Table3_The Responses of Use of Mobile Phones for Sending Text Messages after Lights Out.

	N	No use	1–3 times a month	Once a week	Several times a week	Every day	Uncetain
Male							
Junior high school							
7th grade	6497	80.4	3.8	3.2	6.0	4.8	1.8
8th grade	6769	71.5	5.0	3.9	9.4	8.6	1.5
9th grade	6296	66.9	4.8	4.7	11.0	11.1	1.5
Senior high school							
10th grade	10154	49.4	7.0	7.4	17.6	17.4	1.1
11th grade	9599	49.1	6.2	7.4	17.3	18.9	1.1
12th grade	8762	51.7	5.8	6.9	16.7	17.7	1.3
Total	48077	59.3	5.7	5.9	13.8	14.0	1.3
Female							
Junior high school							
7th grade	6769	64.6	7.6	5.1	11.5	10.1	1.2
8th grade	6837	55.3	8.7	5.1	14.6	15.5	1.0
9th grade	6575	53.0	7.2	5.3	15.3	18.0	1.2
Senior high school							
10th grade	9964	38.5	7.8	7.0	20.2	25.8	0.7
11th grade	8662	36.8	7.6	7.5	19.4	27.8	0.8
12th grade	7893	39.9	6.1	6.9	20.2	26.1	0.9
Total	46700	46.7	7.5	6.3	17.3	21.3	0.9

Data are shown in percentage, %.

Table4_The Prevalence of Sleep Disturbances Among Japanese Adolescents.

	Short sleep duration			Subjective poor sleep quality			Excessive daytime sleepiness			insomnia symptom		
	%	95%CI		%	95%CI		%	95%CI		%	95%CI	
Male												
Junior high school												
7th grade	12.8	12.0 – 13.6		27.9	26.8 – 29.0		25.2	24.1 – 26.3		19.5	18.5 – 20.5	
8th grade	17.7	16.8 – 18.6		32.3	31.2 – 33.4		31.3	30.2 – 32.4		21.0	20.0 – 22.0	
9th grade	26.9	25.8 – 28.0		37.9	36.7 – 39.1		33.6	32.4 – 34.8		23.8	22.7 – 24.9	
Senior high school												
10th grade	33.2	32.3 – 34.1		44.7	43.7 – 45.7		46.0	45.0 – 47.0		21.5	20.7 – 22.3	
11th grade	37.4	36.4 – 38.4		43.1	42.1 – 44.1		45.2	44.2 – 46.2		21.4	20.6 – 22.2	
12th grade	42.9	41.9 – 43.9		44.2	43.2 – 45.2		44.7	43.7 – 45.7		24.2	23.3 – 25.1	
Total	30.0	29.6 – 30.4		39.4	39.0 – 39.8		39.1	38.7 – 39.5		21.9	21.5 – 22.3	
Female												
Junior high school												
7th grade	16.7	15.8 – 17.6		34.3	33.2 – 35.4		31.1	30.0 – 32.2		18.6	17.7 – 19.5	
8th grade	22.7	21.7 – 23.7		37.0	35.9 – 38.1		38.7	37.5 – 39.9		21.6	20.6 – 22.6	
9th grade	31.5	30.4 – 32.6		42.0	40.8 – 43.2		41.4	40.2 – 42.6		23.5	22.5 – 24.5	
Senior high school												
10th grade	42.0	41.0 – 43.0		46.6	45.6 – 47.6		53.4	52.4 – 54.4		22.1	21.3 – 22.9	
11th grade	43.4	42.4 – 44.4		44.8	43.8 – 45.8		52.7	51.6 – 53.8		22.9	22.0 – 23.8	
12th grade	45.8	44.7 – 46.9		43.6	42.5 – 44.7		52.2	51.1 – 53.3		25.1	24.1 – 26.1	
Total	35.0	34.6 – 35.4		41.9	41.5 – 42.3		46.0	45.5 – 46.5		22.4	22.0 – 22.8	

CI: confidence interval.

Subject with missing date were excluded from the analysis.

Table5_ The Association Between Use of Mobile Phones After Lights Out and Sleep Disturbances Among Japanese Adolescents.

Variables	N	Short sleep duration						Subjective poor sleep quality					
		Crude			Adjusted			Crude			Adjusted		
		OR	95%CI	P value	OR	95%CI	P value	OR	95%CI	P value	OR	95%CI	P value
Use of mobile phones for calling after lights out				<0.001			<0.001			<0.001			<0.001
No use	67646	1.00			1.00			1.00			1.00		
1-3 times a month	6229	1.41	1.33 – 1.48		1.12	1.05 – 1.19		1.40	1.33 – 1.48		1.06	1.00 – 1.13	
Once a week	4423	1.26	1.18 – 1.34		0.99	0.92 – 1.07		1.31	1.23 – 1.39		1.01	0.94 – 1.08	
Several times a week	7441	1.49	1.42 – 1.56		1.08	1.02 – 1.14		1.57	1.49 – 1.65		1.08	1.02 – 1.14	
Every day	7853	1.94	1.85 – 2.03		1.21	1.14 – 1.28		2.00	1.90 – 2.09		1.22	1.15 – 1.29	
Use of mobile phones for sending text messages after lights out				<0.001			<0.001			<0.001			<0.001
No use	50349	1.00			1.00			1.00			1.00		
1-3 times a month	6204	1.05	0.99 – 1.12		0.87	0.81 – 0.92		1.19	1.13 – 1.26		1.07	1.00 – 1.13	
Once a week	5767	1.15	1.09 – 1.22		0.88	0.83 – 0.94		1.25	1.18 – 1.32		1.05	0.98 – 1.11	
Several times a week	14698	1.37	1.32 – 1.42		0.97	0.93 – 1.01		1.49	1.43 – 1.54		1.16	1.11 – 1.21	
Every day	16696	1.89	1.82 – 1.96		1.15	1.09 – 1.20		1.95	1.88 – 2.02		1.27	1.21 – 1.33	

OR: odds ratio. CI: confidence interval.
Subject with missing date were excluded from the analysis.
Adjusted factors: sex, grade, drinking alcohol, smoking, eating breakfast, extracurricular activities, mental health

Table6. The Association Between Use of Mobile Phones After Lights Out and Sleep Disturbances Among Japanese Adolescents(continued).

Variables	N	Excessive daytime sleepiness						Insomnia symptom					
		Crude			Adjusted			Crude			Adjusted		
		OR	95%CI	P value	OR	95%CI	P value	OR	95%CI	P value	OR	95%CI	P value
Use of mobile phones for calling after lights out				<0.001			<0.001			<0.001			<0.001
No use	67646	1.00			1.00			1.00			1.00		
1–3 times a month	6229	1.45	1.38 – 1.53		0.98	0.92 – 1.04		1.46	1.38 – 1.55		1.13	1.06 – 1.21	
Once a week	4423	1.30	1.22 – 1.38		0.91	0.85 – 0.98		1.50	1.40 – 1.61		1.19	1.10 – 1.29	
Several times a week	7441	1.58	1.50 – 1.65		0.98	0.93 – 1.04		1.79	1.70 – 1.89		1.26	1.18 – 1.34	
Every day	7853	2.12	2.02 – 2.22		1.17	1.10 – 1.24		2.47	2.35 – 2.60		1.44	1.35 – 1.53	
Use of mobile phones for sending text messages after lights out				<0.001			<0.001			<0.001			<0.001
No use	50349	1.00			1.00			1.00			1.00		
1–3 times a month	6204	1.40	1.32 – 1.47		1.24	1.17 – 1.31		1.15	1.08 – 1.23		1.07	0.99 – 1.15	
Once a week	5767	1.39	1.32 – 1.47		1.16	1.09 – 1.23		1.20	1.12 – 1.28		1.02	0.95 – 1.10	
Several times a week	14698	1.74	1.68 – 1.80		1.37	1.31 – 1.43		1.43	1.37 – 1.49		1.12	1.07 – 1.18	
Every day	16696	2.28	2.20 – 2.36		1.50	1.43 – 1.57		2.28	2.19 – 2.37		1.45	1.38 – 1.53	

OR: odds ratio. CI: confidence interval.
Subject with missing date were excluded from the analysis.
Adjusted factors: sex, grade, drinking alcohol, smoking, eating breakfast, extracurricular activities, mental health

中学生・高校生の衝動性と怒りに関する全国調査

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【目的】

衝動性や怒りの高さは，暴力行動や社会不適応との関連が報告されており，特に思春期の生徒については「キレる」という言葉が用いられ，近年では社会的な問題として認識されている。しかし，日本人の思春期の生徒を対象とした大規模な調査は少なく，実証的な研究が不足している。本研究では，日本人の中高生を対象とした全国調査を実施し，思春期の生徒の衝動性と怒りについて検討を行った。

【方法】

日本全国の中学生と高校生を対象に自記式質問票調査を実施した。全国の 10,955 の中学校と 5,115 の高校のうち，130 の中学校と 110 の高校を無作為抽出し，中学校 92 校（協力率：70.8%），高校 80 校（協力率：72.7%）の協力が得られた。中学校 40,151（回収率：64.6%），高校 55,529（回収率：62.1%），合計 95,980（回収率：63.1%）の質問紙を回収し，無効回答を除いた 94,777 の回答を有効回答とした（有効回答率：62.3%）。

