REPRODUCIBILITY OF THE ORTHOSTATIC RESPONSES AND ORTHOSTATIC DYSREGULATION COMPLAINTS IN JAPANESE JUNIOR AND SENIOR HIGH SCHOOL STUDENTS

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AN individual's blood pressure and pulse rate can fluctuate rapidly. The American Heart Association¹ states that ± 8 mmHg mean error may be expected for individual readings of systolic and diastolic pressures in normal persons and Mitchell and Van Meter² made allowance of ± 10 mmHg. The variability may be much larger in the response to the tilting test used for the diagnosis of the orthostatic hypotension, since the each response is expressed by the difference between two measurements. Moreover, it may not be surprising that the informations on the complaints are inconsistent, since they depend mainly upon answers of testees or their parents, but not upon objective observations or examinations.

Thus it seems indispensable for the analytical study of the orthostatic hypotension and orthostatic dysregulation to examine the reproducibility of the results of the tilting tests and informations of complaints obtained at different times. However only few such data are now available.

The present authors carried out the tilting tests and recorded the complaints 2–5 times at

various intervals in the same samples of junior and senior high school students. The data are analyzed statistically and presented here.

MATERIALS AND METHODS

The materials used for the analyses consist of the following three kinds:

1) Data of blood pressure measured successively three times each in lying supine and erect postures.

Three hundreds and twenty five junior high school students, 12–15 years of age and 497 senior high school ones, 15–18 years of age, were subjected to the tilting tests in which the blood pressure was measured each 3 times after 10 minutes lying on back and after 10 minutes active standing.

2) Data of 5 tilting tests carried out within one month on 19 junior high school students.

3) Data of two tilting tests carried out at about one year interval.

Junior high school boys (N = 165) and girls (N = 210), and senior high school girls (N = 108) were subjected to the tilting tests and information was taken on the complaints twice at one year interval.

Key Words:

Orthostatic dysregulation

RESULTS

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TABLE I VARIANCE ANALYSIS OF THREE SUCCESSIVE BLOOD PRESSURE MEASUREMENTS TAKEN IN A SINGLE DAY ON HIGH SCHOOL STUDENTS

Measurements	School, Year- class, & sex**	No. tested	Variance		Variance ratio*
			Inter- individual	Intra- individual	
Lying posture					
Systolic blood pressure	J2M	58	540.45	30.51	17.71
	J3M	69	298.83	16.96	17.62
	J2F	95	244.59	9.74	25.10
	J3F	113	267.26	5.45	49.03

	S1M	51	328.26	2.46	133.22
	S2M	61	404.98	2.66	152.49
	S3M	57	477.62	5.47	87.26
	S1F	54	268.55	1.70	157.63
	S1F'	52	518.72	3.10	167.19
	S2F	57	297.55	1.80	165.74
	S2F'	53	347.32	3.43	101.33
	S3F	56	423.38	2.74	154.29
S3F'	56	295.81	2.93	101.01	

Diastolic blood pressure	J2M	58	1028.78	50.68	20.30
	J3M	69	452.56	16.13	28.06
	J2F	95	436.28	19.26	22.66
	J3F	113	264.10	12.63	20.91

	S1M	51	794.41	29.05	27.35
	S2M	61	512.28	8.95	57.27
	S3M	57	1001.63	11.58	86.46
	S1F	54	273.54	2.69	101.64
	S1F'	52	354.74	5.07	69.97
	S2F	57	368.34	3.42	107.85
	S2F'	53	257.27	6.75	38.12
	S3F	56	307.53	4.17	73.70
S3F'	56	257.97	5.83	44.22	

Standing posture					
Systolic blood pressure	J2M	58	593.72	27.20	21.83
	J3M	70	475.60	9.19	51.75
	J2F	95	940.36	8.69	108.24
	J3F	114	345.12	6.14	56.21

	S1M	51	467.80	7.48	62.56
	S2M	61	412.88	4.81	85.86
	S3M	57	450.70	4.17	108.17
	S1F	54	317.39	1.85	171.39
	S1F'	52	460.62	2.59	177.86
	S2F	57	404.81	4.23	95.61
	S2F'	53	287.18	7.01	40.97
	S3F	56	423.29	3.80	111.41
S3F'	56	385.58	4.05	95.26	

