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Gender Differences in Body-Sway Factors of Center of Foot Pressure in a Static Upright Posture and under the Influence of Alcohol Intake

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Abstract This study aimed to examine gender differences in 4 body-sway factors of the center of foot pressure (CFP) during a static upright posture and the influence of alcohol intake on them. Four body-sway factors were interpreted in previous studies using factor analysis (the principal factor method and oblique solution by promax-rotation) on 220 healthy young males and females as follows; unit time sway, front-back sway, left-right sway and high frequency band power. The CFP measurement for 1 min was carried out twice with 1 min rest. The measurements of blood pressure, heart rate, whole body reaction time, standing on one leg with eyes closed, and CFP were carried out before and after the alcohol intake using 11 healthy young males and females. The measurement device used was an Anima's stabilometer G5500. The data sampling frequency was 20 Hz. Reliability of 4 body-sway factors was very high. Significant gender differences were found in the left-right sway and the high frequency band power factors, but the influence on body-sway is, as a whole, can be disregarded. These four sway factors can determine the influence of alcohol intake as efficient as 32 sway parameters.
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Introduction

People with balance function disorder show particular characteristics in the center of foot pressure (CFP) movement during static upright posture. CFP movement has, therefore, been used as one of the effective clinical diagnosing methods for giddiness or balance function disorder (Baker et al., 1998; Goldie et al., 1989; Geurts et al., 1993; Woolley et al., 1993). On the other hand, many studies have examined the possible use of CFP measurement during static upright posture to evaluate balance ability for healthy people (Baker et al., 1998; Goldie et al., 1989; Geurts et al., 1993; Woolley et al., 1993). However, effective evaluation parameters for healthy people have not been sufficiently examined. Individual differences of body sway are very small, and they do not show characteristic body sway such as seen in disordered people. Namely, it is difficult to properly evaluate their body sway characteristics by a few parameters.

Evaluation parameters of CFP movement are theoretically categorized into the following 7 domains from characteristics of the CFP trajectory: distance, center average, distribution of the amplitude, area, velocity, power spectrum, and sway vector (Demura et al., 2001; Mizuta et al., 1993). Demura et al. (2000, 2001) and Kitabayashi et al. (2002) examined, after compiling 114 parameters used so far in many studies, the trial-to-trial and day-to-day reliabilities, interrelationships between parameters and gender differences, and reported that the characteristics of CFP movement can be synthetically understood from 36 parameters representing the above-stated 7 domains. However, it is not always effective to evaluate CFP movement using a large number of parameters (Tokita et al., 2001; Pyykko et al., 2000; Collins et al., 1994). Kitabayashi et al. (2003) reported that 32 body-sway parameters selected from 6 domains, except for center average domain, were objectively compressed and summarized into the following 4 sway factors using factor analysis: unit time sway (F1), front-back sway (F2), left-right sway (F3) and high frequency band power (F4). Each factor from F1 to F4 was defined mainly by sway velocity parameters, dividing the movement distance by unit time, by parameters evaluating the amount of front and back sway, by parameters evaluating left and right sway, and by parameters with a high frequency band relating to the body sway respectively. However, gender differences and validity of these 4 sway factors have not been sufficiently examined.

Because maintaining an upright posture is very easy for healthy people, evaluating their balance ability is difficult by analyzing CFP movement only. Their balance ability was, therefore, generally evaluated by giving some disturbance stimulation during an upright posture (Fujiwara et al., 1983;

Hibino et al., 1979). Previous studies used physical and nervous stimulation disturbances such as horizontal movement of a platform, forward or backward pressure, alcohol intake or physical fatigue as the disturbance stimulation of CFP movement (Goldie et al., 1989; Hattori et al., 1992; Kanter et al., 1991). It was reported that alcohol intake causes a nervous function decline, and leads to an inhibition of the central nervous system and dilatation of blood vessels (Nakanishi, 1975; Nakamura et al., 1979). In addition the EMG of muscles supporting an upright posture or the range of CFP movements became large after alcohol intake (Kubo et al., 1989; Ymaji et al., 1998). Moreover, it has been determined that these actions influence autokinesia and reflex movement systems (Nakanishi, 1975; Nakamura et al., 1979), because body-sway relates closely to both movement systems, alcohol intake may influence CFP movement.

The purpose of this study was to examine gender differences in 4 body-sway factors of CFP movement and the influence of alcohol intake on them.