【結果】

衝動性と怒りに関する質問項目により，衝動性が高いと評価された者は，7.5%（男子 7.0%，女子 8.0%），怒りが高いと評価された者は 8.7%（男子 7.9%，女子 9.6%）であり，それぞれ学年が上がるほど割合が増加する傾向が認められた。ロジスティック回帰分析の結果，衝動性が高いことについては，女子，喫煙有，飲酒有，朝食の欠食，部活動の不参加，短い/長い睡眠時間，睡眠の質が悪い，不眠症状有，日中の眠気有，精神的不健康においてオッズ比が有意に高値を示していた。また，怒りが高いことについては，高校 3 年生のオッズ比が有意に低値であり，喫煙有，飲酒有，朝食の欠食，短い/長い睡眠時間，睡眠の質が悪い，不眠症状有，日中の眠気有，精神的不健康においてオッズ比が有意に高値を示していた。

【考察】

本研究結果から，思春期の生徒の衝動性や怒りの高さへの対策として，規則正しい生活習慣，安定した睡眠習慣，そして精神的健康の増進の必要性が示唆された。今後，思春期の生徒に対しては，これらの対策に留意した健康教育活動を推進することが重要である。

Table1_衝動性

	N	never	seldom	sometimes	often	always	Uncetain
Male							
Junior high school							
7th grade	6497	66.1	15.5	12.4	3.4	1.7	0.9
8th grade	6769	62.9	17.2	13.0	4.2	2.0	0.8
9th grade	6296	63.8	15.2	13.6	4.1	2.4	0.9
Senior high school							
10th grade	10154	57.8	18.5	15.8	4.7	2.4	0.9
11th grade	9599	56.5	18.1	16.9	5.1	2.4	1.0
12th grade	8762	58.2	15.9	16.7	5.1	3.0	1.1
Total	48077	60.2	16.9	15.0	4.5	2.4	0.9
Female							
Junior high school							
7th grade	6769	64.4	16.8	12.9	3.5	1.9	0.6
8th grade	6837	60.2	17.8	14.8	4.9	1.8	0.6
9th grade	6575	57.1	18.3	16.3	5.0	2.5	0.7
Senior high school							
10th grade	9964	48.9	20.7	20.9	6.2	2.6	0.6
11th grade	8662	46.6	19.9	23.2	6.5	2.9	0.8
12th grade	7893	49.3	19.4	21.5	6.3	2.8	0.8
Total	46700	53.6	19.0	18.7	5.5	2.5	0.7

Table1_怒り

	N	never	seldom	sometimes	often	always	Uncetain
Male							
Junior high school							
7th grade	6497	61.1	19.0	13.0	3.5	2.4	0.9
8th grade	6769	59.5	19.1	13.4	4.6	2.4	1.0
9th grade	6296	59.4	17.8	14.2	4.6	3.1	0.9
Senior high school							
10th grade	10154	53.9	19.5	17.4	5.5	2.9	0.9
11th grade	9599	52.2	19.6	18.7	5.5	3.0	1.1
12th grade	8762	55.5	17.3	17.7	5.1	3.3	1.2
Total	48077	56.3	18.8	16.1	4.9	2.9	1.0
Female							
Junior high school							
7th grade	6769	53.9	22.1	16.0	4.7	2.6	0.8
8th grade	6837	49.7	21.8	18.7	6.4	2.7	0.8
9th grade	6575	46.4	22.1	21.1	6.2	3.3	0.8
Senior high school							
10th grade	9964	42.2	23.9	22.8	6.9	3.4	0.8
11th grade	8662	40.4	23.6	24.3	7.1	3.7	1.0
12th grade	7893	45.1	21.9	22.7	6.6	2.9	0.9
Total	46700	45.7	22.7	21.2	6.4	3.1	0.9

怒りが高いことを従属変数としたロジスティック回帰分析

Variables	N	Prevalences			Odds ratios		
		%	95%CI	P value[a]	AOR	95%CI	P value[b]
Sex				<0.001			0.031
Male	47602	7.9	7.7 – 8.1		1.00		
Female	46301	9.6	9.3 – 9.9		1.06	1.01 – 1.11	
Grade				<0.001			<0.001
7th grade	13154	6.7	6.3 – 7.1		1.00		
8th grade	13488	8.1	7.6 – 8.6		1.06	0.96 – 1.17	
9th grade	12760	8.7	8.2 – 9.2		1.00	0.91 – 1.11	
10th grade	19948	9.4	9.0 – 9.8		0.92	0.84 – 1.01	
11th grade	18070	9.7	9.3 – 10.1		0.92	0.84 – 1.01	
12th grade	16483	8.9	8.5 – 9.3		0.78	0.71 – 0.87	
Smoking				<0.001			<0.001
No	88947	8.0	7.8 – 8.2		1.00		
Yes	4802	20.8	19.7 – 21.9		1.84	1.68 – 2.02	
Drinking alcohol				<0.001			<0.001
No	77677	7.6	7.4 – 7.8		1.00		
Yes	15745	14.1	13.6 – 14.6		1.30	1.22 – 1.39	
Eating breakfast				<0.001			<0.001
Daily	76930	8.0	7.8 – 8.2		1.00		
Occasional	8337	11.5	10.8 – 12.2		1.07	0.99 – 1.16	
Never	5612	15.2	14.3 – 16.1		1.23	1.13 – 1.34	
Extracurricular activities				<0.001			0.824
Participating	62829	8.1	7.9 – 8.3		1.00		
Not participating	27596	10.3	9.9 – 10.7		1.01	0.95 – 1.06	
Mental health				<0.001			<0.001
good	50607	3.5	3.3 – 3.7		1.00		
poor	42775	14.8	14.5 – 15.1		3.58	3.38 – 3.80	
Sleep duration, h				<0.001			<0.001
<5	15329	12.5	12.0 – 13.0		1.11	1.01 – 1.23	
≥5, 6<	14871	10.0	9.5 – 10.5		1.01	0.91 – 1.11	
≥6, 7<	40904	7.6	7.3 – 7.9		0.99	0.91 – 1.08	
≥7, 8<	12952	6.4	6.0 – 6.8		1.00		
≥8, 9<	6854	6.4	5.8 – 7.0		1.05	0.92 – 1.19	
≥9	2161	14.3	12.8 – 15.8		1.98	1.70 – 2.32	
Subjective sleep assessment				<0.001			<0.001
very good / good	55453	6.1	5.9 – 6.3		1.00		
bad / very bad	37944	12.5	12.2 – 12.8		1.22	1.15 – 1.29	
Insomnia symptoms				<0.001			<0.001
Absence	72492	6.2	6.0 – 6.4		1.00		
Presence	20589	17.6	17.1 – 18.1		2.05	1.94 – 2.16	
Excessive daytime sleepiness				<0.001			<0.001
Absence	53911	5.3	5.1 – 5.5		1.00		
Presence	39818	13.4	13.1 – 13.7		1.78	1.68 – 1.88	

怒りが高いことを従属変数としたロジスティック回帰分析

Variables	N	Prevalences				Odds ratios			
		%	95%CI		P value[a]	AOR	95%CI		P value[b]
Sex					<0.001				0.031
Male	47602	7.9	7.7 –	8.1		1.00			
Female	46301	9.6	9.3 –	9.9		1.06	1.01 –	1.11	
Grade					<0.001				<0.001
7th grade	13154	6.7	6.3 –	7.1		1.00			
8th grade	13488	8.1	7.6 –	8.6		1.06	0.96 –	1.17	
9th grade	12760	8.7	8.2 –	9.2		1.00	0.91 –	1.11	
10th grade	19948	9.4	9.0 –	9.8		0.92	0.84 –	1.01	
11th grade	18070	9.7	9.3 –	10.1		0.92	0.84 –	1.01	
12th grade	16483	8.9	8.5 –	9.3		0.78	0.71 –	0.87	
Smoking					<0.001				<0.001
No	88947	8.0	7.8 –	8.2		1.00			
Yes	4802	20.8	19.7 –	21.9		1.84	1.68 –	2.02	
Drinking alcohol					<0.001				<0.001
No	77677	7.6	7.4 –	7.8		1.00			
Yes	15745	14.1	13.6 –	14.6		1.30	1.22 –	1.39	
Eating breakfast					<0.001				<0.001
Daily	76930	8.0	7.8 –	8.2		1.00			
Occasional	8337	11.5	10.8 –	12.2		1.07	0.99 –	1.16	
Never	5612	15.2	14.3 –	16.1		1.23	1.13 –	1.34	
Extracurricular activities					<0.001				0.824
Participating	62829	8.1	7.9 –	8.3		1.00			
Not participating	27596	10.3	9.9 –	10.7		1.01	0.95 –	1.06	
Mental health					<0.001				<0.001
good	50607	3.5	3.3 –	3.7		1.00			
poor	42775	14.8	14.5 –	15.1		3.58	3.38 –	3.80	
Sleep duration, h					<0.001				<0.001
<5	15329	12.5	12.0 –	13.0		1.11	1.01 –	1.23	
≥5, 6<	14871	10.0	9.5 –	10.5		1.01	0.91 –	1.11	
≥6, 7<	40904	7.6	7.3 –	7.9		0.99	0.91 –	1.08	
≥7, 8<	12952	6.4	6.0 –	6.8		1.00			
≥8, 9<	6854	6.4	5.8 –	7.0		1.05	0.92 –	1.19	
≥9	2161	14.3	12.8 –	15.8		1.98	1.70 –	2.32	
Subjective sleep assessment					<0.001				<0.001
very good / good	55453	6.1	5.9 –	6.3		1.00			
bad / very bad	37944	12.5	12.2 –	12.8		1.22	1.15 –	1.29	
Insomnia symptoms					<0.001				<0.001
Absence	72492	6.2	6.0 –	6.4		1.00			
Presence	20589	17.6	17.1 –	18.1		2.05	1.94 –	2.16	
Excessive daytime sleepiness					<0.001				<0.001
Absence	53911	5.3	5.1 –	5.5		1.00			
Presence	39818	13.4	13.1 –	13.7		1.78	1.68 –	1.88	