Diastolic blood pressure	J2M	58	450.02	30.38	14.81
	J3M	70	238.96	15.55	15.37
	J2F	95	553.31	28.69	19.28
	J3F	114	423.41	22.55	18.78
	S1M	51	642.53	11.76	54.62
	S2M	61	378.29	7.76	48.75
	S3M	57	393.31	3.43	114.72
	S1F	54	196.96	2.91	67.60
	S1F'	52	296.29	4.49	66.03
	S2F	57	237.42	3.06	77.48
	S2F'	53	180.59	7.86	22.99
	S3F	56	216.48	4.26	50.79
	S3F'	56	261.27	6.14	42.53

* All ratios are highly significant at the 0.1% level.

** J: Junior high school; S: Senior high school; Number: Year-class; M: males; F: Females; F and F' in senior high school denote 1970 and 1971 classes, respectively.

1) Variation among three successively taken blood pressure measurements.

The data were subjected to variance analyses and the inter-individual variance, and the residual (or intra-individual variance) were calculated. The variance ratios, or the ratios of the inter-individual variances to the intra-individual ones, are as large as 14–178, which are highly significant at the 0.1% level in all four measurements, that is, systolic and diastolic pressure in both lying and standing postures, in all 13 samples, indicating high reproducibility of the measurements (Table I).

However, occasionally one of the 3 measurements is substantially deviated from the other two, latters being quite similar to each other. This finding may suggest that the median value of the three is more appropriate as the representative of the 3 measurements rather than their mean value.

The reproducibility of responses to the tilting tests were analyzed using each three sets of measurements in lying and erect postures, assuming that a set of the first measurement in the lying posture and the first one in the standing posture is the response to the first tilting test, and so on. The results show that the inter-individual variances are much greater than the intra-individual variances. The variance ratios are as large as 9–83, being highly significant at the 0.1% level in all samples and in all “responses”, i.e. decreases in the systolic pressure, the diastolic pressure, and the pulse pressure (Table II).

There are observed some sex and age dif-

ferences in the amount of variances. The inter- as well as the intra-individual variances are generally larger in junior than in senior high school students. In junior high school ages, the variances are larger in younger (2nd year class) than in older (3rd year class) and in males than in females, whereas senior high school students show no consistent differences in the results of the variance analyses among 3 year classes, but a tendency that the variances are larger in males than in females.

2) Variation among measurements and responses of 5 tilting tests carried out within one month.

Ten male and 9 female junior high school students were tested. Variance analyses were carried out on the data of systolic and diastolic blood pressures and pulse rates in lying and erect postures.

As shown in Table III, the intra-individual variances of blood pressure measurements are much larger than those obtained from the analyses of the data on 3 successive measurements in a single day, whereas the inter-individual variances are similar in size to those of the single day tests. Thus, the variance ratios are considerably decreased, although all but one are statistically significant. A similar trend is shown in the responses to the tilting tests, the variance ratios being highly significant in all but one (Table IV).

Generally speaking, the inter- and intra-individual variances of the measurements and responses are greater in boys than in girls in ac-