Methods

Subjects

Subjects were 220 healthy young adults. They had no evidence or known history of a gait, posture, or skeletal disorder. In addition, the subjects who participated in the alcohol experiment were 11 healthy young adults. Table 1 shows the characteristics of both groups. Before the measurement, the purpose and procedure of this study were explained in detail to subjects. Informed consent was obtained from all subjects. This study was approved by the institution's human subjects ethics committee.

Experimental instrument

The measurement device was an Anima's stabilometer G5500. The measurement principle of this device is explained in previous studies (Demura et al., 2001; Kitabayashi et al., 2002). Data sampling frequency was recorded at 20 Hz.

Experimental procedure

The measurement procedure followed the method prescribed in the standardization of stabilometry test (the Japan Society for Equilibrium Research; 1983, Kitabayashi et al., 2003). The measurements were performed for 1 min after the subject's posture and eyes were stable. The blood pressure and heart rate were measured at 10, 20 and 30 min after alcohol intake to determine the subject's physical state. After measuring the blood pressure and heart rate, the CFP movement was measured twice with a 1 min rest period. During the testing stage, the subjects stood bare-footed with their arms held comfortably and their eyes open (Romberg posture). The subjects were instructed not to change the position of their feet on the plate during the rest period in a sitting position. The whole body reaction time and standing on one leg with eyes closed were measured after the CFP movement test, and the subjects were instructed to drink alcohol (Japanese sake) over 10 min. We selected the above two tests to confirm a decrease of nervous function before and after the alcohol intake. The former test measured the reaction when subjects stood on the plate (Takei Co., Ltd., Whole body reaction type II) with their knees slightly bent and tried to jump up as quickly as possible in response to a light stimulus. The measurement was carried out five times and the mean value of three trials, except the maximum and minimum, was used for further analysis. The latter test measured the continuous time with both hands set on the waist, standing on one leg and eyes closed. The test was stopped when the subjects took their hands away from their waist or the leg that was raised lowered and touched the floor. The test was measured twice and the mean value of the two trials was used for further analysis.

Table 1 Characteristics of original and alcoholic intake groups

	Original group (n=220)		Alcoholic intake group (n=11)	
	Male (n=108)	Female (n=112)	Male (n=5)	Female (n=6)
Age (yr)	20.1±1.6	19.6±1.4	21.4±0.6	21.5±0.2
Height (cm)	173.3±5.5	161.0±5.8	175.2±6.5	160.5±5.7
Weight (kg)	67.0±7.9	54.3±6.1	69.9±7.9	60.1±7.9

Note) mean±SD

Basic alcohol intake volume was about 540 ml of Japanese sake, but it was adjusted somewhat by individual constitution or physique, i.e. according to each subject's weight (0.54–1.83 ml per each subject's weight). In this study, alcohol concentration in the blood (A) was calculated by the prediction equation using the subject's intake volume. The weight of intake alcohol (W) included in the 540 ml (w) that each subject drank was 64.314 g. The specific gravity of alcohol (g) is 0.794 and alcohol concentration in Japanese sake (c) is 15%.

$$W=w\times c\times g=540\times 0.15\times 0.794=64.314$$

The euhydration (E) is almost 2/3 of body-weight (BW). Alcohol concentration in the blood (A) can, therefore, be estimated from the weight ratio of intake alcohol (W) and the euhydration as follows:

$$A=W/E=W/(2\times BW)/3)=64.314/(2\times BW)/3)$$

The CFP measurement and nervous function of whole body reaction time and standing on one leg with eyes closed were performed at 30 min after alcohol intake. All measurements were done from 10:00 to 12:00 pm. The subjects were instructed not to eat, drink, or exercise for 2 hours before the measurement.

Evaluation parameters

Thirty-two parameters with high reliability were selected from the following 6 domains: distance (4 parameters), area (3 parameters), velocity (3 parameters), the amplitude distribution

(4 parameters), the power spectrum (5 position parameters and 5 velocity parameters), and the vector (4 position parameters and 4 velocity parameters) (see Table 2). Four body-sway factors were interpreted after applying factor analysis (the principal factor method and oblique solution by promax-rotation) to a correlation matrix consisting of the above 32 parameters. Each subject's factor scores were calculated from the prediction equation of each factor using the complete estimation method.