	N	High impulsive student				Easily angered student			
		Prevalnece(%)	95%CI		P value[a]	Prevalnece(%)	95%CI		P value[a]
Male					<0.01				<0.01
Junior high school									
7th grade	6497	5.2	4.7 –	5.7		6.0	5.4 –	6.6	
8th grade	6769	6.2	5.6 –	6.8		7.0	6.4 –	7.6	
9th grade	6296	6.6	6.0 –	7.2		7.8	7.1 –	8.5	
Senior high school									
10th grade	10154	7.2	6.7 –	7.7		8.4	7.9 –	8.9	
11th grade	9599	7.6	7.1 –	8.1		8.6	8.0 –	9.2	
12th grade	8762	8.2	7.6 –	8.8		8.4	7.8 –	9.0	
Total	48077	7.0	6.8 –	7.2		7.9	7.7 –	8.1	
Female					<0.01				<0.01
Junior high school									
7th grade	6769	5.4	4.9 –	5.9		7.3	6.7 –	7.9	
8th grade	6837	6.7	6.1 –	7.3		9.2	8.5 –	9.9	
9th grade	6575	7.5	6.9 –	8.1		9.6	8.9 –	10.3	
Senior high school									
10th grade	9964	8.9	8.3 –	9.5		10.3	9.7 –	10.9	
11th grade	8662	9.5	8.9 –	10.1		10.9	10.2 –	11.6	
12th grade	7893	9.2	8.6 –	9.8		9.5	8.9 –	10.1	
Total	46700	8.0	7.8 –	8.2		9.6	9.3 –	9.9	

Clarification of the factor structure of the 12-item General Health Questionnaire among Japanese adolescents and associated sleep status

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ABSTRACT

If the factors affecting the mental health status of adolescents and their association with sleep status could be clarified, this information would be helpful for formulating lifestyle and healthcare guidance for the promotion of healthy growth and the prevention of mental problems in these individuals. The purpose of this study was to clarify (1) the factor structure of the 12-item General Health Questionnaire (GHQ-12), and (2) the associations between the factors extracted from this questionnaire and lifestyle, in particular sleep status, by using a representative sample population of Japanese adolescents. One hundred three thousand sixty hundred fifty self-administered questionnaires were collected from students enrolled in junior high and high schools in Japan. Of these questionnaires, 99,668 were analyzed. Sleep duration, subjective sleep assessment, bedtime, and insomnia symptoms of these students over the past one month were studied to investigate sleep status. The factor analyses yielded two factors: depression/anxiety and loss of positive emotion. Sleep duration of less than 7 h was found to be associated with both depression/anxiety and loss of positive emotion, whereas sleep duration of 8 h or more was associated only with loss of positive emotion. Subjective sleep assessment and insomnia symptoms were associated with both depression/anxiety and loss of positive emotion. It was demonstrated that two underlying factors of mental health status were associated with differences in sleep status. In order to improve the mental health status of adolescents, it is important to provide guidance about sleep and lifestyle habits according to the mental health status of the individual.

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1. Introduction

Epidemiological studies conducted worldwide have shown that the mental health status of adolescents is strongly associated with habitual sleep patterns and insomnia symptoms (Marks and Monroe, 1976; Morrison et al., 1992; Gau and Soong, 1995; Manni et al., 1997; Liu and Zhou, 2002; Bailly et al., 2004; Kaneita et al., 2006, 2007).

We have previously studied the association between sleep problems and mental health status in 100,000 Japanese adolescents by using the 12-item General Health Questionnaire (GHQ-12). We observed a linear association between subjective sleep assessment

and mental health status and a U-shaped association between sleep duration and mental health status, i.e., poor mental health status was associated with both short and long sleep durations (Kaneita et al., 2007).

The GHQ-12, which was used in our previous study, is an instrument that was developed for screening mental health problems. It employs only 12 questions, and can easily evaluate mental health status. Furthermore, as it is also known for its high reliability and validity, the GHQ-12 is now used worldwide (Goldberg et al., 1976; Iwata et al., 1988; Politi et al., 1994; Kilic et al., 1997; Graetz, 1991; Werneke et al., 2000; Doi and Minowa, 2003; French and Tait, 2004; Hu et al., 2007).

Previous factor analyses of the GHQ-12 have suggested that it is influenced by several latent factors of mental health status (Campbell et al., 2003; Doi and Minowa, 2003; Hu et al., 2007). Recent nationwide representative surveys conducted in Japan and the UK

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involving factor analysis of the GHQ-12 yielded a two-factor solution: one was depression/anxiety such as depression and stress and the other was a loss of positive emotion, such as not played a useful part and not enjoyed normal activities (Doi and Minowa, 2003; Hu et al., 2007).

However, to date, no study has analyzed the factor structure of the GHQ-12 by conducting a survey on a representative, large-sized sample of adolescents. Therefore, the sleep status and lifestyle associated with each factor have not been clarified. Such information could be important for understanding the factor structure of mental health measures for adolescents, who are in a developmental phase of life, and the factors that affect these measures. This study has the following three major objectives: (1) To clarify whether or not the factor structure of the GHQ-12 which was obtained from about 100,000 highly representative samples (high school and junior high school students) has the two-factor structure noted in the previous study (2) To clarify the associated sleep characteristics and lifestyle habits when multiple factors are obtained (3) To extract some of the factor items obtained and to clarify whether mental health performance can be evaluated by using a smaller number of items.

We consider that, by clarifying the above, we can create a more specific guidance on sleep/lifestyle habits against signs of deterioration in particular mental health performance, and can correctly understand the mental health performance by using a smaller number of questions on a questionnaire.

2. Methods

2.1. Subjects and sampling

We have previously conducted two cross-sectional nationwide surveys (in 1996 and 2000) on lifestyle habits such as alcohol drinking, smoking, eating, and sleeping among Japanese adolescents (Suzuki et al., 2000; Ohida et al., 2004; Osaki et al., 2006).

For the present study, of the 11,060 junior high schools and 4627 senior high schools registered in Japan in May 2003, 131 junior high schools (selection rate: 1.2%) and 109 senior high schools (selection rate: 1.9%) were sampled. A single-stage cluster sampling method was employed with the probability of sampling proportional to the number of current students. All the students enrolled in the sampled schools were the subjects of this study. The sample size was determined by referring to the response rates and confidence intervals based on variance of results, which were obtained from the two previous studies.

In the Japanese education system, children enter primary school at the age of 6 years and leave after 6 years of study. They then enter junior high school for 3 years of study, followed by a further 3 years of study at senior high school. Primary and junior high school education is compulsory. In this report, the first to the third years of junior high school are called the 7th to 9th grades, and the first to third years of senior high school are called the 10th to 12th grades.

2.2. Survey procedure

We sent a letter to the principal of each selected school asking for cooperation in our survey, along with the same number of questionnaires and envelopes as the number of students enrolled at the school. At each school that agreed to participate in our survey, each class teacher distributed the questionnaires among the students. To protect the privacy of respondents and to obtain as candid a response as possible from each, it was clearly stated on the questionnaire that completed questionnaires would not be seen by the teachers. After filling in the anonymous questionnaire, each student was asked to seal the questionnaire in the provided envelope with an adhesive flap. Delivery and collection of the questionnaire were entrusted to the teachers, who were instructed to follow the guidelines for conducting the survey. The teachers collected and sent the sealed envelopes back to the National Institute of Public Health without opening them. The survey period was from December 2004 to the end of January 2005. This survey was approved by the Ethics Committee of the National Institute of Public Health.

2.3. Measures

The major areas that were included in the questionnaire were (1) lifestyle, including drinking and smoking behavior, (2) sleep status, (3) mental health status, and (4) personal data.

The questions related to lifestyle were whether the student ate breakfast (daily/occasionally/never) and whether he/she participated in extracurricular activities (participating actively/participating but not actively/not participating). The question, "How many days did you smoke in the past one month?" was included in the questionnaire. If the response to this question was "One day or more," then the student

was defined as "smoking." Similarly, the question, "How many days did you consume alcoholic beverages in the past one month?" was asked, and if the response was "One day or more," then the student was defined as "drinking alcohol." In Japan, no smoking or alcohol use is allowed for people under 20 years old. Therefore, the smoking and drinking rates among high school and junior high school students are very low. In our previous study using the same data, regarding the number of days on which they consumed alcohol during the 30 days prior to the questionnaire, 70.3% responded "0 days," while 16.5% responded "1 to 2 days," 8.4% responded "3 to 5 days," 1.8% responded "6 to 9 days," 2.1% responded "10 to 19 days," 0.5% responded "20 to 29 days," and 0.3% responded "everyday." As for smoking, 90.6% responded "0 days," while 1.7% responded "1 to 2 days," 1.1% responded "3 to 5 days," 0.5% responded "6 to 9 days," 0.9% responded "10 to 19 days," 1.1% responded "20 to 29 days," and 4.1% responded "everyday" (Kaneita et al., 2007). From these results, as for drinking/smoking, rather than dividing and analyzing the smoking/drinking rates of one day or more during one month into smaller categories, we considered it more appropriate to define a frequency of one day or more as "having smoking/drinking behavior" and a frequency of zero days as "not having such behavior".

