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The Factor Structure of the 28-Item General Health Questionnaire when Used in Japanese Early Adolescents and Adult Employees: Age- and Cross-Cultural Comparisons

Noboru Iwata[1] and Kazuo Saito[2]

[1]Department of Ergonomics, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health Japan, 1-1 Iseigaoka, Yahatanishi-ku, Kitakyushu, 807 Japan
[2]Department of Hygiene and Preventive Medicine, Hokkaido University School of Medicine, Sapporo, Japan

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Summary. The principal-component analysis (PCA) with varimax rotation on the 28-item General Health Questionnaire (GHQ-28) in Japanese translation was performed separately for two samples of the Japanese population: early adolescents (junior high school students) and adult employees. The initial PCA yielded different number of components across sub-samples. The later PCA, however, with restriction of the number of components four generally produced a similar structure across sub-samples by means of visual inspection and the coefficient of factor similarity between the components calculated by using the loadings matrices, while a slight different structure emerged for the employees aged 40–49 years. Then, based on these two ways of comparison, the factor structure of GHQ-28 was compared between the present Japanese samples and the European and Turkish school-aged adolescent populations with three ethnic backgrounds. The results showed that its structure was highly stable across age (generation) and several cultural backgrounds, at least among these nations. The internal consistency reliability of the GHQ-28 was at a high level among the present sample of Japanese.

Key words: General Health Questionnaire – Principal-component analysis – Adolescents – Employees – Cross-cultural study

Introduction

The General Health Questionnaire (GHQ) was principally designed as a self-administered measurement for the screening of non-psychotic psychiatric illness (Goldberg 1972). The GHQ has been used in various cultural settings (see Harding 1976; Mari and Williams 1984; Munoz et al. 1978; Radovanovic and Eric 1983; Shek 1987; Tarnopolsky et al. 1979; Tennant 1977; Vazquez-Barquero et al. 1982). Numerous validation studies have demonstrated its satisfactory level of validity both in English and non-English speaking countries (Vieweg and Hedlund 1983).

The Japanese version GHQ was translated by researchers of the National Institute of Mental Health of Japan, which was included in the first project of the Institute as a WHO collaborating centre in psychiatry (Nakagawa and Daibo 1982). The original GHQ was translated into Japanese without any modification. This initial Japanese version was retranslated back into English by those who were blind to the original version. Then, Professor S. Hirsch, Institute of Psychiatry, London, was asked to compare the retranslated version with the original version, so as to confirm the content. Like other language versions, the Japanese version has been reported to have good levels of sensitivity and specificity in a clinical validation study (Nakagawa and Daibo 1982), whereas Kitamura et al. (1989) reported somewhat lower validity of its GHQ-30. Iwata and Saito (1987) found that a concurrent validity with the index of neurosis was the highest for its GHQ-28 among the five versions. The GHQ-28, with a scale based on a factor analysis (Goldberg and Hillier 1979), consists of four scales with seven items each "somatic Symptoms (A1–A7)", "anxiety and insomnia (B1–B7)", "social dysfunction (C1–C7)" and "severe depression (D1–D7)". Recently, the GHQ-28 has been widely used in various settings in Japan (e.g. Iwata et al. 1992; Saito et al., in press).

Along with validation studies, psychometric properties including factor structure of the GHQ in various language translations have been often reported, because the nature and/or structure of psychiatric morbidity has been regarded as an important research topic (Medina-Mora et al. 1983; Vazquez-Barquero et al. 1988). Also, such studies have been reported in Asia (Chan and Chan 1983; Chan 1985; Iwata et al. 1988a, b; Nakagawa and Daibo 1982; Shek 1987; Takeuchi and Kitamura 1991),

Correspondence to: N. Iwata

while most studies have analysed the data of fewer subjects, so as to obtain a stable factor solution, except for Iwata et al. (1988a, b) and Shek (1987). Moreover, some studies did not necessarily present the correct results, as cautioned by Iwata (1990). This kind of study based on the GHQ-28 has not been reported in Asian countries, although its four scales would have potential advantages for diagnostic refinement (Banks 1983).