Data Analysis

Each subject's factor score was calculated from the prediction equation of each factor using the complete estimation method. The mean factor scores between males and females were tested. Trial-to-trial reliability was examined by the intraclass correlation coefficient (ICC). Repeated measures one-way analysis of variance (ANOVA) were used to test differences between 4 means for diastolic and systolic blood pressures, and heart rate, and paired t-test to test mean differences for the whole body reaction time, the standing time on one leg with eyes closed, sways parameters and 4 factors before and after alcohol intake. For multiple comparison tests in the former, Tukey's HSD method was used. Effect size (ES) was calculated to examine the size of the mean difference. An ES undr 0.2 is generally interpreted as a small difference and over 0.8 is a large one.

Results

Gender differences in body-sway factors

Table 2 shows the fundamental statistics and reliability coefficients (ICC) of 34 CFP movement parameters. Almost all ICCs (ICC=0.73–0.97) had a very high value over 0.80 except for some power spectrum parameters (see Table 2). Significant gender differences were found in only 5 of 32 parameters. Three parameters were included in the third factor and 2 parameters in the fourth factor (see Table 2).

Factor analysis interpreted 4 factors to explain about 64% of the total variance (Kitabayashi et al., 2003). Table 3 shows the test results between mean factor scores of both sexes for 4 sway factors. Significant gender differences were found in the third and fourth factors, but their ES was moderate (ES=0.30 and 0.45). Reliability of 4 factors was very high (ICC=0.89–0.95).

Comparison of body-sway parameters and factors before and after alcohol intake

The subjects' alcohol concentration in the blood in this study was 0.06–0.22%. This intake volume was equal to or more than that reported in previous studies (Franks et al., 1976; Thysen et al., 1981). It is judged that all subjects were in a state from slight intoxication to drunkenness, and the intake volume was enough to make their nervous function decline. Alcohol concentration in the blood of 0.05–0.15% corresponds to "slight intoxication" and 0.16–0.30% to "drunkenness" (Japan Alcohol Health Medical Incorporated Association).

Fig. 1 shows the test results of one-way ANOVA of selected parameters. The diastolic and systolic blood pressures were unchanged after alcohol intake, but the heart rate changed significantly (after 10, 20 and 30 min). Moreover, the whole body reaction time and the standing time on one leg with eyes closed changed significantly.

Fig. 2 shows the typical pattern of the CFP change before and after alcohol intake for a subject. All subjects tended to have similar CFP changes. A significant change was found in all parameters except for 3 high frequency band parameters of power spectrum domain for body-sway (see Table 4).

Table 5 shows the test results between mean factor scores before and after alcohol intake. Significant differences were found in 3 factors except for the fourth factor. Their ES was very high (ES=1.17–1.81). The standard deviation for the first and second factors showed significant differences in before and after alcohol intake.

Discussion

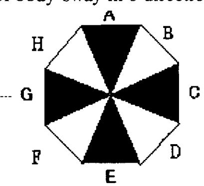
Gender differences in body-sway factors

Evaluation parameters of CFP movement are theoretically categorized into 6 domains, and the characteristics of CFP movement can be synthetically understood from 32 parameters representing the above-stated 6 domains (Demura et al., 2001; Mizuta et al., 1993; Yamaji et al., 2001; Kitabayashi et al., 2002). The autors judged that these parameters have high reliability and validity (Demura et al., 2001; Kitabayashi et al., 2002). Previous studies reported that significant gender differences were found in several body-sway parameters (Kitabayashi et al., 2003; Tokita et al., 2001; Imaoka et al., 1997). Significant gender differences were found only in 2 factors of left-right sway and the high frequency band power factor. Both factors are considered to be influenced somewhat by 5 parameters which showed a significant change. However, their ES was moderate. Kitabayashi et al. (2002) reported that the influence of gender differences on body-sway is not very large, because the ES (0.51–0.61) of each parameter in spite of showing significant gender differences was moderate. Also, according to the present result, the influence of gender difference on body sway is not very large and can be disregarded. Therefore, we judged that it is not necessary to analyze according to gender.