Sleep status was addressed by the following questions about (a) sleep duration, (b) subjective sleep assessment, (c) time of going to bed, (d) difficulty initiating sleep, (e) difficulty maintaining sleep, and (f) early morning awakening experience during the previous month were embedded in the questionnaire: the choices are indicated in parentheses.

a) How many hours on average do you sleep at night? (Less than 5 h/5 h or more but less than 6 h/6 h or more but less than 7 h/7 h or more but less than 8 h/8 h or more but less than 9 h/9 h or more).
b) How do you assess the quality of your sleep? (Very good/good/bad/very bad).
c) What time is your bedtime on average? (Before 10 p.m./10 p.m. or after but before 11 p.m./11 p.m. or after but before midnight/midnight or after but before 1 a.m./1 a.m. or after but before 2 a.m./2 a.m. or after).
d) Do you have difficulty falling asleep at night? (Never/seldom/sometimes/often/always).
e) Do you wake up during the night after you have gone to sleep? (Never/seldom/sometimes/often/always).
f) Do you wake up too early in the morning and have difficulty getting back to sleep? (Never/seldom/sometimes/often/always).

The Japanese version of the 12-item General Health Questionnaire (GHQ-12) was used to evaluate mental health status (Goldberg et al., 1976; Doi and Minowa, 2003). The GHQ-12 is a widely used, self-administered questionnaire that was originally designed as a screening tool for mental illness. It assesses 12 symptoms of psychiatric disorders that have been experienced during the previous month. Every item on the GHQ-12 describes a symptom and has four possible responses: the two answers that indicate the absence of the symptom are given a score of 0, and the two that indicate the presence of the symptom receive a score of 1. The overall score on the scale will thus fall into a range of 0 to 12, and it follows that the higher the total score, the poorer the state of mental health. The GHQ-12 score was originally applied to adult populations and then subsequently used and validated for adolescents as well (Radovanović et al., 1983; D'Arcy and Siddique; 1984; Arakida et al., 2003).

The demographic variables derived from personal data were gender, grade, type of school (junior high school/senior high school), and intention to study at university (yes/no).

2.4. Statistical analyses

To describe the distribution of GHQ-12 scores among the subjects, means, medians and modes were calculated by gender and grade. Gender differences in the scores were examined by Mann–Whitney U-test. Kruskal–Wallis test was used to examine grade differences in the scores. It has already been confirmed by our previous study that the GHQ-12 data used in this study has good internal consistency. Cronbach α for the whole sample was 0.833 (0.837 for males, 0.822 for females; Kaneita et al., 2007). As a usual rule of thumb, a value >0.2 was the correlated coefficient of an item with the item-deleted total score regarding homogeneity of the scale (Nunally and Bernstein, 1994; Doi and Minowa, 2003).

The principal factor method was employed to examine the factor structure of the scale. The unrotated solution was determined, following by an oblique promax rotation as a correlated solution to optimize the properties of the sample data. The number of factors retained and rotated was determined on the basis of an eigenvalue of >1.00. A value of 0.3 was determined to be the minimum value for a salient factor; a criterion of ≥0.5 was regarded as better. We then conducted confirmatory factor analysis (CFA) using the maximum likelihood estimation method. We used the goodness-of-fit index (GFI), the adjusted GFI (AGFI), the root-mean-square error of approximation (RMSEA) values, and the expected cross-validation index (ECVI) to compare models. It was confirmed that the model with the highest GFI and AGFI values and the lowest RMSEA and ECVI values is the most desirable. CFAs were performed using AMOS version 5 for Windows (SPSS, Inc., Chicago, Ill.) with the maximum likelihood method.

We calculated subscale scores by summing the scores for items that constituted each extracted factor. We then compared the score distributions between boys and girls. The significance of categorical data was analyzed using the χ^2 test. Similarly, the associations between subscale scores and sleep status were examined.

Logistic regression analyses were conducted to investigate factors associated with the subscales of the factor structures obtained. The cutoff point of the GHQ-12 scores was set to 4; this is one-third of the full score (12) (Arakida et al., 2003; Fuchino et al., 2003; Shimbo et al., 2005; Kaneita et al., 2007). The mental health status of an individual with four points or greater was defined as poor. Hence, we set the cutoff point of the subscale scores of the factors extracted by factor analysis to one-third of the full score. These subscale scores were then used as a response variable. Gender, grade, subjective sleep assessment, sleep duration, bedtime, difficulty initiating sleep, difficulty maintaining sleep, early morning awakening, eating breakfast, drinking more than once a month, smoking more than once a month, participating in extracurricular activities, and intention of studying at university were used as covariates in these analyses. Adjusted odds ratios (AORs) and 95% confidence intervals were calculated from both the univariate analysis and the multivariate logistic analysis. For all analyses, $p<0.05$ was considered to indicate statistical significance.

The GHQ-12 contains 1 item on sleep. Therefore, when an association between mental health and sleep status is analyzed using a GHQ-12 subscale, a stronger association than the actual one may result. To adjust for this possibility, we excluded the sleep item from the subscale, and calculated the subscale score. Then the statistical analyses mentioned earlier were performed again.

We examined whether it was possible to evaluate mental health status using the GHQ-12 by reducing the number of questions in this questionnaire. For this purpose, we extracted the items with high factor loadings from each factor in the GHQ-12 and calculated the total scores. We then examined the extent to which these scores were able to predict poor mental health status, defined by GHQ-12 scores of 4 points or greater, by evaluating their specificity and sensitivity. We calculated the total scores of the items extracted from the extracted factors and applied the various cutoff definitions.

All analyses except for CFA were performed using SPSS version 11.5 for Windows (SPSS, Inc., Chicago, Ill.).

3. Results

Replies were obtained from 92 of the 131 junior high schools (school response rate = 70.2%) and 87 of the 109 senior high schools (school response rate = 79.8%; combined junior and senior high school response rate = 74.6%). A total of 103,650 envelopes were collected. The student response rate as a proportion of students enrolled at the sampled schools was 88.4% for the junior high schools, 86.3% for the senior high schools, and 87.1% as a whole. Accordingly, the overall response rate was 60.7% for the junior high schools, 67.7% for the senior high schools, and 64.8% as a whole. Of the collected questionnaires, 3982 were excluded because the gender or grade was not specified or the answers for the GHQ-12 were incomplete. The data for the remaining 99,668 questionnaires were analyzed.

The corrected item-total correlation coefficients for the 12 items were all greater than 0.2, which indicated that all the items had similar tendencies.

Factor analysis with promax rotation yielded two factors for both boys and girls (Table 1). For the boys, the eigenvalues for the 1st and 2nd factors were 4.20 and 1.32, respectively. For girls, the eigenvalues for the 1st and 2nd factors were 4.01 and 1.35, respectively. The first

two unrotated factors explained 35.0% and 11.0% of the variance in GHQ-12 score in boys and 34.0% and 11.3% in girls.

The 1st factor was designated as depression/anxiety and included the following six items: feel depressed, lose confidence, hardly overcome difficulties, constantly under strain, think yourself worthless, and lose sleep over worry. The 2nd factor was termed loss of positive emotion, and it also included six items: (not) play a useful part, (not) enjoy activities, (not) face up to problems, (not) make decisions, (not) concentrate, and (not) feel reasonably happy. The factor structures for boys and girls were extremely similar.

The total scores of the six items for each of depression/anxiety and loss of positive emotion factors (score range for each factor: 0–6 points) were calculated as subscale scores. Chronbach's alpha coefficient for the depression/anxiety factor was 0.812 (boys: 0.808, girls: 0.806) and that for the loss of positive emotion factor was 0.675 (boys: 0.681, girls: 0.669).

Table 2 shows measures of fit for CFA models. As Model I, we set the one-factor structure by treating the GHQ-12 as unidimensional. As Model II, we set the two-factor structure with free covariance between factors. As Model III, we set the two-factor structure with zero covariance between factors. When compared to the other two models, Model II has higher GFI and AGFI values and lower RMSEA and ECVI values, thus indicating that the two-factor structure with covariance between factors is the most desirable factor structure for the GHQ-12. The standardized estimate scores of model II are shown in Table 3.

The mean values (mean ± standard deviation (S.D.)) for the depression/anxiety scores were 2.02 ± 1.99 for boys and 2.67 ± 2.07 for girls. The mean values (mean ± S.D.) for the loss of positive emotion scores were 1.21 ± 1.45 for boys and 1.24 ± 1.47 for girls. The results of the Mann–Whitney U-test of differences between boys

Table 2
Measures of fit from confirmatory factor analysis (CFA).

	Sample	GFI	AGFI	RMSEA	ECVI
Model I (one factor)	Boys	0.916	0.879	0.089	0.433
	Girls	0.917	0.881	0.089	0.431
Model II (Two factor)[a]	Boys	0.975	0.964	0.052	0.146
	Girls	0.974	0.962	0.054	0.156
Model III (Two factor)[b]	Boys	0.936	0.907	0.092	0.455
	Girls	0.938	0.911	0.089	0.432

Abbreviation: GIF, goodness-of-fit index; AGFI, Adjusted GFI; RMSEA, root-mean-square error of approximation; and ECVI, expected cross-validation index
Boys: 54,355 boys, girls: 45,313 girls.
[a] Model II: two factors with free covariance between factors.
[b] Model III: two factors with zero covariance between factors.

Table 1
Promax rotated factor structures on the GHQ-12.

	Boys (n = 54,355)		Girls (n = 45,313)	
GHQ-12 item	Factor 1	Factor 2	Factor 1	Factor 2
9. Depressed	**0.83**	−0.08	**0.84**	−0.09
10. Lose confidence	**0.78**	−0.08	**0.77**	−0.08
6. Hardly overcome difficulties	**0.61**	0.07	**0.61**	0.07
5. Constantly under strain	**0.58**	0.06	**0.60**	0.03
11. Think yourself worthless	**0.51**	0.11	**0.51**	0.10
2. Lose sleep over worry	**0.45**	0.06	**0.42**	0.12
3. (Not) play a useful part	−0.07	**0.63**	−0.07	**0.61**
8. (Not) face up to problems	0.05	**0.59**	0.07	**0.55**
7. (Not) enjoy activities	0.10	**0.58**	0.07	**0.59**
4. (Not) make decisions	0.08	**0.49**	0.08	**0.46**
1. (Not) concentrate	0.05	**0.39**	0.07	**0.36**
12. (Not) feel reasonably happy	−0.04	**0.39**	−0.06	**0.42**
Correlation between factors	0.63		0.60	

Factor 1, depression/anxiety; factor 2, loss of positive emotion. **Bold** values >0.30 in factor loadings.
Abbreviation: GHQ-12, 12-item General Health Questionnaire.

