Eur Arch Psychiatr Neurol Sci (1986) 236:75–82

European Archives of Psychiatry and Neurological Sciences

The Principal Component Structure of the General Health Questionnaire Among Greek and Turkish Adolescents*

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Summary. The 28-item version of the General Health Questionnaire was administered to Greek and Turkish school pupils in their mother country as well as to Greeks in Munich. Principal component analysis with varimax rotation was carried out separately for both the individual populations and sexes separately. Visual inspection of the matrices suggested overall agreement with the sub-scales obtained by Goldberg and Hillier (1979). The coefficient of factor similarity, calculated between matrices, suggested a highly similar principal component structure between the population samples as a whole and separately for the sexes living in their own country, but not between male and female Greek pupils in Germany. Highly similar component matrices were obtained for Greek males living in Greece with those in Germany, but not for females.

Key words: General health questionnaire – Principal component analysis – Adolescent psychiatry – Cross-cultural study

Introduction

The General Health Questionnaire (GHQ), designed by Goldberg (1972) in England as a self-administered instrument to screen for minor psychiatric illnesses, has been successfully used in primary care, hospital and community settings. Average sensitivity and specificity have been shown (Goldberg 1983) to be over 80% in 32 validity studies. Most of these validation studies have concerned adult populations so that it is necessary to revalidate the GHQ when investigating populations with different characteristics, e.g. adolescents. Since screening as well as case identification is complicated by lack of certainty as to whether the criteria applied should be those usually considered for children or adults it is not suprising that there are very few epidemiological studies among adolescents (Mann et al. 1983; Banks 1983). Based on a sample of 200 17-year-olds Banks (1983) determined validity coefficients for different versions of the GHQ in comparison to the Present State Examination (Wing et al. 1974). Using the GHQ-28 with a cutting score of 5/6, sensitivity and specificity were found to be very high at 100% and 85% respectively. In a study of 15-year-old schoolgirls in London (Mann et al. 1983) validation of GHQ scores was carried out in comparison to the Clinical Interview Schedule developed by Goldberg et al. (1970). In this study specificity of the GHQ-28 with a cutting score of 5/6 was comparable (89%), but sensitivity lower (54%), to that in the Banks' study. Although the GHQ has been designed to work optimally in a particular cultural environment, various studies demonstrated that average sensitivity (77.6%) and specificity (77,3%) in non-English speaking countries was slightly lower than that in English speaking countries (sensitivity: 82.1%; specificity: 84.3%). Based on the fact that the GHQ is almost as effective in non-English speaking countries as it is in the population for which it was originally intended, Goldberg (1983) concluded that there is a common language of psychological distress which cuts across cultural barriers.

The original questionnaire comprised 60 items from which shorter versions of 30, 20 and 12 best items were extracted. Also, based on the GHQ-60, Goldberg and Hillier (1979) developed the 28-item GHQ which incorporated four sub-scales, each comprising 7 items. On the basis of data obtained from 523 consecutive attenders at a group practice in South Manchester the first four factors, namely, somatic symptoms, anxiety and insomnia, social dysfunction and severe depression, were found to account for 59% of the total variance. Replication studies on 552 consecutive attenders in Blackwell's practice in Croydon (Goldberg and Blackwell 1970) and 4247 patients in 92 general practices in Greater Manchester (Marks et al. 1979) revealed very similar factor structures. Since its original publication the GHQ-28 version has not been extensively reported despite the potential advantages of using the four sub-scales for diagnostic refinement (Banks 1983).

There have been very few published investigations into the factor structure in other populations, especially those with a different cultural background. Medina-Mora et al. (1983) compared the factor structure of the GHQ obtained from 597 Mexicans attending an out-patient general hospital with the results obtained from general practice out-patients in North America (Goldberg et al. 1976) and England (Goldberg and Hillier 1979). Only 67% of the items in their GHQ-28 coincided with those included in the version by Goldberg and Hillier. The most striking differences between the versions were observed in sleep disturbance items. Whereas in both the Mexican and the black American population insomnia items factored out separately, in the English studies the items for insomnia and anxiety were combined. Chan and Chan (1983) carried out principal component analysis (PCA) based on the 30-item GHQ which they administered to 225 English speaking Chinese students attending the University of Hong Kong.

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* Dedicated to Prof. Dr. Dr. Heinz Häfner on the occasion of his 60th birthday.