Comparison of body-sway parameters and factors before and after alcohol intake

Because the performance of nervous function tests selected in this study changed significantly, nervous function is considered to have decreased by alcohol intake. It was determined that CFP movement has peculiar fluctuations when the nervous function is in an abnormal state, as in the case with disordered people such as those with unilateral labyrinth disability and bilateral labyrinth disability (the Japan Society for Equilibrium Research; 1994). If alcohol intake causes a

Table 2 Means, Standard deviations, ICCs and gender differences for 32 CFP parameters

Domains	No	Parameters	Properties	M	SD	ICC	Male M	Male SD	Female M	Female SD	t-value
Distance	1	Mean path length	Mean length of center of foot pressure (CFP) path	1.1	0.27	0.97	1.14	0.27	1.03	0.26	3.20
	2	Root mean square	Equation: $\sqrt{(1/N\{(\Sigma Xi-Xmean)^2+\Sigma(Yi-Ymean)^2\}}$: The dispersion from CFP	0.8	0.27	0.92	0.84	0.30	0.76	0.23	2.35
	3	Root mean square of X-axis	Equation: $\sqrt{(1/N(\Sigma Xi-Xmean)^2}$	0.5	0.15	0.94	0.51	0.14	0.44	0.15	3.52 *
	4	Root mean square of Y-axis	Equation: $\sqrt{(1/N(\Sigma Yi-Ymean)^2}$	0.6	0.26	0.86	0.65	0.29	0.60	0.22	1.47
Area	5	Area surrounding mean path length	Total path length was broken with in the circumference area	22.5	9.03	0.92	21.30	8.88	23.72	9.02	1.99
	6	Area surrounding maximal amplitude rectangular	Area surrounding maximal amplitude rectangular for each axis	7.9	4.76	0.93	8.93	5.43	6.99	3.78	3.07
	7	Area surrounding root mean square	The area of the circle which makes actual effect value radius	2.2	1.82	0.90	2.51	2.20	1.98	1.30	2.14
Velocity	8	Mean velocity of X-axis	Mean velocity of X-, Y-axis for body-sway	0.7	0.18	0.96	0.70	0.18	0.64	0.19	2.43
	9	Mean velocity of Y-axis		0.6	0.15	0.96	0.59	0.16	0.54	0.14	2.69
	10	Root mean square of sway velocity	Root mean square of sway velocity	1.5	0.37	0.96	1.53	0.36	1.40	0.36	2.66
Distribution of amplitude	11	Standard deviation of X-axis	Equation: $Sx=\sqrt{1/N\Sigma(xi-Xmean)^2}$	0.5	0.15	0.94	0.51	0.14	0.44	0.15	3.52*
	12	Standard deviation of Y-axis	Equation: $Sy=\sqrt{1/N\Sigma(yi-Ymean)^2}$	0.6	0.26	0.86	0.65	0.29	0.60	0.22	1.47
	13	Standard deviation of X-axis velocity	Standard deviation of X- and Y-axis velocity	1.1	0.30	0.96	1.16	0.29	1.06	0.31	2.38
	14	Standard deviation of Y-axis velocity		0.9	0.25	0.96	0.98	0.26	0.89	0.23	2.60
Power spectrum	15	Ratio of A domain for power spectrum of X-axis	Power spectrum area by the fourier translate for the body-sway value (X-, Y-, R-direction) divided A, B, C, domain. A domain; 0–0.2 Hz, B domain; 0.2–2 Hz, C domain; above 2 Hz	29.6	6.37	0.82	31.04	6.41	28.20	6.02	3.37*
	16	Ratio of C domain for power spectrum of X-axis		14.0	3.63	0.82	14.15	3.77	13.82	3.48	0.65
	17	Ratio of C domain for power spectrum of Y-axis		16.7	4.84	0.73	17.52	4.41	15.85	5.10	2.58
	18	Ratio of A domain for power spectrum of R-axis		27.3	6.42	0.80	27.63	6.72	27.07	6.11	0.65
	19	Ratio of C domain for power spectrum of R-axis		15.8	3.65	0.89	16.19	3.88	15.36	3.35	1.69
	20	Ratio of A domain for power spectrum of X-axis velocity	Power spectrum area by the fourier translate for the body-sway velocity (X-, Y-, R-direction) divided A, B, C, domain. A domain; 0–0.2 Hz, B domain; 0.2–2 Hz, C domain; above 2 Hz	5.2	1.56	0.91	5.42	1.54	4.90	1.54	2.53
	21	Ratio of C domain for power spectrum of X-axis velocity		25.2	3.80	0.93	26.03	3.84	24.38	3.59	3.27*
	22	Ratio of C domain for power spectrum of Y-axis velocity		27.0	3.60	0.95	28.03	3.62	26.04	3.31	4.23*
	23	Ratio of A domain for power spectrum of R-axis velocity		8.7	1.49	0.88	8.64	1.43	8.83	1.55	0.95
	24	Ratio of C domain for power spectrum of R-axis velocity		43.5	3.99	0.94	44.23	3.65	42.81	4.17	2.68
Vector	25	Mean vector length of A direction sway	Mean distance of body-sway in 8 directions (A to H) 	0.8	0.33	0.82	0.79	0.38	0.71	0.27	1.76
	26	Mean vector length of C direction sway		0.6	0.20	0.87	0.61	0.21	0.54	0.19	2.53
	27	Mean vector length of E direction sway		0.8	0.33	0.83	0.77	0.36	0.73	0.31	1.08
	28	Mean vector length of G direction sway		0.6	0.22	0.84	0.62	0.22	0.54	0.21	2.99
	29	Mean vector length of A direction velocity		0.9	0.24	0.95	0.91	0.26	0.82	0.22	2.75
	30	Mean vector length of C direction velocity		1.1	0.28	0.95	1.10	0.26	1.02	0.29	2.21
	31	Mean vector length of E direction velocity		0.9	0.24	0.95	0.93	0.27	0.85	0.22	2.55
	32	Mean vector length of G direction velocity	Mean distance of body-sway velocity in 8 directions (A to H)	1.1	0.29	0.95	1.10	0.28	1.02	0.30	2.01