Table 3
Standardized estimate scores of model II (two factors with free covariance between factors).

	Boys (n = 54,355)		Girls (n = 45,313)	
GHQ-12 item	Factor 1	Factor 2	Factor 1	Factor 2
9. Depressed	0.77		0.77	
10. Lose confidence	0.73		0.71	
6. Hardly overcome difficulties	0.65		0.65	
5. Constantly under strain	0.62		0.63	
11. Think yourself worthless	0.60		0.58	
2. Lose sleep over worry	0.49		0.50	
3. (Not) play a useful part		0.54		0.53
8. (Not) face up to problems		0.64		0.61
7. (Not) enjoy activities		0.67		0.64
4. (Not) make decisions		0.54		0.52
1. (Not) concentrate		0.43		0.41
12. (Not) feel reasonably happy		0.36		0.37
Correlation between factor	0.67		0.65	

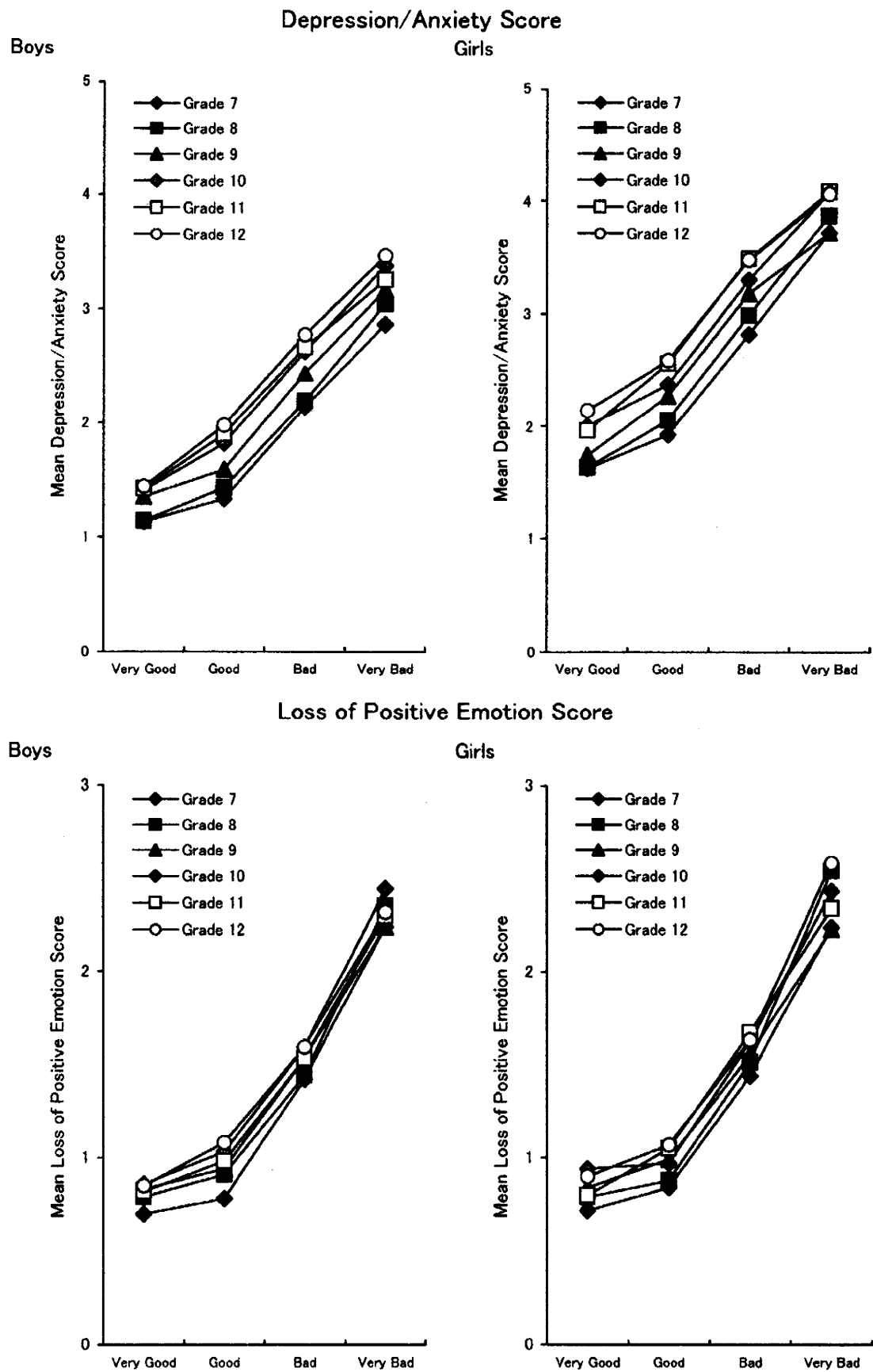Factor 1, depression/anxiety; factor 2, loss of positive emotion.

Depression/Anxiety Score

Boys   **Girls**

Loss of Positive Emotion Score

Boys   **Girls**

Fig. 1. Relationship between subjective assessment and factor scores by gender and school grade.

and girls with regard to the mean values of both the depression/anxiety and loss of positive emotion factor scores (depression/anxiety: $U = 1,007,494,912$, $p<0.01$; loss of positive emotion: $U = 1,217,609,088$, $p<0.01$) were significant. The calculation of the effect size indicated that "depression/anxiety" has a small effect size ($r = 0.17$, $0.10<$, >0.30) and "loss of positive emotion" has non-substantial effect size ($r = 0.011$; <0.10). We defined the subscale scores of 2 or greater for each factor as "depression/anxiety" and "loss of positive emotion" and then calculated the distributions of these scores. High "depression/anxiety" was observed among 55.6% of the students (boys: 49.1%, girls: 63.3%) and "loss of positive emotion" was observed among 31.2% of the students (boys: 30.5%, girls: 32.0%). The results of the χ^2 test indicated that a greater proportion of girls than boys showed "depression/anxiety" and "loss of positive emotion" (depression/anxiety: $\chi^2 = 2004.60$, d.f. $= 1$, $p<0.001$; loss of positive emotion: $\chi^2 = 23.36$, d.f. $= 1$, $p<0.001$). The effect size of gender differences was found to be small ($\varphi = 0.142$) with regard to "depression/anxiety" and substantially none ($\varphi = 0.015$) with regard to "loss of positive emotion".

The association of depression/anxiety and loss of positive emotion with subjective sleep assessment by school grade and gender is shown in Fig. 1. In both boys and girls of all school grades, the scores for depression/anxiety and loss of positive emotion increased with the worsening of the subjective sleep assessment scores.

Figures indicating the association of depression/anxiety and loss of positive emotion with sleep duration by school grade and gender are shown in Fig. 2.

In both boys and girls of all school grades, depression/anxiety scores increased with a decrease in sleep duration. Although depression/anxiety scores gradually decreased with an increase in sleep duration, for sleep durations of 7 h or more barely any difference was observed between the depression/anxiety scores. Unlike the scores for the depression/anxiety factor, the loss of positive emotion scores increased substantially when sleep duration was 8 h or more. In both boys and girls of all school grades, a clear U-shaped association was observed between loss of positive emotion and sleep duration.

The results of the logistic regression analysis demonstrated that the variables that showed significant associations with both depression/anxiety and loss of positive emotion were gender, school grade, subjective sleep assessment, sleep duration, difficulty in initiating sleep, difficulty in maintaining sleep, early morning awakening, and smoking (Table 4). The association of depression/anxiety and loss of positive emotion with sleep duration demonstrated different patterns. The adjusted odds ratio for the association of depression/anxiety with short sleep duration was high, whereas that for the association of loss of positive emotion with both short and long sleep duration was high. Some factors were associated with either depression/anxiety or loss of positive emotion. Bedtime, alcohol consumption, and a desire to pursue university education were associated only with depression/anxiety. In contrast, skipping breakfast and lack of participation in club activities were associated only with loss of positive emotion. After eliminating one item regarding insomnia from the six items pertaining to depression/anxiety, a similar analysis was conducted for the remaining five items. Results similar to those mentioned above were obtained for the association between depression/anxiety and sleep.

We selected three items whose factor loadings were high: two items (feeling depressed and lose confidence) from the depression/anxiety factor and one item (not play a useful part) from the loss of positive emotion factor, and termed these three items the GHQ-3. Subsequently, we selected one item (feel depressed) from the depression/anxiety factor and another item (not play a useful part) from the loss of positive emotion factor, and termed these two items the GHQ-2. Table 5 indicates how precisely the total scores of the items extracted from the two factors can predict the total score which is four points or more of the GHQ-12. When the cutoff point is one point for the GHQ-2, both the specificity and the sensitivity are 80% or more.

4. Discussion

The features of this study were as follows: (1) data obtained from a nationwide survey were employed, (2) the sample size was large (about 100,000), (3) mental health status was assessed using the GHQ-12, whose validity has already been established, (4) the factor structure of the GHQ-12 was examined, and (5) specific associations between the factors extracted in this study and sleep/lifestyle were clarified. To our knowledge, no analogous studies have been reported previously.