TABLE II VARIANCE ANALYSIS OF RESPONSES TO THE TILTING TEST

Response	School, Year- class & sex**	No. Tested	Variance		Variance ratio*
			Inter- individual	Intra- individual	
Systolic pressure decrease	J2M	54	629.33	60.01	10.49
	J3M	64	297.42	24.23	12.27
	J2F	92	191.82	16.47	11.65
	J3F	112	245.20	8.76	27.98
	S1M	51	156.91	9.30	16.87
	S2M	61	312.41	8.66	36.09
	S3M	57	294.88	10.86	27.16
	S1F	54	136.42	2.67	51.16
	S1F'	52	207.47	6.64	31.24
	S2F	57	247.33	6.09	40.63
	S2F'	53	253.73	10.48	24.22
	S3F	56	454.87	5.50	82.77
	S3F'	56	185.44	7.48	24.80
Diastolic pressure decrease	J2M	53	1010.10	81.48	12.40
	J3M	62	321.14	31.61	10.16
	J2F	92	550.42	56.18	9.80
	J3F	112	418.03	37.65	11.10
	S1M	51	636.14	53.15	11.97
	S2M	61	496.60	16.24	30.58
	S3M	57	816.28	15.51	52.64
	S1F	54	225.69	5.19	43.53
	S1F'	52	202.93	9.90	20.49
	S2F	57	356.62	5.47	65.15
	S2F'	53	311.46	14.21	21.91
	S3F	56	309.71	6.91	44.82
	S3F'	56	191.27	10.81	17.69
Pulse pressure decrease	J2M	54	1574.78	119.54	13.17
	J3M	64	545.21	55.47	9.83
	J2F	92	609.80	49.58	12.30
	J3F	111	383.17	42.52	9.01
	S1M	51	693.93	72.35	9.59
	S2M	61	700.34	25.29	27.69
	S3M	57	684.64	29.20	23.45
	S1F	54	254.48	7.88	32.31
	S1F'	52	286.86	15.98	17.95
	S2F	57	345.51	14.39	24.01
	S2F'	53	340.57	27.64	12.32
	S3F	56	266.50	12.09	22.04
	S3F'	56	193.83	16.29	11.90

* All ratios are highly significant at the 0.1% level.

** See the footnote in Table I.

TABLE III VARIANCE ANALYSIS OF MEASUREMENTS OF FIVE TILTING TESTS CARRIED OUT WITHIN ONE MONTH (10 MALE AND 9 FEMALE JUNIOR HIGH SCHOOL STUDENTS)

Measurements	Sex	Variance		Variance ratio
		Inter-individual	Intra-individual	
Lying posture				
Systolic pressure	M	111.58	51.52	2.17*
	F	58.00	48.31	1.20
Diastolic pressure	M	423.31	150.14	2.82*
	F	148.29	54.49	2.72*
Pulse rate	M	113.16	24.78	4.57***
	F	366.89	35.47	10.34***
Standing posture				
Systolic pressure	M	280.39	80.92	3.47**
	F	460.20	64.31	7.16***
Diastolic pressure	M	450.39	94.72	4.75***
	F	318.99	67.78	4.71***
Pulse rate	M	100.62	34.36	2.93**
	F	635.19	41.18	15.43***

Significant * at the 5%, ** at the 1%, and *** at the 0.1% level.

TABLE IV VARIANCE ANALYSIS OF RESPONSES TO FIVE TILTING TESTS CARRIED OUT WITHIN ONE MONTH (10 MALE AND 9 FEMALE JUNIOR HIGH SCHOOL STUDENTS)

Response	Sex	Variance		Variance ratio
		Inter-individual	Intra-individual	
Systolic pressure decrease	M	468.46	102.78	4.56***
	F	357.02	83.38	4.28***
Diastolic pressure decrease	M	584.45	195.96	2.98**
	F	473.09	79.87	5.92***
Pulse pressure decrease	M	1466.70	112.48	13.04***
	F	162.39	89.91	1.81
pulse rate increase	M	310.72	64.50	4.82***
	F	226.29	55.11	4.11**

Significant * at the 5%, ** at the 1%, and *** at the 0.1% level.

TABLE V MEAN DIFFERENCE BETWEEN MEASUREMENTS IN TWO TILTING TESTS CARRIED OUT AT ONE YEAR INTERVAL AND ITS STANDARD DEVIATION

Measurements and responses	Junior high school students				Senior high school girls	
	2nd-1st year class		3rd-2nd year class		2nd-1st year class	3rd-2nd year class
	Males (N=72)	Females (N=98)	Males (N=93)	Females (N=112)	(N=53)	(N=55)
<i>Lying posture</i>						
Systol. pressure	1.33±14.33	3.45±10.48	1.55±12.34	-1.46±12.92	-0.11± 7.57	-5.22± 9.19
Diastol. pressure	-3.71±23.11	2.07±16.50	9.16±23.32	3.74±19.00	-0.17±11.26	0.87±12.19
Pulse rate	-2.51±10.61	-5.39±11.52	-7.69±11.60	-6.63±11.90	-2.65±11.13	-4.82±12.58
<i>Standing posture</i>						
Systol. pressure	1.14±15.65	1.77±13.64	4.08±14.23	-1.65±13.64	-3.34± 8.88	-5.38±10.18
Diastol. pressure	-2.71±16.40	-1.95±17.59	9.05±18.73	3.71±20.19	0.60± 9.93	0.91± 8.58
Pulse rate	-3.61±13.38	-6.34±15.36	-8.45±14.11	-7.48±11.22	-1.19±11.22	-1.18±12.19
<i>Response to tilting test</i>						
Systol. pressure decrease	-0.07±17.22	1.67±15.13	-2.48±12.62	0.08±12.28	3.86±10.24	0.05±10.46
Diastol. pressure decrease	-1.04±24.68	3.87±20.67	0.10±25.51	0.21±23.22	0.17±12.05	0.22±13.48
Pulse pressure decrease	1.53±27.32	-2.60±24.16	-3.02±26.39	-0.01±23.38	3.87±12.54	-0.27±13.19
Pulse rate increase	-1.24±13.91	-0.43±14.30	-0.72±10.19	-0.24±10.53	1.37±11.42	3.75±11.95