Note) M: mean, SD: standard deviation, ICC: Intraclass correlation coefficient, CFP: center of foot pressure
*: $P<\alpha'=(\alpha/\text{number of parameter})=(0.05/32)=0.00156$

Table 3 Gender difference, ES and ICC of each factor

Factors (parameter number)	ICC	Male M	Male SD	Female M	Female SD	t-value		ES
F1: unit time sway (1, 8, 9, 10, 13, 14, 29, 30, 31, 32)	0.89	0.19	1.036	−0.18	1.034	2.651	ns	−0.19
F2: front-back sway (2, 4, 5, 6, 7, 12, 18, 25, 27)	0.90	0.05	1.086	−0.05	0.969	0.718	ns	−0.08
F3: left-right sway (3, 11, 15, 20, 26, 28)	0.95	−0.26	0.933	0.25	0.956	4.050	*	0.30
F4: high frequency band power spectrum (16, 17, 21, 22, 23, 24)	0.92	0.25	0.997	−0.24	0.959	3.683	*	−0.45

Note) *: P<$\alpha'=(\alpha/2)/(\text{number of factor})=(0.05/2)/4=0.00625$, ns: not significant
M: mean, SD: standard deviation, ES: Effect size, ICC: Intraclass correlation coefficient
( ): The parameter number corresponds to the number in Table 2