Previous factor analysis studies of translated versions of the GHQ-12 yielded Two factors. Werneke et al. (2000) reviewed previous factor analysis studies of the GHQ-12 conducted worldwide and indicated that 10 of 15 studies had yielded a two-factor solution. Hu et al. (2007) administered the GHQ-12 to a representative sample population in the UK, conducted factor analyses, and demonstrated that two factors were extractable, as was the case in our study. Doi and Minowa (2003) analyzed the data obtained from a representative Japanese adult population and demonstrated a two-factor solution: a group of items expressing depression/anxiety and a group of items expressed by positive sentences. However, they reported that a 3rd factor consisting of two items (not feel reasonably happy and not play a useful part) was evident in men. This result differed from ours in that two factors were obtained for both boys and girls. This difference in the results may be attributable to the differences in the age groups (adults and adolescents) of the subjects investigated in the two studies.

Several previous GHQ-12 factor analysis studies of adolescents have been carried out in which two or three factors were extracted (Graetz, 1991; Politi et al., 1994; López-Castedo and Fernández, 2005). However, unlike our study, none of these studies used representative, large-scale samples. Based on our present results for adolescents and the results of the study on the general Japanese adult population, it may be considered that regardless of the age group (adolescents or adults) evaluated, at least two different latent factors (depression/anxiety and loss of positive emotion) are included in evaluation of mental health status using the GHQ-12. Good mental health is defined not only by an absence of depression/anxiety, but also by good physical health, cognitive health, and human relationships. It is thus important to consider the above-mentioned two facets of mental health when evaluating an individual's mental health status (Danner et al., 2001; Huppert and Whittington, 2003; Keyes, 2005; Hu et al., 2007). Use of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) for diagnosis of mental disorders has indicated that "depressive mood" and "loss of interest or pleasure" are principal features of a major depressive episode (American Psychiatric Association, 2000). The manual stipulates that either of these two symptoms needs be exhibited for diagnosis of a major depressive episode. The fact that our factor analysis of the GHQ-12 yielded a two-factor solution (depression/anxiety and loss of positive emotion) indicates that mental health status determined by the GHQ-12 is analogous to the symptoms of major depressive episode diagnosed by the DSM-IV. The results of the present study suggest that measurement of both depression/anxiety and loss of positive emotion may be effective in medical interviews for evaluating an individual's mental health status or for examination of the effects of treatment.

Previous studies have indicated that the deterioration of an individual's mental health status is caused by depression/anxiety and loss of positive emotion (Danner et al., 2001; Huppert and Whittington, 2003; Keyes, 2005; Hu et al., 2007; American Psychiatric Association, 2000). However, no epidemiological study has investigated the sleep and lifestyle habits associated with these two factors. Hence, the present study yielded important findings for understanding the mental health status of adolescents. We found that worsening of subjective sleep sufficiency and a sleep duration of less than 7 h were associated with depression/anxiety and loss of positive emotion,
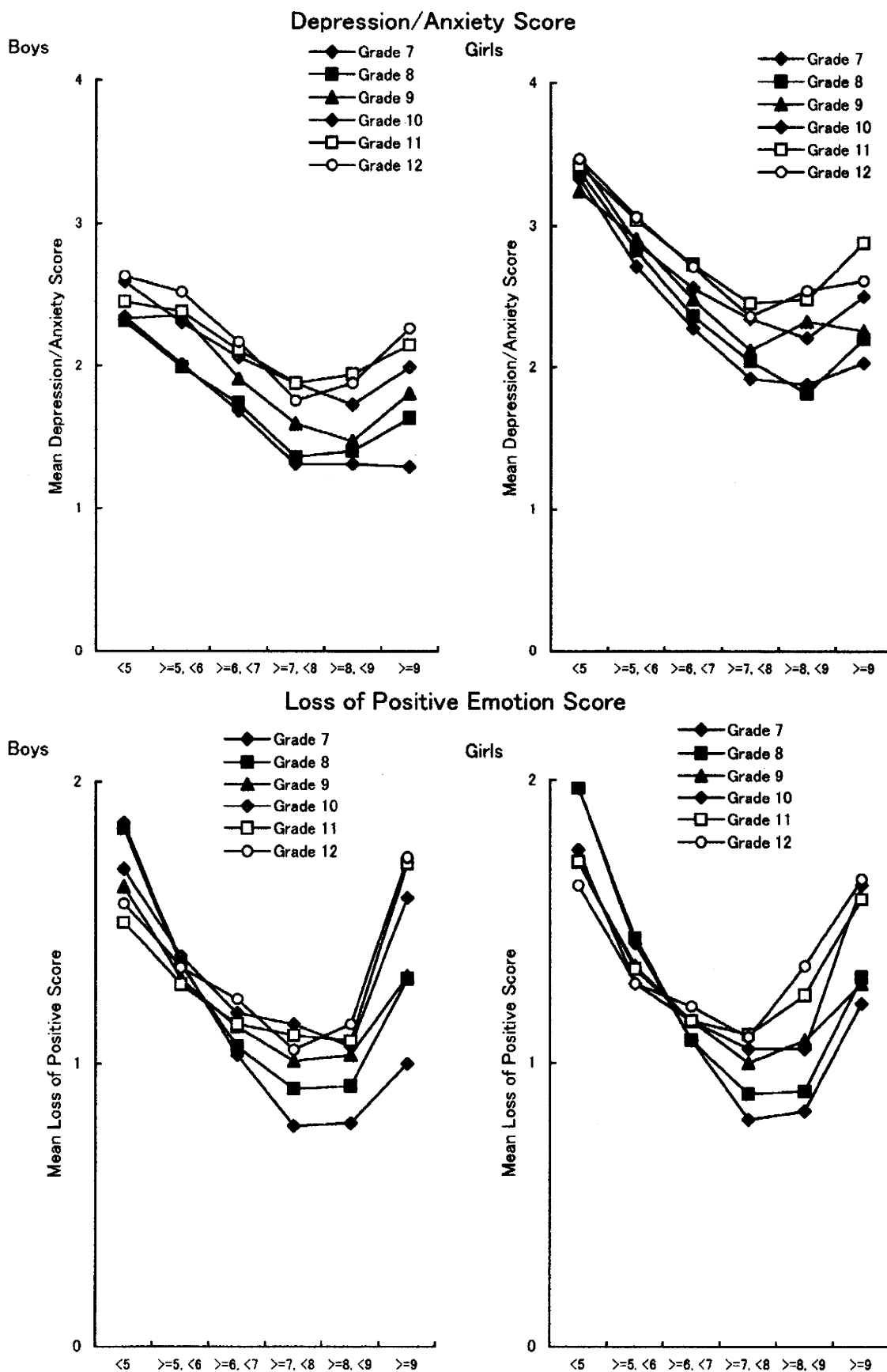
Depression/Anxiety Score

Loss of Positive Emotion Score

Fig. 2. Relationship between sleep duration and factor scores by gender and school grade.

Table 4

Logistic regression result: variables predicting depression/anxiety and loss of positive emotion in a sample of Japanese adolescents (N = 99,668).

Variable	N	Depression/anxiety			Loss of positive emotion		
		AOR	95% CI	p value	AOR	95% CI	p value
Gender							
Male	54,355	1.00			1.00		
Female	45,313	1.86	1.81 to 1.92	<0.01	1.08	1.05 to 0.11	<0.01
Grade							
7	12,670	1.00			1.00		
8	12,654	1.02	0.97 to 1.08	0.38	1.10	1.04 to 1.17	<0.01
9	12,766	1.24	1.17 to 1.31	<0.01	1.10	1.04 to 1.18	<0.01
10	21,282	1.36	1.29 to 1.44	<0.01	1.23	1.16 to 1.31	<0.01
11	21,034	1.45	1.37 to 1.53	<0.01	1.17	1.11 to 1.25	<0.01
12	19,262	1.53	1.44 to 1.62	<0.01	1.18	1.11 to 1.26	<0.01
Subjective sleep assessment							
Very good	14,867	1.00			1.00		
Good	44,277	1.40	1.34 to 1.46	<0.01	1.23	1.17 to 1.29	<0.01
Bad	32,923	2.55	2.44 to 2.68	<0.01	2.28	2.16 to 2.40	<0.01
Very bad	5596	3.68	3.38 to 4.00	<0.01	3.82	3.52 to 4.13	<0.01
Sleep duration, h							
<5	14,757	1.24	1.16 to 1.32	<0.01	1.19	1.12 to 1.27	<0.01
≥5, <6	17,563	1.22	1.16 to 1.29	<0.01	1.07	1.01 to 1.14	0.02
≥6, <7	40,030	1.13	1.08 to 1.18	<0.01	1.09	1.04 to 1.14	<0.01
≥7, <8	15,151	1.00			1.00		
≥8, <9	7416	0.99	0.93 to 1.05	0.78	1.08	1.01 to 1.16	0.03
≥9	3002	1.08	0.98 to 1.18	0.11	1.52	1.38 to 1.67	<0.01
Bedtime							
Before 10 p.m.	4332	1.00			1.00		
10 p.m.–11 p.m.	12,044	1.04	0.96 to 1.12	0.39	0.94	0.86 to 1.03	0.20
11 p.m.–midnight	34,925	1.01	0.94 to 1.10	0.72	0.95	0.88 to 1.04	0.28
Midnight–1 a.m.	23,870	1.02	0.94 to 1.11	0.58	0.95	0.87 to 1.04	0.23
1 a.m.–2 a.m.	14,345	1.00	0.92 to 1.09	0.98	0.94	0.85 to 1.03	0.17
After 2 a.m.	8490	0.90	0.82 to 0.99	0.03	0.94	0.85 to 1.04	0.24
Difficulty initiating sleep							
Never/seldom/sometimes	83,296	1.00			1.00		
Often/always	14,802	1.81	1.73 to 1.89	<0.01	1.60	1.54 to 1.67	<0.01
Difficulty maintaining sleep							
Never/seldom/sometimes	86,914	1.00			1.00		
Often/always	11,258	1.58	1.50 to 1.66	<0.01	1.44	1.37 to 1.50	<0.01
Early morning awakening							
Never/seldom/sometimes	94,136	1.00			1.00		
Often/always	5467	1.68	1.56 to 1.81	<0.01	1.55	1.46 to 1.66	<0.01
Eating breakfast							
Daily	76,860	1.00			1.00		
Occasionally	10,219	1.03	0.99 to 1.08	0.17	1.10	1.05 to 1.15	<0.01
Never	6822	1.01	0.95 to 1.07	0.80	1.25	1.18 to 1.32	<0.01
Drinking more than once a month							
No	69,775	1.00			1.00		
Yes	29,412	1.10	1.07 to 1.14	<0.01	0.97	0.94 to 1.00	0.06
Smoking more than once a month							
No	89,301	1.00			1.00		
Yes	9276	1.13	1.07 to 1.19		1.11	1.05 to 1.17	
Participating in extracurricular activities							
No	32,204	1.00			1.00		
Yes	65,440	1.03	0.99 to 1.06	0.11	0.77	0.75 to 0.80	<0.01
Intention of studying at university							
No	57,536	1.00			1.00		
Yes	40,389	1.14	1.10 to 1.18	<0.01	0.99	0.95 to 1.02	0.50