cordance with the results of the single day test.

3) Variation between two tests carried out at one year interval.

Samples of junior high school male and female students and senior high school girls were subjected to the tilting tests and recorded their complaints in their first or second year class. About one year later they were tested using the same procedure in their second or third year class.

The differences between the two measurements are distributed with large standard deviations (Tables V and VI). Generally speaking the variations of the diastolic pressure are greater than those of systolic one in lying as well as in erect posture. Of the responses to the tilting test, the systolic pressure decrease is less variable than the diastolic pressure decrease and the pulse rate decrease. The blood pressure measurements and their responses to the posture change are slightly more variable in male than in female junior high school students, and remarkably more variable in junior than senior high school

girls. Variations in the pulse rate and its change by the tilting show no distinct sex and age differences.

The reproducibility may be expressed by correlation coefficients (Table VII). More than two thirds of the correlations between each two measurements taken at one year interval are statistically significant; especially, the correlation of the systolic pressure is highly significant in both lying and standing postures in all 6 samples.

The responses to the tilting tests show much poorer reproducibility. The 2nd-1st year class junior high school students give the poorest with negative correlation in all eight but one. In 3rd-2nd year class students the reproducibility is somewhat improved. Seven of the eight coefficients take positive signs and three of the seven are statistically significant. High school girls show the highest reproducibility, though no correlation coefficient is significant, supposedly owing to small sample sizes.

The reproducibility of the information on the

TABLE VI DISTRIBUTION OF DIFFERENCES BETWEEN RESPONSES TO TWO TILTING TESTS CARRIED OUT AT ONE YEAR INTERVAL (165 MALE AND 210 FEMALE STUDENTS)

Difference (2nd-1st test)	Systolic pressure decrease		Diastolic pressure decrease		Pulse pressure decrease		Pulse rate increase	
	M	F	M	F	M	F	M	F
~-85						1*		
-84~-75					1	1		
-74~-65				2	2	2		
-64~-55			4	1	2	1		
-54~-45			2		4	4		1
-44~-35	2	2	6	7	7	4	2	1
-34~-25	9	3	9	8	8	11	1	2
-24~-15	21	20	20	21	21	24	16	18
-14~-5	29	42	37	33	26	35	40	49
-4~4	52	64	27	51	29	48	54	71
5~14	34	44	22	37	29	38	39	46
15~24	10	30	17	30	15	20	12	18
25~34	7	3	8	5	7	12	1	3
35~44	1	2	3	8	7	3		
45~54			2	3	2	5		1
55~64			7		2			
65~74				2	2	2		
75~84			1	2				
85~94					1			

*: -110

complaints was tested by comparing each two answers taken at one year interval (Table VIII). Chi-square tests reveal that those who gave negative answers in both times (— —) and those who gave affirmative ones in both times (+ +) are significantly more numerous than the expectation of random distributions in 19 of 22 comparisons (each 11 items for males and females) in junior high school students and in 12 of 13 comparisons in senior high school girls.

The coefficients of association for the presence or absence of the complaints have the positive sign in all but one comparisons, a half of which are 0.3 or larger. The correlations in junior high school girls are, in general, closer than in boys, but the formers are similar to those in senior high school girls.

For each testee, the number of complaints was counted ignoring their severity and relative importance as criteria in the diagnosis of orthostatic dysregulation. The correlation between

the numbers recorded at one year interval is as high as 0.344–0.526 indicating a high reproducibility (Table IX).