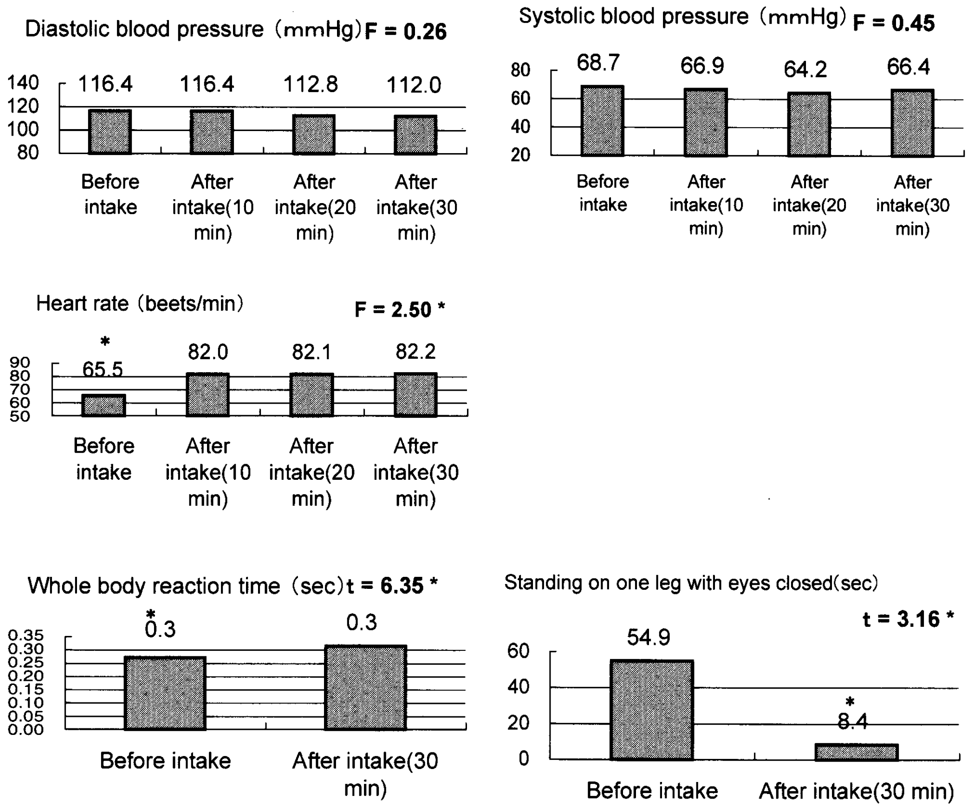


Fig. 1. Change in diastolic and systolic blood pressure, pulse, whole body reaction time, and standing time on one leg with eyes closed before and after the intake of alcohol.
*: There was significant difference between before and after the intake of alcohol ($p<0.05$).

temporary nervous function decline, that will also influence CFP movement.

All parameters, which were mainly selected from distance, area, amplitude distribution and velocity domains except for 3 parameters representing the high frequency band, showed significant variations after alcohol intake. Significant differences were found in 3 factors of unit time sway, front-back sway and left-right sway except for the high frequency band power factor. From the above results, 4 sway factors may be able to evaluate the influence of alcohol intake as close as using 32 parameters. In addition, the following may be important; alcohol intake greatly influences the parameters regarding sway size and velocity, but has little influence on the high frequency band of periodicity characteristics. From the present result, four sway factors are considered to be able to determine almost the same sway characteristics as 32 parameters which synthetically evaluate body-sway.

Demura et al. (2001) and Fujiwara et al. (1984) reported that CFP movement in a rest state does not change much, and the variation within individuals is small (Demura; 2001, Fujiwara; 1984). On the other hand, it is reported that inter-individual variations become large by alcohol intake or the influence of alcohol intake volume on body-sway differs in individuals (Yamaji et al.; 1998 and Franks et al.; 1976). Because the individual differences of unit time sway and front-back sway factor became large by alcohol intake, they may be able to be

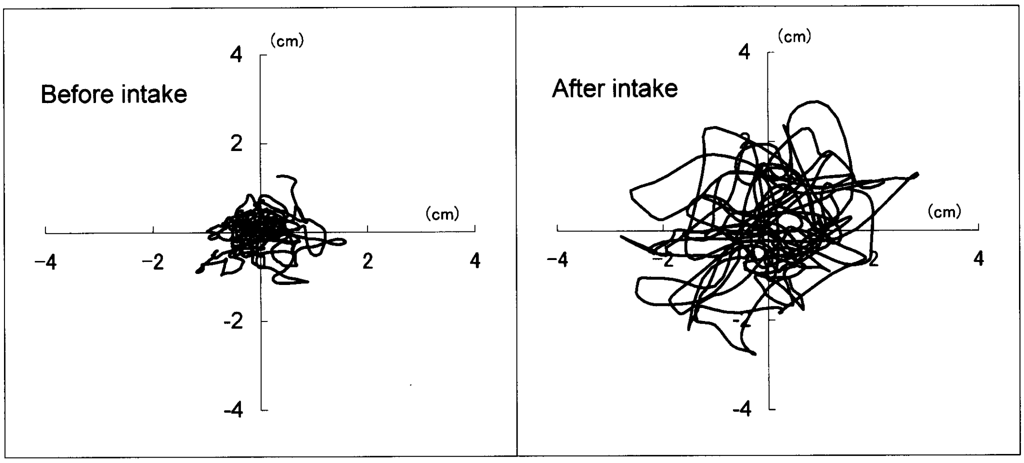


Fig. 2. Typical pattern of the CFP change before and after alcoholic intake in a subject.