They obtained five dimensions related to psychopathology, namely, anxiety, inadequate coping, depression, insomnia and social dysfunction. On the basis of 164 British and Irish students Parkes (1982) investigated the component structure of the 28-item GHQ in relation to the role of field dependence as measured by the Hidden Figures Test (Witkin and Goodenough, 1977). They reported a greater differentiation in the field independent group (FI) in comparison to the field dependent group (FD). In the FD group the first four components accounted for 59% of the total variance in comparison to 49% in the FI group. The four sub-scales derived by Goldberg and Hillier (1979) emerged more clearly in the principal component matrix for the FI group than for the FD group. Hobbs et al. (1983, 1984) carried out a factor analysis of the GHQ-60 based on responses from 1011 men and 1517 women in general practices. For 43 of the 60 items the same factor was "allocated" for both men and women. However, women tended to include somatic items with anxiety and men included depressive items with anxiety (Hobbs et al. 1984).

This report is part of a large-scale survey into anorexia nervosa and other psychological symptoms among Greek pupils in Greece and West Germany as well as Turkish pupils in Turkey. Epidemiological studies in different countries using identical methodological procedures can help to elucidate some socio-cultural factors associated with psychological disorders. Immigrants from Greece to West Germany are exposed to many new social influences which affect family norms, values and structure. This process of adaptation to a new environment can in some cases cause a disruption in the individual or the family system. We evaluated the principal component structure of the GHQ-28 in male and female adolescents living in Greece with those in Turkey as well as with a sample of young Greeks living in Germany in order to investigate to what extent a common language exists in which psychological distress may be transmitted cross-culturally and cross-sexually. In common with other methodology (Goldberg and Hillier 1979; Parkes 1982; Chan and Chan 1983) we examined the matrices obtained by PCA following varimax rotation.

Method

The GHQ was administered to students of both sexes aged between 13 and 19. Three surveys of the following groups were completed (Table 1): (a) the total school population of 2700 Greek pupils in the provincial Greek town of Veria in Macedonia, (b) all 867 Greek pupils who attended Greek schools and whose parents had moved from Greece to Munich as immigrant workers, and (c) 2784 Turkish pupils in five schools (three state and two private) in Istanbul. However, we were unable to obtain permission to survey young Turks living in the Federal Republic of Germany.

The average age of the pupils was 14.5 years in Munich, 15.1 in Veria and 15.4 in Istanbul. In the first stage of a two-stage procedure a 45-item GHQ, comprising all items in the 28-item and 30-item versions of Goldberg, was administered in addition to a self-rating inventory for anorexia nervosa developed by Fichter and Keeser (1980). In the second stage probable cases of anorexia nervosa were interviewed personally (Fichter et al. 1983). The present report is concerned only with the evaluation of the GHQ-28 screening data.

Goldberg and Hillier (1979) labelled the four components, that they obtained somatic symptoms (A1 to A7), anxiety and insomnia (B1 to B7), social dysfunction (C1 to C7) and severe depression (D1 to D7). The same classification is adopted in this report to aid comparisons with their results.

Table 1. The number of subjects in the study (complete data on number in brackets)

	Male		Female		Total no.
	No.	(%)	No.	(%)	
Greeks in Veria (Greece) (GG)	1280 (1121)	47.4	1420 (1269)	52.6	2700 (2390)
Greeks in Munich (West Germany) (GD)	414 (405)	47.8	453 (435)	52.2	867 (840)
Turks in Istanbul (Turkey) (TT)	1196 (1027)	43.0	1588 (1370)	57.0	2784 (2397)

Statistical evaluation of the GHQ-28 item version was concerned with ethnic background differences between the populations as a whole and separately for the sexes and with gender differences in the populations. These are abbreviated as follows: Turks in Turkey (TT), Greeks in Greece (GG) and Greeks in Germany (GD).

Separate PCAs (SPSS, Nie et al. 1975) were conducted without iteration using varimax rotation. In the initial analysis the Guttman criterion was applied to the selection of components and, in subsequent analyses, the number of components to be selected was restricted to four. This procedure of statistically reapportioning variance was adopted rather than that of arbitrarily combining components within the sub-samples analysed. Morrison (1967) argues that the question of the number of components to be selected is based on their interpretability. Accordingly, we felt justified in this procedure so as to permit comparisons of the principal components that we obtained with those of Goldberg and Hillier (1979): a cut-off of 0.4 was adopted to identify the components on which the items loaded.