Weyerer et al. (1986) and Elton et al. (1988) explored the factor structure of GHQ-28 in adolescents of school age in three European countries and in Turkey in order to examine its similarity or comparability across these nations. Although both compared the factor structure in adolescents with that of British adult population (Goldberg and Hillier 1979), they did not make any distinction regarding age differences. To the authors' knowledge, age difference in psychometric properties of the GHQ-28 has not been examined.

The present study, which was intended to provide such data, firstly explored the factor structure of GHQ-28 in Japanese early adolescents and adult employees, and examined its age (generation) and gender differences. Then, the difference in factor structure across nations or ethnic/cultural backgrounds was examined by comparing with those of European and Turkish adolescents. This comparison seems to yield meaningful data for further use of the GHQ in a cross-cultural study. The internal consistency reliability of the GHQ-28 was also explored.

Methods

Subjects

The GHQ-28 data were obtained from two samples, as shown in Table 1. Adolescents' data were obtained from 1,392 students of the first to third grade, seventh to ninth grade in the US equivalent, between 12 and 15 years of age, in two public junior high schools in Gotemba, located on the foot of Mt. Fuji, Shizuoka, Japan. The data were collected in each class during the period from mid-October to the beginning of November, 1988. The research location was an average city in Japan, and this sample can be regarded as a representative sample of Japanese early adolescents. Adult employees' data were obtained from 2,108 employees (containing five respondents with gender not specified), aged 19–63 years, affiliated with a Japanese public institution. The GHQ-28 data for the adult employees were derived from the GHQ-60. The characteristics of the adult employees have been fully described elsewhere (Iwata et al. 1988c).

Table 1. Gender and age distribution of the subjects who completed the Japanese version GHQ-28

Samples	Males	Females
Adolescents (school grade[a])		
First graders (12–13 years)	236	220
Second graders (13–14 years)	222	243
Third graders (14–15 years)	234	236
Not specified	–	1
Total	692	700
Adult employees (ages)		
19 years	25	7
20–29 years	424	57
30–39 years	670	20
40–49 years	286	30
50–59 years	518	32
60–63 years	8	1
Not specified	23	2
Total	1,954	149

[a] The first to third graders correspond to the seventh to ninth graders in the US equivalent

Statistical Analyses

Responses to an item were scored by the Likert scoring method, instead of 0-0-1-1 GHQ scoring. The principal-component analysis (PCA) followed by varimax rotation on the GHQ-28 data was performed separately by gender for adolescents and by age group divided into age categories of 10-year intervals for adult employees. The employees aged 19 years and those of aged 60–63 years were combined with the sub-sample of employees aged 20–29 years and that of those aged 50–59 years, respectively. The cirterion for an item to be regarded as loading significantly on a component was defined as 0.40. The components extracted were conceptualised by referring to those of Goldberg and Hillier (1979).

The loadings matrices were compared with each other by means of visual inspection and the method of relating factor structures, coefficient of factor similarity (CFS) (Kaiser et al. 1969). As Elton et al. (1988) cautioned, the CFS statistic cannot provide a significant level owing to the lack of distribution theory. Although some structural equation models with latent variables such as the LISREL (Joreskog and Sorbom 1986) are more suitable to this issue, a correlation matrix or covariance matrix, which was needed to perform it, was not available for the reference data on European and Turkish adolescents, so that we adopted the CFS, which could be calculated based only on the loadings in a case of orthogonal rotation, throughout the present analyses.

The CFS statistic is described as follows: the components of one matrix are rotated rigidly to yield maximum congruence with those of the other matrix, and then the CFS is calculated as the cosine between the components. Thus, it can be regarded as a correlation coefficient between the components (Kaiser et al. 1969; White 1966). According to Weyerer et al. (1986), a CFS value of 0.80 can be accepted as a criterion to guide interpretation, and its high value can be considered to indicate a marked similarity between the components. We programmed to calculate the CFS by a series of matrix language equations (within the Statistical Analysis System) according to Kaiser et al. (1969). Prior to the present analyses by this programmed, its precision had been ascertained in comparisons with the indices of Kaiser et al.

The coefficient alpha (Cronbach 1951) was calculated as an index of internal consistency reliability. The alpha in the case when an individual item was deleted was also calculated in order to detect an item attenuating the internal consistency of the scale.