Table 4 Significant differences between before and after alcohol intake for 32 parameters

Domains	Parameters	Before intake M	Before intake SD	After intake M	After intake SD	t-value	
Distance	Mean path length	0.90	0.16	2.00	1.37	9.59	**
	Root mean square	0.66	0.17	1.35	0.70	11.56	**
	Root mean square of X-axis	0.42	0.14	0.81	0.35	12.53	**
	Root mean square of Y-axis	0.49	0.17	1.08	0.63	10.85	**
Area	Area surrounding mean path length	25.02	8.53	12.30	5.09	15.37	**
	Area surrounding maximal amplitude rectangular	2.46	1.03	13.93	14.73	9.32	**
	Area surrounding root mean square	1.45	0.69	7.31	8.46	8.28	**
Velocity	Mean velocity of X-axis	0.55	0.11	1.14	0.59	11.63	**
	Mean velocity of Y-axis	0.49	0.09	1.25	1.06	8.62	**
	Root mean square of sway velocity	1.22	0.22	2.87	2.04	9.66	**
Distribution of amplitude	Standard deviation of X-axis	0.42	0.14	0.81	0.35	12.53	**
	Standard deviation of Y-axis	0.49	0.17	1.08	0.63	10.85	**
	Standard deviation of X-axis velocity	0.92	0.19	1.90	1.00	11.52	**
	Standard deviation of Y-axis velocity	0.80	0.15	2.12	1.82	8.66	**
Power spectrum	Ratio of A domain for power spectrum of X-axis	32.03	4.32	30.07	7.84	2.62	**
	Ratio of C domain for power spectrum of X-axis	12.24	4.20	11.26	3.47	2.15	ns
	Ratio of C domain for power spectrum of Y-axis	14.64	4.24	14.19	5.34	0.78	ns
	Ratio of A domain for power spectrum of R-axis	27.37	5.12	24.27	6.98	4.30	**
	Ratio of C domain for power spectrum of R-axis	13.78	3.15	14.08	4.10	0.70	ns
	Ratio of A domain for power spectrum of X-axis velocity	5.77	1.22	7.10	2.38	5.98	**
	Ratio of C domain for power spectrum of X-axis velocity	24.79	4.33	20.92	2.90	8.91	**
	Ratio of C domain for power spectrum of Y-axis velocity	25.91	5.01	22.70	2.62	6.80	**
	Ratio of A domain for power spectrum of R-axis velocity	8.95	1.68	9.79	1.67	4.24	**
	Ratio of C domain for power spectrum of R-axis velocity	40.87	5.32	36.47	3.96	7.95	**
Vector	Mean vector length of A direction sway	0.60	0.27	1.40	0.89	10.38	**
	Mean vector length of C direction sway	0.51	0.14	1.00	0.40	13.97	**
	Mean vector length of E direction sway	0.59	0.17	1.20	0.54	13.03	**
	Mean vector length of G direction sway	0.51	0.18	0.98	0.37	13.62	**
	Mean vector length of A direction velocity	0.74	0.16	2.00	1.54	9.71	**
	Mean vector length of C direction velocity	0.85	0.16	1.76	0.83	12.82	**
	Mean vector length of E direction velocity	0.79	0.15	1.96	1.77	7.96	**
	Mean vector length of G direction velocity	0.91	0.19	1.91	1.08	10.96	**

Note) M: mean, SD: standard deviation, **: $P<\alpha'=(\alpha/\text{number of parameter})=(0.05/32)=0.00156$, ns: not significant

Table 5 Significant differences between mean factor scores before and after alcoholic intake

	Before		After		Mean difference			Variance difference	
Factors (parameter number)	M	SD	M	SD	t-value		ES	t-value	
F1: unit time sway (1, 8, 9, 10, 13, 14, 29, 30, 31, 32)	−0.21	0.390	1.28	1.386	4.09	*	1.81	9.55	*
F2: front-back sway (2, 4, 5, 6, 7, 12, 18, 25, 27)	−0.54	0.224	0.56	1.037	4.81	*	1.52	9.88	*
F3: left-right sway (3, 11, 15, 20, 26, 28)	−0.25	0.540	0.46	0.421	4.86	*	1.17	1.13	ns
F4: high frequency band power spectrum (16, 17, 21, 22, 23, 24)	−0.01	0.652	0.01	0.981	0.05	ns	0.20	2.03	ns

Note) *: $P<\alpha'=(\alpha/2)/(\text{number of factor})=(0.05/2)/4=0.00625$, ns: not significant
( ): The parameter number corresponds to the number in Table 2

used to evaluate individual differences (see Table 5).

In summary, significant gender differences were found in left-right sway and the high frequency band power factors, but the influence on body-sway is, as a whole, can be disregarded. Four sway factors can determine the influence of alcohol intake as efficient as using 32 sway parameters.

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