In order to compare the PCA solutions for each of the subsamples the matrices were compared by a program described by White (1966). By this procedure, the components of one matrix are rotated rigidly to yield maximum congruence with the components of the second. Coefficients of factor similarity (CFS) are computed as the cosines between the components of the two matrices. These may be interpreted as correlation coefficients (Kaiser et al. 1969; White et al. 1966). The internal relationship between components of either matrix is not affected by this rotation.

Results

The PCA analysis of the individual samples produced different numbers of rotated components when the Guttman criterion was adopted to determine component selection. Thus, in the analysis of the sexes separately, seven components were obtained for GG males, six for GD males, GD females, and TT males, and five for GG females and TT females. Accordingly, the number of components to be extracted was limited to four in all analyses.

The PCA solution obtained for the three populations is presented with the abbreviated item descriptions, based on those of Goldberg and Hillier (1979), and the four components obtained by them in Table 2. Visual inspection of the

Table 2. The items and loadings obtained when restricting the number of factors to four for the sexes combined. The component obtained by Goldberg and Hillier (1979) is shown before each item. For reasons of economy of space figures have been rounded to two decimal places and the decimal point omitted. Figures at the the foot of each column indicate the sum of squared loadings on that component

Item	Greeks in Greece				Greeks in Germany				Turks in Turkey			
	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
Somatic symptoms												
A1 Not feeling well and in good health	**63**	07	08	24	00	00	**61**	26	10	06	39	39
A2 Feeling in need of a tonic	**61**	16	20	13	18	18	**52**	08	39	16	29	14
A3 Felt rundown and out-of-sorts	**54**	34	20	11	26	17	**58**	03	**41**	14	**50**	19
A4 Felt ill	**73**	09	18	13	14	09	**71**	08	17	10	**65**	07
A5 Getting pains in head	**66**	19	12	−04	06	28	**63**	00	04	08	**78**	05
A6 Felt tightness or pressure in head	**64**	24	12	−03	13	34	**64**	04	16	11	**73**	10
A7 Having hot or cold spells	**44**	27	04	06	21	31	37	−09	31	17	**51**	04
Anxiety and insomnia												
B1 Lost much sleep over worry	38	**47**	17	−02	26	**50**	29	05	**40**	19	**43**	03
B2 Difficulty in staying asleep	29	38	08	00	15	**46**	19	08	18	13	31	14
B3 Constantly under strain	24	**52**	32	11	39	**46**	24	13	**65**	13	29	16
B4 Getting edgy and bad-tempered	15	**70**	16	15	10	**66**	16	18	**65**	15	15	03
B5 Getting scared or panicky	16	**52**	18	18	17	**63**	06	17	**58**	13	23	14
B6 Found everything getting on top	17	**59**	22	10	29	**46**	17	19	**56**	22	09	17
B7 Feeling nervous and strung up	14	**63**	26	04	22	**66**	20	09	**72**	21	20	14
Social dysfunction												
C1 Managing to keep oneself busy	17	06	01	**45**	17	−12	18	**43**	14	07	07	**47**
C2 Taking longer over things	23	23	03	28	08	14	35	21	15	00	14	**58**
C3 Not doing things well	09	17	04	**65**	12	06	19	**61**	10	12	05	**64**
C4 Not satisfied with task executed	05	25	04	**61**	04	14	14	**59**	36	09	04	38
C5 Felt useless	−04	−03	13	**58**	05	03	−02	**63**	−02	08	−00	**66**
C6 Not capable of making decisions	−00	−12	23	**57**	05	17	−08	**57**	03	08	11	**55**
C7 Not able to enjoy day-to-day activities	17	35	14	38	09	27	09	**49**	25	17	07	**45**
Severe depression												
D1 Felt worthless	07	20	**63**	28	**65**	18	21	24	34	**44**	04	31
D2 Life entirely hopeless	10	15	**70**	19	**63**	25	10	14	34	**53**	09	22
D3 Life not worth living	11	18	**73**	09	**74**	22	06	09	20	**70**	14	14
D4 Thoughts of making away with oneself	14	26	**56**	04	**70**	14	16	06	15	**79**	16	08
D5 Couldn't do anything because of bad nerves	29	**58**	31	09	35	**53**	31	−02	**56**	23	15	12
D6 Death wishes	21	27	**69**	06	**76**	19	20	11	21	**74**	19	08
D7 Constant idea of taking one's life	24	19	**69**	03	**79**	23	10	03	18	**80**	17	08
Sum of squared loadings	3.37	3.35	3.34	2.21	3.84	3.20	3.16	2.24	3.62	3.21	3.00	2.59