In each section, the missing data have been excluded from the statistical analyses.
Depression/anxiety has been defined as a negative emotion score ≥2.
Loss of positive emotion has been defined as a loss of positive emotion score ≥2.
All the items included in this table were input as covariates in the logistics model.
Abbreviation: AOR = adjusted odds ratio.

but that a sleep duration of 8 h or more was associated only with the loss of positive emotion. In our previous study, we demonstrated a U-shaped association between mental health status and sleep duration (Kaneita et al., 2006, 2007). However, in the present study, it was clarified that the U-shaped association was evident only between sleep duration and loss of positive emotion, and was not evident between sleep duration and depression/anxiety. This result suggests that a long sleep duration may suppress feelings of happiness and impair mental function, thus inducing poor mental health. It has been reported that subjects who were experimentally subjected to a pattern of long sleep duration complained of sleepiness, lethargy, and feeling worn

out (Globus, 1969, 1970; Hartmann et al., 1971). This suggests that long sleep duration may have deleterious effects on mental health. On the other hand, there may also be an opposite causal relationship, i.e., loss of positive emotion may result in earlier bedtime or late waking up time, leading to longer sleep duration. Furthermore, a third factor such as disease or physical impairment may affect both loss of positive emotion and an increase of sleep duration. Thus, further examinations are required in order to clarify the causal relationships between long sleep duration and loss of positive emotion.

In this study, some factors such as smoking and symptoms of insomnia were associated with both depression/anxiety and loss of

Table 5

Specificity and sensitivity of selected items from GHQ-12 for predicting poor mental health defined as a GHQ-12 score of 4 points or greater.

Index	Cutoff	Sample	Specificity	Sensitivity
GHQ-3	1 point(0/1)	All	76.7	93.9
		Boys	80.6	92.2
		Girls	71.0	95.6
	2 point(1/2)	All	95.2	74.5
		Boys	96.5	70.0
		Girls	93.3	78.7
GHQ-2	1 point(0/1)	All	87.0	85.1
		Boys	89.9	81.5
		Girls	82.7	88.4
	2 point(1/2)	All	99.9	26.0
		Boys	99.9	26.4
		Girls	99.8	25.6

GHQ-3: 2 items (feeling depressed and lose confidence) from the depression/anxiety factor and 1 item (not play a useful part) from the loss of positive emotion factor.
GHQ-2:1 items (feeling depressed) from the depression/anxiety factor and 1 item (not play a useful part) from the loss of positive emotion factor.
All: 54,355 boys and 45,313 girls.

positive emotion. Interestingly, however, some differences were observed in the associations between these two factors and lifestyle habits. For example, the odds ratios with regard to loss of positive emotion for skipping breakfast and for lack of participation in club activities were significantly high; however, these two factors did not show significant associations with depression/anxiety. Moreover, previous studies reported that alcohol consumption was a factor affecting the mental health of adolescents (Hallfors et al., 2004; Saluja et al., 2004; Verdurmen et al., 2005). However, alcohol drinking was not significantly associated with loss of positive emotion although it did increase the odds ratio for depression/anxiety significantly. Furthermore, a desire to pursue a university education was associated only with depression/anxiety and not with a loss of positive emotion. As for the reason why some of lifestyle habits can be associated only with "depression/anxiety" or only with "loss of positive emotion", the causal relationship cannot be explained based on the results of this cross-sectional survey. As a possible assumption for this, the occurrence of the negative life events such as illegal alcohol consumption and severe competition in entrance examinations may contribute to depression/anxiety, while the positive life events such as skipping breakfast and lack of participation in club activities may be associated with loss of positive emotion.

The above-mentioned lifestyle factors associated with poor mental health differ according to the two types of mental health status. This finding is important from the viewpoint of health guidance provided by schools. For those students who complain of a loss of positive emotion, encouraging them to participate in a club activity may be effective. It has been reported that participation in club activities is associated with improvement of self-efficacy and well-being (Sonstroem, 1984; Kirkcaldy et al., 2002). The longitudinal study has also indicated that the amount of exercise during the ages of 15 and 16 can predict the mental health performance at the ages of 18 and 19 (Sagatun et al., 2007). It is important that future school health policies should be formulated on the basis of the present results.

A simplified version of the GHQ-12 can be created by clarifying the factor structure of this questionnaire. By extracting items from the depression/anxiety and loss of positive emotion factors, a simplified version of the GHQ-12 can be created. With this questionnaire, the mental health status of individuals reflecting the effects of the two factors can be evaluated in a shorter period of time. This questionnaire can serve as a very effective screening instrument in epidemiological surveys and healthcare settings. In this study, we predicted the mental health status of subjects whose GHQ-12 scores were 4 points or greater, using the GHQ-2 scores. The GHQ-2 scores were calculated by summing the scores of the two items that had been extracted from each from the

two factors. The cutoff point for the GHQ-2 was defined as 1 point. The specificity and sensitivity of this questionnaire were sufficiently high at 87.0% and 85.1%, respectively. From this result, it is inferred that the total score for the two items, one extracted respectively from depression/anxiety and loss of positive emotion, can be a useful index for the evaluation of mental health status. This study demonstrated that analysis of subjects with regard to only two items of the GHQ-2 (whether the subject was more depressed than usual and enjoyed activities) was sufficient for prediction of mental health status. In the event of space constraints in the GHQ-12 questionnaire or time limitations when implementing this questionnaire, we believe that using these two questions in preference to the GHQ-12 items should be effective in evaluating the mental health status.

There were some limitations to this study. First, since this was a cross-sectional survey, a causal relationship could not be determined. When examining a causal relationship, a longitudinal study such as a cohort study is required, and such a study will be required in the future. Second, physiological measurements such as electroencephalography could not be employed to obtain the objective data for the evaluation of sleep status. However, such measurements, although desirable, are not normally included in epidemiological studies because of the very large number of subjects involved. Furthermore, several reports have stated that self-reported data on sleep status are consistent with physiological data to a certain degree (Frankel et al., 1976; Hoch et al., 1987). Third, the items included in our questionnaire did not incorporate all the factors that are considered to affect sleep. For example, noise levels at night, the person/s with whom a subject sleeps, and commuting time to school are all possible factors that could affect a subject's sleep. However, we were unable to include them in the questionnaire because of space limitations, and these items will need to be examined in the future. Fourth, there may have been a non-response bias. The rate of response to the questionnaire in this study was 64.8%; therefore, approximately 35% of the subjects did not participate in the survey. In Japan, people below 20 years of age are prohibited by law from smoking and drinking alcohol. Therefore, schools and individual students tend to be non-cooperative in responding to any survey that includes questions on smoking and drinking alcohol. This reluctance may be the main reason for the high level of non-responsiveness. However, there is a possibility that students with poorer mental health did not participate in this survey. Fifth, we defined "smoking one day or more" as "smoking" and "consuming an alcoholic beverage one day or more" as "drinking alcohol" similarly. Smoking one cigarette or having one alcoholic drink per month itself has little pharmacological effect or lifestyle significance. Therefore, it can be interpreted that indulging in these habits with the knowledge that they are illegal may have deleterious effects on mental health. Sixth, a question on excessive daytime sleepiness (EDS) was not included in the questionnaire used. It is known that chronic sleep insufficiency may induce EDS or mood and behavior problems among adolescents (Carskadon, 1990, 2004). The association between short sleep duration and poor mental health recognized in the present study may be explained by EDS. In future studies, associations between sleep habits and mental health status among adolescents should be examined by taking EDS into consideration. Seventh, an analysis that took into consideration the hierarchical structure of the dataset was not conducted in this study. If a multilevel analysis had been performed, which covered the characteristics of the households, schools, and regions to which the students belonged, the effects of not only the students' individual characteristics but also those of the demographic/socioeconomic structure on the mental health performance could have been clarified. Unfortunately, we did not have data on the hierarchical structure. In our future studies, we need to collect data on these points and to also discuss the effects of the hierarchical structure.

