scales, require further investigation. The findings as they stand suggest that the nature of anxiety may change with age, with a reduction in the intensity of symptoms, such as decreases in complaints of physical tension and headache.

Age effects and age specific effects for depression

Age was found to correlate negatively with the depression factor of each scale, confirming other findings that depression decreases with age. In addition, direct age effects were found for both of the scales, although the items which were found to be biased differed for the two scales. For a given level of depression on the Goldberg scales, 'waking early' and 'feeling slowed up' were more likely to be endorsed by elderly people, while 'losing weight' was more likely to be endorsed by younger participants. On the DSSI, the items 'miserable', 'can't sleep', 'hopeless' and items reflecting loss of interest in living: 'loss of interest' and 'suicide thoughts' were significantly associated with age. These findings do not necessarily reflect a lack of consistency in the findings across the scales, since the items used in the scales differ quite markedly from each other.

The findings from the Goldberg scale suggest that direct age effects may reflect an increase in somatic complaints, as has been suggested by Ernst & Angst (1995), albeit that items reflecting weight loss are more likely to be endorsed by the young. The findings from the DSSI suggest that the depression picture for elderly persons may be characterized by a diminished or reduced evaluation of the future. Being older was associated with a loss of interest in living. This may not so much reflect an elderly person's urgent need to do away with themselves because living is too painful (considered a severe symptom of major depression), but rather an acceptance that the future is limited, that lifetime pursuits are necessarily reduced, that opportunities are less available and that motivation is lower. In short, these findings suggest that the nature of depression may differ across age and that the elderly may have a depression picture that is characterized by changes in two components: one somatic, linked to physical changes ('feeling slowed down'; 'waking early') and the other psychological, reflecting a recognition of contracting opportunities and a belief in the futility of life ('hopeless about the future').

It is of interest that the DSSI identified a direct age effect on hopelessness and loss of interest while the Goldberg did not. This may have been a function of the manner in which the questions were asked. For the DSSI, the hopeless item is phrased in terms of the future rather than the present. The item reads 'Recently the future has seemed hopeless', while the Goldberg asks 'Have you felt hopeless?'. The lost interest question is also phrased differently; 'Recently, I have lost interest in just about everything' compared to the Goldberg phrasing 'Have you lost interest in things'. It may be that the DSSI items reflect a general view that ageing is associated with reduced opportunities for the

future. Related views about hopelessness characterizing the nature of depression in older age have been expressed by Abramson *et al*. (1989) and reported by Gatz *et al*. (1996). There was little support for the depletion syndrome hypothesis of Newmann *et al*. (1996), since only one of the two symptoms of the triad measured by the present items ('sleep disturbance' *v*. 'lack in energy') was associated with a specific age effect.

Gallo *et al*. (1994), using a MIMIC model, reported age effects on symptoms with age, those showing a decrease with age were dysphoria, anorexia, weight change or agitation, while those showing an increase with age were sleep difficulty, tiredness, thinking about death. It is difficult to compare directly these findings with those of the present study because Gallo *et al*.'s work was based on an analysis of items from the Diagnostic Interview Schedule (DIS). Each of these items covers a broader range of symptoms than do the individual Goldberg or DSSI items. For example, the item which measures dysphoria from the DIS uses multiple descriptors of dysphoria and anhedonia, viz: 'Have you ever had two weeks or more during which you felt sad, blue, depressed, or when you lost all interest and pleasure in things that you usually cared about or enjoyed?'. A number of the DSSI and Goldberg items covered aspects included within this item ('Lost interest'; 'Depressed') but no items directly tapped loss of pleasure, or 'sad' or 'blue' feelings. One item which reflected the DIS dysphoria/anhedonia question ('Lost interest') did shown a differential age effect on the DSSI but in the opposite direction to that found by Gallo *et al*.

Gender effects on depression and anxiety scales

The data from the present study are also informative about the direct effects of sex, marital status, education and financial hardship on items for the two scales. Although an analysis of these differential effects is not central to aims of the present paper (these variables were included to control for their influence on depression and anxiety), they point to the existence of important gender effects in these depression scales. The pattern of associations between marriage, education and financial hardship and anxiety or depression are consistent with previous reports, for example, those showing the protective effects of marriage on emotional state. Being female was associated with an increased level of anxiety and depression, consistent with many epidemiological studies (see Bebbington, 1998). In addition, women had a different depression profile to men. Thus, for the same level of depression, women were more likely to report feelings of being worried, having panic, reporting pain and neck or head tension, and being more miserable and depressed, whereas men were more likely to feel worked up. As summarized by Bebbington (1998), it has been claimed that women have cognitive or personality styles which differ from men, such as the tendency to engage in greater rumination (Nolen-Hoeksema *et al*. 1993) and our findings are consistent with this interpretation. It may also be the case that men show greater arousal than do women at the same level of depression.

Methodological considerations

While the present results confirm a decrease in depression and anxiety symptoms with age, several caveats must be given. First, item bias can only be judged relative to other items in the pool. If the set of items selected happened all to be biased in the same direction, this could not be detected except by evaluating them against some external gold standard. However, the fact that similar results emerged using two different scales increases confidence in the conclusions. Secondly, our data are cross-sectional and any age group differences could reflect either ageing or cohort effects. Thirdly, the procedure to identify age bias in specific items required that two items from each scale were constrained. The two items constrained for each of the DSSI and Goldberg scales were very different. The possibility cannot be ruled out that the different age bias effects between the scales were due to the nature of the constrained items. Nevertheless, the findings point to the importance of further research using a number of scales with a greater pool of items with similar scoring systems to confirm the possibility of two previously described factors underlying the age bias effects in depression.

Given the size of the sample used, statistical significance does not necessarily indicate that the effects have clinical or epidemiological significance. This must be derived from a consideration of the size of the path coefficients. An indication of the magnitude of the differential

effects is most easily seen in the case of the dichotomous responses to the Goldberg inventory. For a dichotomous predictor, the unstandardized path coefficients reflect the predicted difference between the two categories (e.g. males *v*. females) in item endorsement, for the sample as a whole. For age, the sole scaled predictor in the analysis, this coefficient reflects the change in predicted endorsement for a one year increase in age. In both cases, these changes are net of change due to the latent variable and other covariates. That is, even when adjustments are made for the effects of the other covariates, and the level of the latent variables, these differences will persist. The significant raw coefficients range from changes of approximately 5% to 15% in predicted endorsements rates for the dichotomous predictors, and 1% to 6% for a 10-year increment in age. If these symptoms were incorporated into an algorithm to produce diagnoses, effects of such magnitude could have a substantial effect on case rates. Because no similar interpretation of raw or standardized path coefficients is possible for the DSSI, whose items are coded on a four point ordinal scale, it is less easy to assess the practical significant of the paths representing differential effects. There is, however, no reason to suspect that the effects on this instrument would be less than on the Goldberg scales for standardized coefficients of similar magnitude.

Conclusions

The central findings of the present study are that anxiety and depression are highly correlated but distinct entities. The prevalence of depressive symptoms is lower in older people. The nature of the depression experienced by younger and older people may be qualitatively different, and this difference may result from changes in two components of depression – one somatic and one psychological. The prevalence of anxiety may be lower in older adults, and its nature may also change across the lifespan. Anxiety in the elderly may be characterized by a reduced level of complaint about pain and physical tension. If age specific effects such as those reported in this study are replicated, these findings suggest that the emphasis of treatment strategies (both cognitive and pharmacological) may need to vary as a function of age (and gender).

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