Table indicates a reasonable separation of the components following rotation. However not all items obtained the criterion cut-off loading for selection. Thus, e.g., the items A1 (not feeling well and in good health) and A2 (feeling in need of a tonic) did not reach criterion in the TT population. In all four items did not obtain the cut-off of 0.4 in the TT population in comparison to three in GG and two in GD. Two items loaded on more than one component, namely, A3 (felt rundown and out-of-sorts) and B1 (lost much sleep over worry) in the TT population. Finally, one item, D5 (couldn't do anything because of bad nerves) was allocated to a different component, i.e. "anxiety and insomnia", in each population analysis.

The CFSs for the comparison of TT with GG and GD with GG sample matrices are presented in Table 3. The principal components, as reported in Table 2, are labelled according to their predominant pattern of item loading. A value of 0.80 may be accepted as a working, albeit rule-of-thumb, criterion to guide interpretation. The comparison of the principal component matrices for GG and TT, as well as that between GG and GD produced consistently high CFSs of 0.99 between identically labelled components. All other CFSs were low and unimportant.

In order to separate a differential contribution for the sexes PCA was repeated for males and females separately.

Table 3. The CFSs obtained from the comparison of PCA matrices in the comparison of Greeks (GG) and Turkish pupils (TT) (**A**) in their mother country and Greeks in Greece (GG) with Greeks in Germany (GD) (**B**)

A: Greeks in Greece and Turks in Turkey						
Component			TT			
			I Anxiety and insomnia	II Severe depression	III Somatic symptoms	IV Social dysfunction
GG	I	Somatic symptoms	−0.01	0.01	0.99	0.11
	II	Anxiety and insomnia	0.99	0.04	0.02	−0.04
	III	Severe depression	0.04	0.99	−0.01	−0.05
	IV	Social dysfunction	0.05	−0.05	−0.11	0.99
B: Greeks in Germany with Greeks in Greece						
Component			GG			
			I Somatic symptoms	II Anxiety and insomnia	III Severe depression	IV Social dysfunction
GD	I	Severe depression	0.04	0.02	0.99	−0.02
	II	Anxiety and insomnia	0.00	0.99	−0.02	−0.04
	III	Somatic symptoms	0.99	0.00	−0.04	−0.06
	IV	Social dysfunction	−0.06	0.04	−0.02	0.99

Visual comparison of Tables 2 and 4 suggests good overall agreement in the allocation of the items to components; differences in item loadings and the order of components subsequent to rotation being irrelevant. Of the items which failed to obtain the cut-off criterion in the analysis of the sexes combined A1 (not feeling well and in good health) passed the cut-off for both groups, albeit allocated to "social dysfunction" for males, and A2 (feeling in need of a tonic) achieved the cut-off only for females and was allocated to the component "anxiety and insomnia". Other items, e.g. A3 (felt rundown and out-of-sorts), continued to load on more than one component for the sexes separately. The item D5 (couldn't do anything because of bad nerves) loaded on the component "anxiety and insomnia" in five of the six sub-analyses.

The PCA results for the sexes separately were also compared to the original component solution of Goldberg and Hillier (1979). Generally similar results were found for GG males, although the order of "social dysfunction" and "severe depression" components was reversed. The order appeared very different for GG females by whom "severe depression" made the largest contribution and "somatic symptoms" the third. Further, certain items loaded on different components than those originally reported. Thus, B7 (feeling constantly under strain), originally loading on "anxiety and insomnia", loaded here on "severe depression" and A6 (feeling tightness in the head), A7 (having hot and cold spells), and D5 (couldn't do anything because of bad nerves) loaded on "anxiety and insomnia" instead of exclusively on "somatic symptoms" and "severe depression". It should be noted that two of these three items also loaded on "somatic symptoms". Comparable differences were also obtained in the analyses of the other sub-samples. Generally with both TT groups a reasonable separation of components was obtained together with a good, but not exact, correspondence in the order of components to that extracted by Goldberg and Hillier (1979). However, with both sexes, "somatic symptom" items often loaded on different components from that originally reported, i.e. on "anxiety and insomnia" and, for TT males, with one item on "social dysfunction". Also with males the item D5 (couldn't do anything because of bad nerves) loaded on "anxiety and insomnia". A different allocation of variance was also observed for females by whom the item B1 (lost much sleep over worry) was allocated to "somatic symptoms". With GD males a good separation of components was obtained with the exception of one item, D5 (couldn't do anything because of bad nerves), which loaded exclusively on "anxiety and insomnia". Least clear were the results obtained for GD females. Although two groupings of items were obtained which corresponded to "severe depression" and "somatic symptoms", that of "anxiety and insomnia" was apparently mixed in with them both and that of "social dysfunction" was separated between two principal components.