4) Reproducibility of orthostatic dysregulation (O.D.) diagnosis in the same subject after a year.

Of the 108 senior high school girls examined twice at one year interval, 3 were diagnosed as O.D. in both examinations according to criteria proposed by the Japan O.D. Study Group³ (see also Honda et al⁴), 7 were diagnosed as O.D. in the second but not in the first examination, and 98 were not accord with the criteria in both times. No girl was diagnosed as O.D. in the first but not in the second examination. Fisher's direct method revealed that the distribution is highly significant at the 0.06% level.

Number of symptoms and complaints possessed by girls diagnosed as O.D. at least in one examination were shown in Table X. In 3 girls who were diagnosed as O.D. in both examina-

TABLE VII CORRELATION BETWEEN TWO VALUES OF EACH MEASUREMENT OR ORTHOSTATIC RESPONSE TAKEN AT ONE YEAR INTERVAL

Measurements and responses	Junior high school students				Senior high school girls	
	2nd-1st year class		3rd-2nd year class		2nd-1st year class	3rd-2nd year class
	Males (N=72)	Females (N=98)	Males (N=93)	Females (N=112)	(N=53)	(N=55)
<i>Lying posture</i>						
Systol. pressure	0.359**	0.462**	0.372**	0.351**	0.732**	0.573**
Diastol. pressure	-0.014	0.281**	0.189	0.096	0.283	0.299
Pulse rate	0.150	0.315**	0.429**	0.514**	0.527**	0.503**
<i>Standing posture</i>						
Systol. pressure	0.350**	0.315**	0.376**	0.332**	0.620**	0.613**
Diastol. pressure	0.246*	0.172	0.216*	0.038	0.224	0.563**
Pulse rate	0.210	0.040	0.354**	0.451**	0.570**	0.576**
<i>Response to tilting test</i>						
Systol. pressure decrease	-0.015	-0.030	0.162	0.162	0.219	0.269
Diastol. pressure decrease	-0.190	-0.018	-0.034	0.190*	0.182	0.038
Pulse pressure decrease	-0.048	-0.091	0.017	0.103	0.230	0.091
Pulse rate increase	-0.039	0.077	0.246**	0.311**	0.310	0.053

Significant * at the 5% level and ** at the 1% level.

tions, number of symptoms were quite similar in both times. In other 7 girls, it may be noteworthy that one or two major symptoms were positive even in the first examination in which they were not accord with the O.D. criteria.

DISCUSSION

There have been numerous reports on the variability of the symptoms and complaints occurred frequently in orthostatic hypotension or orthostatic dysregulation patients, and on the variability of frequency of O.D. patients.

Nakae et al.⁵ and Murakami et al.⁶ reported seasonal variations in the incidence of orthostatic dysregulation (O.D.) patients among primary school children, the incidence being higher in autumn than in summer or winter. According to Takatsu and others⁷ the frequency and the severity of the O.D. symptoms are the highest in the first half of primary school age, 6-9 years, but decrease thereafter. A similar trend was reported by many authors.⁸⁻¹²

As shown in the present paper, the measurements of the blood pressure and the pulse rate, and their changes due to tilting experiments are considerably variable. However, the variance analyses revealed that the intra-individual variances are significantly smaller than the inter-individual ones, if the tests are carried out within a day or a month, indicating high reproducibility. There are some sex and age differences in the reproducibility; that is, it is higher in senior than in junior high school students, and is higher in girls than in boys in the junior high school ages, while there is no sex difference in senior high school students.

Each two measurements taken at one year interval also revealed highly significant correlations, while the responses to the tilting test are much more variable than the measurements, the magnitude of the variation is in the order: junior high school boys > junior high school girls > senior high school girls.