Results

1. PC Structure of the Japanese Version GHQ-28 and its Generational Differences

In the initial PCA for all the adolescents, the Kaiser's measure of sampling adequacy (MSA) value (Cenry and Kaiser 1977), which is a summary of how much smaller the partial correlations are than the original correlations, was found to be sufficient as follows: overall MSA value was 0.92 and no items had MSA value being below 0.5,

Table 2. The items and loadings on the four components obtained from the Japanese version GHQ-28 for the early adolescents and adult employees

Items	Adolescents				Adult employees			
	C1	C2	C3	C4	C1	C2	C3	C4
Somatic symptoms								
A1 Feeling perfectly well	0.09	**0.60**	0.06	0.19	0.07	**0.51**	0.05	0.32
A2 In need of tonic	0.08	0.39	0.26	0.00	−0.02	**0.48**	0.28	0.00
A3 Rundown and out-of-sorts	0.10	**0.58**	0.30	0.06	0.04	**0.59**	0.38	0.18
A4 Feeling ill	0.17	**0.62**	0.10	0.00	0.16	**0.66**	0.19	0.04
A5 Pains in head	0.14	**0.72**	0.05	0.03	0.14	**0.76**	0.06	0.05
A6 Pressure in head	0.18	**0.69**	0.15	0.04	0.13	**0.78**	0.08	0.05
A7 Hot or cold spells	0.10	**0.59**	0.22	0.02	0.16	**0.61**	0.15	0.01
Anxiety and insomnia								
B1 Lost sleep over worry	0.32	0.27	**0.43**	0.00	0.24	**0.40**	**0.47**	0.10
B2 Difficulty staying asleep	0.18	0.21	0.23	−0.08	0.15	**0.41**	0.26	0.11
B3 Constantly under strain	0.19	0.34	**0.48**	0.17	0.19	0.29	**0.63**	0.21
B4 Edgy and bad-tempered	0.11	0.32	**0.47**	0.11	0.19	0.21	**0.64**	0.02
B5 Scared and panicky	0.29	0.10	**0.52**	0.08	0.52	0.15	**0.41**	0.06
B6 Everything on top of you	0.23	0.24	**0.58**	0.15	0.25	0.20	**0.68**	0.19
B7 Nervous and strung up	0.18	0.19	**0.63**	0.04	0.28	0.21	**0.64**	0.07
Social dysfunction								
C1 Busy and occupied	0.00	−0.06	−0.35	0.20	0.18	0.14	−0.30	0.39
C2 Taking longer to do things	0.05	0.05	**0.56**	0.04	0.10	0.28	**0.46**	0.21
C3 Doing things well	0.05	0.06	−0.20	**0.64**	0.04	0.06	0.16	**0.70**
C4 Satisfied with task	0.13	0.02	0.23	**0.52**	0.05	0.06	0.23	**0.65**
C5 Playing useful part	0.04	0.08	−0.10	**0.67**	0.12	0.09	0.00	**0.70**
C6 Making decisions	0.09	0.01	0.13	**0.59**	0.06	0.03	0.10	**0.70**
C7 Enjoy normal activities	0.21	0.10	0.15	**0.60**	0.11	0.09	0.12	**0.59**
Severe depression								
D1 Feeling worthless	**0.53**	0.08	0.31	0.16	**0.53**	0.11	**0.45**	0.19
D2 Life entirely hopeless	**0.72**	0.14	0.24	0.13	**0.72**	0.11	0.32	0.13
D3 Life not worth living	**0.80**	0.17	0.11	0.14	**0.81**	0.12	0.21	0.10
D4 Make away with yourself	**0.84**	0.17	0.09	0.07	**0.84**	0.14	0.18	0.09
D5 Nerves too bad	**0.53**	0.16	0.26	0.17	**0.81**	0.14	0.17	0.10
D6 Dead and away from it all	**0.84**	0.18	0.09	0.05	**0.87**	0.14	0.05	0.10
D7 Idea of taking your life	**0.81**	0.17	0.09	0.09	**0.84**	0.13	0.03	0.08
Sum of squared loadings	4.3	3.2	2.8	2.1	5.0	3.6	3.3	2.8
Variance explained:		44.4%				52.5%		

The items are listed according to Goldberg and Hillier (1979). For reasons of economy of space, loadings have been rounded to two decimal places

indicating an unacceptable level for factor analysis. The lowest MSA value was 0.67 for C3 and the highest value was 0.95 for D5. Similarly, for the whole group of employees, the overall MSA value was 0.92 and no items had an MSA value below 0.5. The lowest value was 0.82 for C1 and the highest value was 0.97 for C2. These indicated the appropriateness of factor analysis on these data.