The matrices, following varimax rotation, were examined for gender comparisons by the method outlined above for the whole populations (Table 5). High CFSs were obtained between male and female pupils in the GG sample (CFS "severe depression": 0.96; "anxiety and insomnia": 0.95; "somatic symptoms": 0.98; "social dysfunction": 0.99). This high degree of similarity was also observed in the evaluation of male and female pupils in the TT sample in which a CFS of 0.99 was obtained between each of the correspondingly labelled components. All other CFSs were low and unimportant in these two analyses. Comparison of the components obtained for male and female GD did not produce high CFSs with the exception of "severe depression" (CFS: 0.87). High CFSs, albeit below criterion, were obtained between seemingly incomparable components as between male pupils' "anxiety and insomnia" and female pupils' "social dysfunction" (CFS: 0.75). Similarly, CFSs of 0.70 were obtained between males' "somatic symptoms" and "social dysfunction" with an unlabelled fourth component in females.

Further to the comparison of the whole sample (Table 3), CFSs were calculated for the sexes separately between GD and GG and between GG and TT (Table 6). High CFSs were obtained in the analysis for Greek and Turkish male pupils (CFS "somatic symptoms": 0.98; "anxiety and insomnia":

Table 4. The items and loadings on the components obtained when restricting the maximum number to four. The components obtained by Goldberg and Hillier (1979) are shown before each item. For reasons of economy of space figures have been rounded to two decimal and the decimal point omitted. Figures at the foot of each column indicate the sum of squared loadings of all items on that component