These findings may suggest that the blood

TABLE VIII CORRELATION BETWEEN TWO INFORMATIONS ON PRESENCE OR ABSENCE OF EACH SYMPTOMS OBTAINED AT ONE YEAR INTERVAL

Symptoms	Presence or absence in the 1st and 2nd examinations				χ^2	Coefficient of association
	(--)	(- +)	(+ -)	(++)		
Junior high school boys (N = 165)						
A	116	15	22	12	11.213***	0.261
B	146	6	9	4	15.133***	0.303
C	147	5	11	2	4.313*	0.162
D	151	6	8	0	0.317	0.044
E	124	17	16	8	7.222**	0.209
a	129	16	11	9	15.772***	0.309
b	120	14	25	6	1.875	0.107
c	115	21	15	14	15.420***	0.306
d	122	18	18	7	3.784	0.151
e	140	7	7	11	52.391***	0.563
f	105	14	12	34	62.118***	0.614
Junior high school girls (N = 210)						
A	96	31	26	57	40.400***	0.439
B	182	8	15	5	13.467***	0.253
C	174	7	20	9	26.210***	0.353
D	176	11	14	9	26.275***	0.354
E	178	14	9	9	30.779***	0.383
a	135	52	8	15	13.193***	0.251
b	163	19	19	9	9.892**	0.217
c	148	27	21	14	11.208***	0.231
d	153	32	15	10	7.095**	0.184
e	147	17	26	20	27.137***	0.359
f	96	21	18	75	82.073***	0.625
Senior high school girls (N = 106)						
A	41	18	15	32	14.823***	0.374
B	86	11	3	6	18.722***	0.420
C	88	7	7	4	8.912**	0.290
D	94	6	3	3	14.104***	0.365
E	84	9	7	6	12.492***	0.343
a	94	8	3	1	1.458	0.117
b	79	9	11	7	9.579**	0.301
c	73	16	10	7	4.521*	0.207
d	78	14	7	7	9.254**	0.295
e	69	10	17	10	7.813**	0.271
f	51	15	16	24	14.878***	0.375
g	48	19	14	25	12.972***	0.350
h	36	20	21	29	5.278*	0.223

Symptoms and complaints are shown by alphabetical abbreviations: A, dizziness; B, fainting on standing; C, queasiness at warm bathing, or at seeing or hearing unpleasant matters; D, palpitation or short breathing after slight body exercises; E, difficulty in getting out of bed, and/or laziness in the morning; a, pallor; b, poor appetite; c, abdominal pain; d, fatigability; e, headache; f, car-sickness; g, excessive or reduced perspiration; h, constipation or diarrhoea; and i, menstruation anomaly.

TABLE IX CORRELATION COEFFICIENT BETWEEN NUMBERS OF SYMPTOMS REPORTED BY EACH STUDENTS AT ONE YEAR INTERVAL

School	Year class	Sex	No. examined	r
Junior high school	1st - 2nd	Male	72	0.422**
		Female	98	0.526**
	2nd - 3rd	Male	93	0.344**
		Female	112	0.504**
Senior high school	1st - 2nd	Female	53	0.452**
	2nd - 3rd	Female	53	0.521**

** Significant at the 1% level.

TABLE X REPRODUCIBILITY OF O.D. DIAGNOSIS IN SENIOR HIGH SCHOOL GIRLS WHO WERE DIAGNOSED AS O.D. AT LEAST ONE OF TWO EXAMINATIONS CARRIED OUT AT ONE YEAR INTERVAL

Case	First examination			Second examination		
	No. of symptom		O.D. Diagnosis	No. of symptom		O.D. Diagnosis
	Major	Minor		Major	Minor	
M.A.	4	1	+	4	4	+
C.A.	1	3	+	2	2	+
C.K.	2	1	+	2	1	+
T.O.	1	2	—	2	2	+
K.K.	1	0	—	2	1	+
R.H.	1	1	—	3	4	+
M.S.	2	0	—	2	1	+
Y.H.	1	0	—	3	1	+
T.K.	1	1	—	2	2	+
E.T.	1	0	—	2	1	+

TABLE XI CORRELATIONS BETWEEN VALUES OF TWO TESTS CARRIED OUT AT 4-18 DAY INTERVAL ON 19 JUNIOR HIGH SCHOOL STUDENTS (BOTH SEXES POOLED)

	In lying posture	In erect posture
Systolic blood pressure	0.165	0.789***
Diastolic blood pressure	0.079	0.214
Pulse rate	0.502*	0.456*
Systolic pressure decrease		0.672***
Pulse pressure decrease		0.392*
Pulse rate increase		0.229

Data on the first and fifth tilting tests of 5 tests were used for the calculation.
Significance levels are shown by * (5%) and *** (0.1%).

pressure and its response to the tilting test tend to become more stable with increasing age and the stability is attained earlier in females than in males.