The initial PCA for each complete sample and for individual sub-samples produced a different number of components with an eigenvalue greater than one: five components appeared for the entire samples of adolescents and adult employees and for the employees aged 50–63 years, and six for each gender of adolescents and the employees aged 19–29, 30–39, and 40–49 years. Then, following Weyerer et al. (1986) and Elton et al. (1988), the number of components was limited to four in the subsequent analyses. As Weyerer et al. (1986) mentioned, this procedure can be justified only in comparing the factor structure to be examined with the reference structure(s).

Table 2 shows the four-component solutions of the adolescents and adult employees, respectively. For both samples, the separation of the items was clear. Table 3 shows the CFSs between the components in comparisons of these two samples. The CFSs between the similarly

Table 3. The CFSs between the components extracted from the GHQ-28 in comparisons of the Japanese early adolescents to the Japanese adult employees

	Japanese early adolescents			
	C1 Depression	C2 Somatic symptoms	C3 Anxiety and insomnia	C4 Social dysfunction
The entire adult employees				
C1 Depression	**0.999**	−0.025	−0.006	−0.013
C2 Somatic and insomnia	0.024	**0.998**	0.005	−0.058
C3 Anxiety and insomnia	0.007	−0.003	**0.999**	0.041
C4 Social dysfunction	0.014	0.058	−0.041	**0.997**

The CFS values above 0.80, a criterion to guide interpretation, are displayed in boldface

Table 4. The CFSs between the components extracted from the GHQ-28 in comparisons across four age-groups of the Japanese adult employees

	Adult employees											
	Aged 19–29 years				Aged 30–39 years				Aged 40–49 years			
	C1	C2	C3	C4	C1	C2	C3	C4	C1	C2	C3	C4
Those aged 30–39 years												
C1	**0.998**	0.008	−0.035	0.057	—	—	—	—	—	—	—	—
C2	−0.006	**0.999**	0.045	−0.007	—	—	—	—	—	—	—	—
C3	0.045	−0.045	**0.982**	−0.178	—	—	—	—	—	—	—	—
C4	−0.050	0.001	0.181	**0.982**	—	—	—	—	—	—	—	—
Those aged 40–49 years												
C1	−0.013	0.476	**0.864**	0.163	−0.033	0.495	**0.868**	−0.008	—	—	—	—
C2	**0.993**	−0.094	0.067	0.001	**0.993**	−0.079	0.083	−0.026	—	—	—	—
C3	−0.025	−0.087	0.230	**0.969**	0.014	−0.085	0.059	**0.995**	—	—	—	—
C4	0.112	**0.870**	−0.442	0.186	0.112	**0.861**	−0.486	0.101	—	—	—	—
Those aged 50–63 years												
C1	**0.999**	0.026	−0.008	0.034	**0.999**	−0.038	0.031	−0.008	−0.024	**0.997**	0.012	0.066
C2	0.026	**0.999**	0.011	0.008	0.040	**0.998**	−0.044	0.005	0.444	−0.048	−0.063	**0.892**
C3	0.012	−0.010	**0.991**	−0.134	−0.029	0.045	**0.998**	0.038	**0.895**	0.049	0.070	−0.438
C4	−0.032	−0.009	0.134	**0.990**	0.009	−0.007	−0.038	**0.999**	−0.035	−0.018	**0.995**	0.086

The CFS values above 0.80, a criterion to guide interpretation, are displayed in boldface

C1 = Depression; C2 = somatic symptoms; C3 = anxiety and insomnia; C4 = social dysfunction, except for those aged 40–49 years

labelled components were greater than 0.990 and all others were quite low.

Visual inspection also indicated that the allocation of the items to components was generally comparable between these samples, whereas the following differences were found. The items A2, B2, and C1 did not load significantly on any factor for the adolescents, and only C1 for the employees. Although no items loaded on two components (duplicated allocation) for the adolescents, B1 and D1 loaded on two components for the adult employees, i.e. B1 loaded on both "somatic symptom" and "anxiety" and D1 loaded on both "anxiety" and "depression".