Item	Male				Female				Male				Female				Male				Female			
	Greeks in Greece				Greeks in Greece				Greeks in Germany				Greeks in Germany				Turks in Turkey				Turks in Turkey			
	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
Somatic symptoms																								
A1 Not feeling well and in good health	**52**	07	−01	31	12	11	**72**	13	−01	02	**71**	21	−00	**50**	10	23	08	−02	**50**	35	13	15	**42**	28
A2 Feeling in need of a tonic	**58**	16	15	08	25	24	**67**	13	22	21	**53**	10	16	**63**	−14	16	35	11	10	19	**44**	17	29	17
A3 Felt rundown and out-of-sorts	**49**	30	17	11	26	36	**56**	09	**46**	12	**45**	−04	19	**68**	04	05	**41**	05	22	**50**	**41**	21	**50**	17
A4 Felt ill	**68**	−01	11	10	19	30	**69**	09	17	16	**70**	−03	10	**68**	09	09	13	08	18	**67**	22	12	**63**	05
A5 Getting pains in head	**62**	08	06	−04	09	52	**44**	−12	05	30	**58**	02	07	**56**	33	−31	10	10	06	**74**	02	06	**79**	05
A6 Felt tightness or pressure in head	**60**	19	09	−03	10	**48**	**47**	−09	24	32	**57**	07	14	**63**	35	−27	19	14	10	**71**	15	09	**75**	10
A7 Having hot or cold spells	**52**	08	06	06	05	**49**	25	02	27	30	25	−09	22	**41**	21	−29	32	23	03	**42**	34	12	**52**	04
Anxiety and insomnia																								
B1 Lost much sleep over worry	33	**43**	12	00	22	**57**	24	−05	31	**48**	26	05	39	38	26	13	**52**	13	−03	34	32	22	**47**	08
B2 Difficulty in staying asleep	28	31	07	−01	10	**56**	10	00	10	**40**	16	07	30	**47**	−00	11	26	15	12	15	14	11	37	15
B3 Constantly under strain	25	**49**	26	11	**43**	**40**	22	13	35	**49**	20	05	**51**	35	27	03	**71**	15	17	16	**61**	13	37	17
B4 Getting edgy and bad-tempered	07	**70**	09	17	28	**59**	16	20	−08	**58**	20	24	38	**48**	14	09	**64**	14	04	09	**67**	16	14	03
B5 Getting scared or panicky	29	22	19	09	24	**62**	−05	25	20	**62**	−09	09	30	**42**	19	16	**56**	15	22	11	**63**	12	24	09
B6 Found everything getting on top	14	**51**	21	12	29	**57**	12	12	20	**44**	16	08	**47**	31	32	10	**58**	20	15	07	**53**	23	10	22
B7 Feeling nervous and strung up	07	**68**	19	00	36	**48**	20	12	12	**67**	20	10	**43**	**49**	12	05	**73**	23	16	11	**71**	21	24	14
Social dysfunction																								
C1 Managing to keep oneself busy	14	09	08	**42**	−03	−02	31	**46**	22	−12	10	**40**	09	08	**41**	22	14	01	**47**	07	14	12	08	**45**
C2 Taking longer over things	27	11	03	26	04	38	10	27	−02	06	37	13	20	28	34	04	21	−04	**55**	11	11	04	15	**59**
C3 Not doing things well	11	15	02	**67**	04	18	08	**64**	16	03	22	**64**	15	05	**74**	15	08	15	**63**	09	10	11	04	**64**
C4 Not satisfied with task executed	06	22	−05	**65**	14	17	08	**58**	19	03	09	**60**	04	07	**76**	14	24	07	36	07	38	13	08	**42**
C5 Felt useless	−02	−04	16	**56**	08	−07	−02	**58**	11	17	03	**61**	09	07	17	**68**	00	17	**70**	−05	−06	01	03	**62**
C6 Not capable of making decisions	00	−17	22	**56**	17	02	−10	**55**	11	25	−04	**50**	02	08	16	**65**	−01	09	**61**	02	08	06	10	**52**
C7 Not able to enjoy day-to-day activities	04	33	07	34	24	16	28	**45**	−01	28	12	**45**	22	20	31	**45**	24	12	**43**	05	25	21	09	**46**
Severe depression																								
D1 Felt worthless	11	08	**62**	27	**63**	24	−05	31	**64**	27	14	18	**65**	21	20	17	36	**49**	30	01	29	**40**	08	32
D2 Life entirely hopeless	08	06	**69**	18	**70**	22	01	20	**44**	**44**	12	13	**71**	08	09	09	31	**53**	20	11	35	**52**	07	22
D3 Life not worth living	10	22	**66**	08	**77**	12	11	09	**59**	35	−05	10	**80**	10	06	06	24	**69**	12	10	16	**71**	17	15
D4 Thoughts of making away with oneself	11	33	**51**	−00	**62**	15	21	07	**71**	10	15	11	**73**	12	07	−04	13	**79**	05	13	18	**78**	16	10
D5 Couldn't do anything because of bad nerves	21	**62**	24	08	**41**	**50**	30	11	25	**61**	22	−04	**50**	38	32	−26	**59**	21	15	12	**53**	25	15	12
D6 Death wishes	12	27	**65**	05	**74**	21	23	07	**78**	11	17	18	**76**	22	06	03	20	**74**	07	14	22	**74**	20	08
D7 Constant idea of taking one's life	18	18	**65**	01	**72**	16	24	02	**78**	27	−00	06	**81**	14	01	01	20	**78**	05	11	18	**80**	17	09
Sum of squared loadings	2.9	2.8	2.8	2.2	4.0	3.8	2.7	2.3	3.6	3.4	2.8	2.2	5.0	4.1	2.4	1.9	3.8	3.2	2.7	2.4	3.6	3.2	3.2	2.5

Table 5. The CFSs for the principal component matrix comparisons of males and females for the three sub-samples separately. Components are shown in the order obtained in the PCA after varimax rotation. Each cell may be interpreted as the correlation coefficient between the item loadings for the corresponding factors in the original matrices. Greeks in Greece (GG), Greeks in Germany (GD), Turks in Turkey (TT)

Greeks in Greece

	Component		Females			
			I Severe depression	II Anxiety and insomnia	III Somatic symtoms	IV Social dysfunction
Males	I	Somatic symptoms	−0.02	0.17	0.98	−0.02
	II	Anxiety and insomnia	0.26	0.95	−0.16	−0.02
	III	Severe depression	0.96	−0.25	0.06	0.10
	IV	Social dysfunction	−0.09	−0.05	0.15	0.99