In this study, factor analysis of the GHQ-12 was performed using the data obtained from a questionnaire survey conducted on a

representative sample population of approximately 100,000 Japanese adolescents. The survey yielded a two-factor solution: depression/anxiety and loss of positive emotion. It was indicated that poor subjective sleep assessment and short sleep duration influenced both depression/anxiety and loss of positive emotion. In contrast, long sleep duration was observed to be associated only with loss of positive emotion. Some lifestyle habits such as smoking were associated with both depression/anxiety and loss of positive emotion. Other lifestyle habits such as alcohol consumption and participation in club activities were associated with either of the two factors. Therefore, while providing health guidance to adolescents, it is necessary to observe them from the viewpoint of the two latent factors (depression/anxiety and loss of positive emotion). This would provide a rational basis for guidance about sleep and lifestyle habits according to the mental health status of the individual.

References

American Psychiatric Association, 2000. Diagnostic and Statistical Manual of Mental Disorders. text rev 4th ed. American Psychiatric Association, Washington DC.

Arakida, M., Takahashi, S., Aoyagi, M., Kanamori, M., 2003. Examination of mental health status and related factor in junior high school students: a three-year longitudinal investigation (in Japanese). Shouni Hoken Kenkyuu 62, 667–679.

Bailly, D., Bailly-Lambin, I., Querleu, D., Beuscart, R., Collinet, C., 2004. Sleep in adolescents and its disorders: a survey in schools (in French). Encephale 30, 352–359.

Campbell, A., Walker, J., Farrell, G., 2003. Confirmatory factor analysis of the GHQ-12: can I see that again? Australian and New Zealand Journal of Psychiatry 37, 475–483.

Carskadon, M.A., 1990. Patterns of sleep and sleepiness in adolescents. Pediatrician 17, 5–12.

Carskadon, M.A., 2004. Sleep deprivation: health consequences and societal impact. Medical Clinics of North America 88, 767–776.

D'Arcy, C., Siddique, C.M., 1984. Psychological distress among Canadian adolescents. Psychological Medicine 14, 615–628.

Danner, D.D., Snowdon, D.A., Friesen, W.V., 2001. Positive emotions in early life and longevity: findings from the nun study. Journal of Personality and Social Psychology 80, 804–813.

Doi, Y., Minowa, M., 2003. Factor structure of the 12-item General Health Questionnaire in the Japanese general adult population. Psychiatry and Clinical Neurosciences 57, 379–383.

Frankel, B.L., Coursey, R.D., Buchbinder, R., Snyder, F., 1976. Recorded and reported sleep in chronic primary insomnia. Archives of General Psychiatry 33, 615–623.

French, D.J., Tait, R.J., 2004. Measurement invariance in the General Health Questionnaire-12 in young Australian adolescents. European Child & Adolescent Psychiatry 13, 1–7.

Fuchino, Y., Mizoue, T., Tokui, N., Ide, R., Fujino, Y., Yoshimura, T., 2003. Health-related lifestyle and mental health among inhabitants of a city in Japan (in Japanese). Nippon Koshu Eisei Zasshi 50, 303–313.

Gau, S.F., Soong, W.T., 1995. Sleep problems of junior high school students in Taipei. Sleep 18, 667–673.

Globus, G.G., 1969. A syndrome associated with sleeping late. Psychosomatic Medicine 31, 528–535.

Globus, G.G., 1970. Sleep duration and feeling state. International Psychiatry Clinics 7, 78–84.

Goldberg, D.P., Rickels, K., Downing, R., Hesbacher, P., 1976. A comparison of two psychiatric screening tests. British Journal of Psychiatry 129, 61–67.

Graetz, B., 1991. Multidimensional properties of the General Health Questionnaire. Social Psychiatry and Psychiatric Epidemiology 26, 132–138.

Hallfors, D.D., Waller, M.W., Ford, C.A., Halpern, C.T., Brodish, P.H., Iritani, B., 2004. Adolescent depression and suicide risk: association with sex and drug behavior. American Journal of Preventive Medicine 27, 224–231.

Hartmann, E., Baekeland, F., Zwilling, G., Hoy, P., 1971. Sleep need: how much sleep and what kind? American Journal of Psychiatry 127, 1001–1008.

Hoch, C.C., Reynolds, C.F., Kupfer, D.J., Berman, S.R., Houck, P.R., Stack, J.A., 1987. Empirical note: self-report versus recorded sleep in healthy seniors. Psychophysiology 24, 293–299.

Hu, Y., Stewart-Brown, S., Twigg, L., Weich, S., 2007. Can the 12-item General Health Questionnaire be used to measure positive mental health? Psychological Medicine 37, 1005–1013.

Huppert, F.A., Whittington, J.E., 2003. Evidence for the independence of positive and negative well-being: implications for quality of life assessment. British Journal of Health Psychology 8, 107–122.

Iwata, N., Okuyama, Y., Kawakami, Y., Saito, K., 1988. The twelve-item General Health Questionnaire among Japanese workers. Environmental Science 11, 1–11 Hokkaido University.

Kaneita, Y., Ohida, T., Osaki, Y., Tanihata, T., Minowa, M., Suzuki, K., Wada, K., Kanda, H., Hayashi, K., 2007. Association between mental health status and sleep status among adolescents in Japan: a nationwide cross-sectional survey. Journal of Clinical Psychiatry 68, 1426–1435.

Kaneita, Y., Ohida, T., Uchiyama, M., Takemura, S., Kawahara, K., Yokoyama, E., Miyake, T., Harano, S., Suzuki, K., Fujita, T., 2006. The relationship between depression and sleep disturbances: a Japanese nationwide general population survey. Journal of Clinical Psychiatry 67, 196–203.

Keyes, C.L., 2005. Mental illness and/or mental health? Investigating axioms of the complete state model of health. Journal of Consulting and Clinical Psychology 73, 539–548.

Kilic, C., Rezaki, M., Rezaki, B., Kaplan, I., Ozgen, G., Sağduyu, A., Oztürk, M.O., 1997. General Health Questionnaire (GHQ12 & GHQ28): psychometric properties and factor structure of the scales in a Turkish primary care sample. Social Psychiatry and Psychiatric Epidemiology 32, 327–331.

Kirkcaldy, B.D., Shephard, R.J., Siefen, R.G., 2002. The relationship between physical activity and self-image and problem behaviour among adolescents. Social Psychiatry and Psychiatric Epidemiology 37, 544–550.

Liu, X., Zhou, H., 2002. Sleep duration, insomnia and behavioral problems among Chinese adolescents. Psychiatry Research 111, 75–85.

López-Castedo, A., Fernández, L., 2005. Psychometric properties of the Spanish version of the 12-item General Health Questionnaire in adolescents. Perceptual & Motor Skills 100, 676–680.

Manni, R., Ratti, M.T., Marchioni, E., Castelnovo, G., Murelli, R., Sartori, I., Galimberti, C.A., Tartara, A., 1997. Poor sleep in adolescents: a study of 869 17-year-old Italian secondary school students. Journal of Sleep Research 6, 44–49.

Marks, P.A., Monroe, L.J., 1976. Correlates of adolescent poor sleepers. Journal of Abnormal Psychology 85, 243–246.

Morrison, D.N., McGee, R., Stanton, W.R., 1992. Sleep problems in adolescence. Journal of the American Academy of Child and Adolescent Psychiatry 31, 94–99.

Nunally, J.C., Bernstein, I.H., 1994. Psychometric Theory, 3rd edn. McGraw-Hill Inc, New-York, NY.

Ohida, T., Osaki, Y., Doi, Y., Tanihata, T., Minowa, M., Suzuki, K., Wada, K., Suzuki, K., Kaneita, Y., 2004. An epidemiologic study of self-reported sleep problems among Japanese adolescents. Sleep 27, 978–985.

Osaki, Y., Tanihata, T., Ohida, T., Minowa, M., Wada, K., Suzuki, K., Kaetsu, A., Okamoto, M., Kishimoto, T., 2006. Adolescent smoking behavior and cigarette brand preference in Japan. Tobacco Control 15, 172–180.

Politi, P.L., Piccinelli, M., Wilkinson, G., 1994. Reliability, validity and factor structure of the 12-item General Health Questionnaire among young males in Italy. Acta Psychiatrica Scandinavica 90, 432–437.

Radovanović, Z., Erić, L., 1983. Validity of the General Health Questionnaire in a Yogoslav student population. Psychological Medicine 13, 205–207.

Sagatun, A., Søgaard, A.J., Bjertness, E., Selmer, R., Heyerdahl, S., 2007. The association between weekly hours of physical activity and mental health: a three-year follow-up study of 15–16-year-old students in the city of Oslo, Norway. BMC Public Health 7, 155.

Saluja, G., Iachan, R., Scheidt, P.C., Overpeck, M.D., Sun, W., Giedd, J.N., 2004. Prevalence of and risk factors for depressive symptoms among young adolescents. Archives of Pediatrics & Adolescent Medicine 158, 760–765.

Shimbo, M., Nakamura, K., Jing Shi, H., Kizuki, M., Seino, K., Inose, T., Takano, T., 2005. Green tea consumption in everyday life and mental health. Public Health Nutrition 8, 1300–1306.

Sonstroem, R.J., 1984. Exercise and self-esteem. Exercise and Sport Sciences Reviews 12, 123–155.

Suzuki, K., Minowa, M., Osaki, Y., 2000. Japanese national survey of adolescent drinking behavior in 1996. Alcoholism: Clinical and Experimental Research 24, 377–381.

Verdurmen, J., Monshouwer, K., van Dorsselaer, S., ter Bogt, T., Vollebergh, W., 2005. Alcohol use and mental health in adolescents: interactions with age and gender-findings from the Dutch 2001 Health Behaviour in School-Aged Children survey. Journal of Studies on Alcohol and Drugs 66, 605–609.

Werneke, U., Goldberg, D.P., Yalcin, I., Ustün, B.T., 2000. The stability of the factor structure of the General Health Questionnaire. Psychological Medicine 30, 823–829.