Table 4 shows the CFSs between the GHQ-28 components in comparisons across the four age groups of adult employees. The CFSs indicated that the components for the sub-sample aged 40–49 years differed somewhat from the others, whereas higher CFSs (all greater than 0.990) were obtained across the other age groups. Such a picture was also recognized by means of visual inspection. For the employees aged 40–49 years, "somatic symptoms" was not clear, since its three items loaded on "anxiety and insomnia". For the other age groups, however, the components highly agreed with those of Goldberg and Hillier (1979). (Since the loadings matrix for each age group of the employees was similar to that of the entire group, only that of each entire sample is presented here. However, the data are available on request to the first author.)

As with the PC structure of the entire group of employees, the item C1 did not load significantly on any factor for the employees aged 30–39 and 50–63 years, and B2 showed a similar picture for those aged 19–29 years. Also, the duplicated allocation was found for a few items: A3 and B1 loaded on both "somatic symptoms" and "anxiety and insomnia", and D1 loaded on

Table 5. The CFSs between the components of the GHQ-28 in comparisons of the Japanese female adolescents to the Japanese male adolescents and female adolescents in the European countries and Turkey

		Japanese female adolescents			
		C1 Depression	C2 Somatic symptoms	C3 Anxiety	C4 Social dysfunction
Japanese male adolescents					
C1	Depression	**0.998**	0.010	−0.042	0.053
C2	Anxiety and insomnia	0.043	0.151	**0.986**	−0.055
C3	Somatic symptoms	−0.018	**0.988**	−0.149	0.026
C4	Social dysfunction	−0.050	−0.018	0.060	**0.997**
Female adolescents in European countries and Turkey[a]					
C1	Anxiety	0.146	0.180	**0.970**	−0.069
C2	Severe depression	**0.989**	−0.021	−0.145	−0.009
C3	Somatic symptoms	−0.006	**0.983**	−0.183	−0.019
C4	Social dysfunction	0.019	0.031	0.063	**0.997**

[a] The PC structure reported by Elton et al. (1988) as a representative structure obtained from the selected samples with an identical structure

The CFS values above 0.80, a criterion to guide interpretation, are displayed in boldface

Table 6. The CFSs between the components extracted from the GHQ-28 in comparisons of the Japanese male adolescents to the Greek and Turkish male adolescents

		Japanese male adolescents			
		C1 Depression	C2 Anxiety and insomnia	C3 Somatic symptoms	C4 Social dysfunction
Greek male adolescents[a]					
C1	Somatic symptoms	0.017	0.171	**0.981**	−0.089
C2	Anxiety and insomnia	0.112	**0.974**	−0.161	0.115
C3	Severe depression	**0.994**	−0.112	0.000	−0.016
C4	Social dysfunction	0.005	−0.100	0.107	**0.989**
Turkish male adolescents[a]					
C1	Anxiety and insomnia	0.124	**0.990**	0.045	0.043
C2	Severe depression	**0.992**	−0.122	−0.021	−0.029
C3	Social dysfunction	0.026	−0.053	0.175	**0.983**
C4	Somatic symptoms	0.011	−0.038	**0.983**	−0.178

[a] The PC structure for each group living in their home countries reported by Weyerer et al. (1986)

The CFS values above 0.80, a criterion to guide interpretation, are displayed in boldface

both "anxiety and insomnia" and "depression". Two sleep-condition items, B1 and B2, loaded not only on "anxiety and insomnia" but also on "somatic symptoms". C1 and C2 had greater loadings on "anxiety" or "anxiety and insomnia" rather than on "social dysfunction".

2. *Cross-Cultural Comparisons of the GHQ-28 Structure*

Table 5 shows the CFSs between the components in comparisons of Japanese female adolescents with Japanese male adolescents and European and Turkish female adolescents. The loadings matrix for the combined sample of 15-year-old schoolgirls in England, Greece, and Turkey, which yielded high CFSs (Elton et al. 1988), was used as the representative components for European and Turkish female adolescents. The CFSs between the components identically labelled were quite high for all comparisons, which indicated that the PC structure of the GHQ-28 closely agreed between genders for Japanese adolescents and between female adolescents of the Japanese and European and Turkish samples.