Greeks in Germany

	Component		Females			
			I Severe depression	II Somatic symptoms	III Social dysfunction	IV
Males	I	Severe depression	0.87	0.45	−0.20	0.03
	II	Anxiety and insomnia	−0.14	0.63	0.75	−0.09
	III	Somatic symptoms	0.30	0.41	0.49	0.70
	IV	Social dysfunction	−0.37	0.47	−0.38	0.70

Turks in Turkey

	Component		Females			
			I Anxiety and insomnia	II Severe depression	III Somatic symptoms	IV Social dysfunction
Males	I	Anxiety and insomnia	0.99	−0.02	0.00	−0.09
	II	Severe depression	0.02	0.99	−0.02	−0.01
	III	Social dysfunction	0.10	0.01	0.05	0.99
	IV	Somatic symptoms	−0.01	0.02	0.99	−0.05

0.99; "severe depression": 0.99; "social dysfunction": 0.99) and female pupils (CFS "severe depression": 0.97; "anxiety and insomnia": 0.92; "somatic symptoms": 0.92; "social dysfunction": 0.97). Comparison of the component matrices for male pupils in the GG and GD samples produced a high CFS for "severe depression" (CFS:0.97), "anxiety and insomnia" (CFS:0.99), "somatic symptoms" (CFS:0.98), and "social dysfunction" (CFS:0.99). All other CFSs were low and unimportant in these analyses. By contrast, the comparison of the component matrices for female pupils in the GD and GG samples produced a high CFS for the same component only for "severe depression" (CFS:0.96). A high CFS was obtained between GGs' "anxiety and insomnia" and GDs' "social dysfunction" and a weak similarity between "social dysfunction" and an unlabelled component (CFS:0.91 and 0.76 respectively). Also in contrast to the preceding analyses a weak similarity was indicated between all components as seen particularly in GDs' CFS for "somatic symptoms" with all other GG components.

Discussion

In contrast to the numerous validation studies there are relatively few studies on the factor structure of the GHQ. While our PCA was based on the 28-item version developed by Goldberg and Hillier (1979), most studies have factor analysed the 60-item version (Medina-Mora et al. 1983; Hobbs et al. 1983, 1984) or the 30-item version (Chan and Chan 1983). Thus, direct comparisons are not possible. To our knowledge, the only PCA of the 28-item questionnaire was carried out by Parkes (1982). In her four factor solution the results for the FI group were very similar to that reported by Goldberg and Hillier (1979). With the exception of the item (difficulty in staying asleep once asleep) which failed to load on any of the four factors and the item (couldn't do anything because of bad nerves), from the "severe depression" sub-scale, which loaded on anxiety more highly than depression, the items were allocated to sub-scales which corresponded closely to those of Goldberg and Hillier (1979). The FD group, however, showed a completely different pattern "with more of the sub-scales loading entirely on one factor; nine items loading significantly on more than one factor (as compared with two in the FI group); and with generally higher loadings than in the FI group on factors other than that to which the item is assigned" (Parkes 1982). The results suggest that the mixed neurotic states are more likely to be presented by FD subjects and more clear-cut symptom configurations by FI subjects.

To the authors' knowledge no PCA has been conducted for the GHQ-28 for an age group as in our study. Thus, it

Table 6. The CFSs for the principal component matrix comparisons between sub-samples for males and females separately. Components are shown in the order obtained in the PCA after varimax rotation. Each cell may be interpreted as the correlation coefficient between the item loadings for the corresponding factors in the original matrices. Greeks in Greece (GG), Greeks in Germany (GD), Turks in Turkey (TT)

Males: Turks in Turkey with Greeks in Greece

	Component		TT			
			I Somatic symptoms	II Anxiety insomnia	III Severe depression	IV Social dysfunction
GG	I	Anxiety and insomnia	0.12	0.99	0.01	0.04
	II	Severe depression	−0.01	−0.01	0.99	−0.06
	III	Social dysfunction	0.12	−0.06	0.06	0.99
	IV	Somatic symptoms	0.98	−0.11	0.00	−0.13

Females: Turks in Turkey with Greeks in Greece

	Component		TT			
			I Severe depression	II Anxiety and insomnia	III Somatic symptoms	IV Social dysfunction
GG	I	Anxiety and insomnia	0.23	0.92	−0.29	0.13
	II	Severe depression	0.97	−0.19	0.15	−0.05
	III	Somatic symptoms	−0.08	0.34	0.92	−0.19
	IV	Social dysfunction	0.00	−0.07	0.22	0.97