Informations on the presence or absence of each complaint taken at one year interval are significantly correlated. This may accord with an opinion of most Japanese pediatricians that some selected items of complaints are more reliable as criteria for diagnosis of the orthostatic dysregulation than the responses to the tilting.³ The results of the present analyses indicate that the total number of the complaints and O.D. diagnosis for each individual are less variable than the presence or absence of each complaint.

Watanabe et al.¹³ examined 100 otherwise healthy primary schoolchildren, 9–10 years of age and reexamined 31 children after 1–3 weeks. Data on 27 children was analyzed. There were observed a moderate correlation between the two values of each child for pulse rate increase due to postural change ($r = 0.268$), but almost no correlations for pulse pressure decrease ($r = 0.09$) and systolic pressure decrease ($r = 0.02$).

To compare with the results of Watanabe et al. the present authors estimated correlations between values of the first and fifth of the 5 tests carried out within a month. Intervals of the two tests ranged from 4 to 18 days. As shown in Table XI each two values of the same child are positively correlated in all measurements and responses. Correlation coefficients are 0.672 in systolic pressure decrease, 0.392 in pulse pressure decrease, and 0.229 in pulse rate increase, the first two values being statistically significant.

The discrepancy in the observations of the present authors and Watanabe et al. may be attributable, at least in part, to following two reasons:

- 1) Difference in sampling procedure of the testees subjected to the second examination.

The present authors examined unselected children, whereas Watanabe et al. picked up children who showed a contradiction between number of complaints and responses to the tilting test at the first examination; that is, who had numerous complaints but responded to the tilting test in a degree of normal ranges, or who were hyperresponsive but had few complaints.

- 2) Difference in age of the subjects.

Testees of the present study are junior high school students, aged 12–15 years, and those of Watanabe et al. were primary schoolchildren, aged 9–10 years.

Medicamental therapy is effective against orthostatic dysregulation, and follow-up studies indicated that considerable proportion of O.D. patients were improved or completely recovered (Brück und Oltmann¹⁴, Genz und Stolowsky¹⁵, Okuni et al.¹⁶ and many others^{8,10,11,17}). On the other hand, the present study showed that children diagnosed as not O.D. at one moment can become to accord with the criteria for O.D. diagnosis in future. Kitamura et al.⁹ showed that untreated O.D. children were recovered as frequently as treated children. According to Suzuki et al.⁸ some symptoms disappeared and other new symptoms appeared in a long time, resulting in alteration of symptoms.

Such phenomena may be attributable, at least in part, to inconsistency or reduced reproducibility of O.D. complaints and responses to the tilting test as revealed in the present study.

SUMMARY

Junior ($N = 325$) and senior ($N = 497$) high school students were subjected to the tilting tests, in which the systolic and diastolic blood pressure were measured each 3 times after 10 minutes lying supine and after 10 minutes active standing. The inter-individual variances are much larger than the intra-individual ones and their ratios (variance ratios) are highly significant in all measurements and responses to the tilting test (systolic and diastolic pressure decreases and pulse pressure decrease) in all 13 samples, indicating high reproducibility.

The tilting tests were carried out on 19 junior high school students 5 times within a month, and the reproducibility of the measurements and responses including pulse rate increases was proved to be reduced only slightly.

At one year interval junior high school boys ($N = 165$) and girls ($N = 210$), and senior high school girls ($N = 108$) were similarly tested and taken information on the complaints frequent in orthostatic dysregulation patients. The reproducibility is reduced more remarkably in the responses than in the measurements, especially in boys. The two informations on the presence or absence of each complaint are rather similar with significant positive correlations in 31 of 35 comparisons. High positive correlations ($r = 0.334$ – 0.526) are shown between numbers of complaints recorded at one year interval. All three girls diagnosed as orthostatic dysregulation (O.D.) at the first examination were found to accord with the criteria of O.D. diagnosis after one year.

The results of the analyses may suggest that the blood pressure and its responses to the tilting test tend to become more stable with increasing age and the stability is attained earlier in females than in males.

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