Table 6 shows the CFSs between the components in comparisons of Japanese male adolescents with their Greek and Turkish counterparts, which were derived from Weyerer et al. (1986). All the CFSs between the components identically labelled were quite high.

3. *Internal Consistency of the Japanese Version GHQ-28*

Coefficient alpha was 0.85 for each gender of the adolescents. The values in the case when individual item was

deleted were approximately equal to those of the whole items; the values ranged from 0.84 and 0.86 (mean = 0.85). These values indicated that there were no items particularly disturbing the internal consistency. Similarly, for the adult employees, the alphas were 0.86 and the values when individual item was deleted ranged from 0.86 to 0.87 (mean = 0.86). The alphas calculated by age group were at similar levels; 0.85, 0.85, 0.87, and 0.89 for those aged 19–29, 30–39, 40–49, and 50–63 years, respectively.

Discussion

The present study revealed that the allocation pattern of the GHQ-28 items to the four components was generally similar among the present Japanese samples and across the Japanese, European and Turkish populations (Elton et al. 1988; Goldberg and Hillier 1979; Weyerer et al. 1986). Variances explained for the total variance also were at similar levels across these samples. According to Weyerer et al. (1986), the difference in order of the components found in the present study is not regarded as the difference in factor structure. Therefore, it could be suggested that the PC structure of the GHQ-28 was stable throughout the generational and cross-cultural comparisons tested here.

Visual inspection, however, indicated that a few divergences existed in the allocation of C2 and two items related to insomnia or sleep disturbance, B1 and B2, i.e. for the adult employees, B1 and B2 loaded on "somatic symptoms", whereas such a picture was never observed for the adolescents, and C2 always had a significant loading not an "social dysfunction" but on "anxiety" or "anxiety and insomnia" throughout the analyses. On the other hand, although for the European and Turkish adolescents (Elton et al. 1988; Weyerer et al. 1986) and for the UK college students (Parkes 1982) D5 loaded on a different component or on two components, such a picture was never found in the Japanese samples.

The finding that the PC structure in the employees aged 40–49 years appeared to differ slightly from the others could be partially influenced by the statistical reapportioning of variance adopted here, i.e. the number of components extracted was restricted to four, and to the relatively fewer number of subjects ($n = 318$) in this kind of analysis. A different number of components might be suitable for this age group, and the respondents with a specific personality, such as field dependence (Parkes 1982), might be more included in this age group.

Weyerer et al. (1986) and Elton et al. (1988) investigated the hypothesis presented by Goldberg (1983) that there existed a common language of psychological distress which cut across cultural barriers by comparing the PC structure across their adolescent samples with different cultural backgrounds. The resulting CFSs indicated high agreement between the similarly labelled components among their samples, particularly for males, and thus they regarded their results as supportive of Goldberg's hypothesis (1983). Similarly, in the present study, identical findings were obtained in a comparison between the Japanese and the European and Turkish adolescents. Although D'Arcy and Siddique (1984) reported that the factor structure of GHQ-30 in Canadian adolescents was different from that typically reported for the general adult population, the PC structure of GHQ-28 in the Japanese early adolescents coincided with that of both Japanese and British adult populations.

It is obvious that cultures and some psychosocial factors or backgrounds vary considerably across Europe and Turkey. Even though recently Japanese culture and life style have been changing and westernizing rapidly, it still is true that Japanese culture is very different for European and Turkish cultures. Thus, the present study further provides supportive evidence for Goldberg's hypothesis, but it should be noticed that these findings were derived from the CFS, which is inferior to some updated statistics such as LISREL, for the reason mentioned earlier (see Methods section).

In summary, the present study shows that the PC structure of GHQ-28 was quite stable between genders and across age groups (generations) and nations, at least among some European, Turkish and Japanese populations, when analysed with its four-factor solution according to Goldberg and Hillier (1979). Its internal consistency reliability also yielded such a conclusion. These findings suggest that the psychometric properties of the GHQ-28 are highly stable, based on a cross-cultural comparison of these populations. Further research, however, will be needed to elicit its structure for various samples of other cultural settings or backgrounds, with analysis, by more powerful statistic procedures.

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