Males: Greeks in Greece with Greeks in Germany

	Component		GD			
			I Severe depression	II Anxiety and insomnia	III Somatic symptoms	IV Social dysfunction
GG	I	Somatic symptoms	0.18	−0.09	0.98	−0.01
	II	Anxiety and insomnia	0.03	0.99	0.09	−0.05
	III	Severe depression	0.97	−0.01	−0.17	0.13
	IV	Social dysfunction	−0.13	0.05	0.04	0.99

Females: Greeks in Greece with Greeks in Germany

	Component		GD			
			I Severe depression	II Somatic symptoms	III Social dysfunction	IV
GG	I	Severe depression	0.96	0.25	−0.11	0.01
	II	Anxiety and depression	0.00	0.41	0.91	−0.04
	III	Somatic symptoms	−0.21	0.67	−0.28	0.65
	IV	Social dysfunction	0.17	−0.56	0.28	0.76

could be particularly rewarding to extend our evaluation to an unselected sample of 15-year-old South London schoolgirls (Mann et al. 1983). Considering the fact that the Greek and Turkish populations studied are, in comparison to the English samples, not only different in ethnic background but also in age, our four factor solution of the GHQ 28-item version is remarkably similar on visual inspection to that reported by Goldberg and Hillier (1979). Thus, in the analysis of the whole sample 72 items from a possible 84 were allocated to components agreeing with those of Goldberg and Hillier (1979) and, for the sexes separately 141 from 184. The single notable exception was that of the GD female sample in the analyses for the sexes separately. However, two comments must be noted. Firstly, the order of components after rotation was different to that reported by Goldberg and Hillier (1979) as well as being different between sub-samples in this study. However, factor invariance has not been claimed by Goldberg (1985, personal communication) for the GHQ across different cultural settings. Secondly, certain systematic differences were observed. A different allocation of items, with one exception for "social dysfunction", occurred between "severe depression" or "somatic symptoms" and "anxiety and insomnia". In particular, one item D5 (couldn't do anything because of bad nerves) was allocated either entirely to a different principal component, or to more than one, in five of the sub-analyses and each of the analyses for the sexes combined. This last

point suggests that certain items may not have equivalent meanings in other cultural settings or with younger samples, and agrees with the finding of Parkes (1982) concerning this item.

In order to investigate the principal component structures, i.e. psychiatric health, more closely, the CFS was calculated between the components obtained in the separate PCAs. The CFS comparison of the population samples (GG with GD and GG with TT) reinforced the visual inspection of the individual principal components in that consistently high coefficients were obtained. This indicated that the four component solutions obtained by PCA with varimax rotation were highly similar and suggested that psychiatric health, as measured in the 28-item GHQ, is highly similar in the different samples of pupils. With the single exception of Greek females, highly similar results were obtained for the sexes separately between GG and TT and between GG and GD. Finally, the CFS comparison of sexes within the population samples indicated highly similar principle component matrices, but again with the exception of GD. These last two results taken together suggest a different principal component structure, i.e. concept of psychiatric health, in Greek females living in Germany. This is supported by visual inspection of the principle components which shows "anxiety and insomnia" items loading on the components "somatic symptoms" and "severe depression" as well as "social dysfunction" items being split between two components. On the one hand this illustrates the dangers inherent in labelling components and assuming that they have the same referant across different samples, but also raises interesting questions on the other. Since Greek females in Germany were subjected to the same test situation as males interpretation of the different component solution can only be tentative, but may be accounted for in terms of a different acculturation process in these pupils.

In conclusion, our results on school pupils generally support Goldberg's statement (1983) that a common language of psychological stress exists which cuts across cultural barriers. The high coefficients of factor similarity provide an objective metric of the degree to which superficially identical components are similar, as discussed by Kaiser et al. (1969). This may be particularly useful in situations in which no clear-cut principal component solution is obtained. However, our analysis was based on the assumption of their being four orthogonal components in the 28-item GHQ. The anomalous result for Greek female pupils living in Germany indicates that this may not always be the case and suggests the investigation of other rotational methods which permit correlation between components.

Acknowledgements. The authors thank Dipl. Psych. Z. Sourdi, S. Sourdi, Dr. Dr. Fthenakis, the Greek Department of Education (Athens, Greece), Professor G. Koptagel-Ilal (University of Istanbul) and K. Heilbronn for their assistance in carrying out the study and Dr. M. Wiseman (Leibniz Rechenzentrum, Munich) and Dr. P. O. White for statistical consultations.

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Received December 13, 1985