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Nutritional Status Associated with Drinking Status in Korean Adults : 2001 Korean National Health and Nutrition Survey

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ABSTRACT

This study was performed to investigate the nutritional status associated with alcohol consumption in Korean adults men and women. The data was derived from the 2001 Korean National Health and Nutrition Survey. The number of subjects included were 6090 (Men : 2789, Women : 3031) aged 20 ≤ < 65y. Men consuming moderate alcohol (≥ 24 g/day but < 48g/day) had higher intakes of energy and vitamin B groups than the ones consuming less than 24g/day. Heavy drinking men reporting more than 48g alcohol/day were observed as having 3207.2kcal of energy intake (130% of Korean RDA) and significantly elevated levels in most of the nutrients. For women drinkers, when the alcohol consumption was moderate (≥ 12g/day but 24g/day) or heavy (≥ 36g/day) the energy intake was 2188.9kcal (100% of RDA) or 2627.5kcal (130% of RDA). The other nutrients protein, fat, calcium, iron and vitamin B group were also higher in women with heavy alcohol consumption. Heavy drinking women showed significantly higher weight, BMI and HDL-C. In contrast, heavy drinking men did not show any significant difference in BMI but showed significantly elevated blood pressure, HDL-C and lower serum cholesterol. (*J Community Nutrition* 6(2) : 61~66, 2004)

KEY WORDS : drinking status · nutrient intakes · anthropometric · serum lipid profiles.

Introduction

Alcohol has an important role in the daily life of many healthy as well as sick individuals. It has three major characteristics ; it is a nutrient, a psycho-active drug and a toxin (Suter 2004).

Alcohol is regarded as empty calorie foods, containing energy but lacking in other macro or micronutrients. It was known that alcohol represents a risk factor for overweight and obesity as a result of specific effects on energy metabolism (Suter 2004).

Alcohol is commonly consumed around meal time with various side dishes like roasted pork, eels or roasted beef in the social gatherings in Korea. It was reported that the energy intake with Soju (Korean wine) and roasted pork, for one occasion was, about 800 - 1000kcal ; which is about half of the RDA for Korean adults (Son et al. 2004). Unlike other macronutrients, there is minimal evidence for any reduction in food intake to compensate for the potential energy in alcohol. Yeoms et al. (2003) reported moderate alcohol consumption prior to meals led to a short-term increase in food intake. The inability to reduce voluntary energy intake in response to energy from alcohol metabolism is evident and therefore alcohol consumption is associated with overeating. In contrast, Raben et al. (2003) reported that satiety and ad libitum energy intake were not significantly different between meals rich in alcohol, protein, carbohydrate, or fat. Intake of an alcohol-rich meal stimulates energy expenditure but suppressed fat oxidation and leptin more

In contrast to the overeating of occasional, healthy and social drinkers, patients of Alcohol Misuse Clinic showed undernutrition in UK (Manari et al. 2003). Between 50 - 85% of the patients showed intakes below UK recommended standards in calcium, zinc and vitamin A, B_1 B_2, B_6 and C. There was no difference in the degree of malnutrition between the harmful drinkers and heavily dependent subgroup. Consequently one third of the subjects showed underweight (Manari et al. 2003).

Supporting this, Addolorato et al. (1998) reported that chronic ethanol abusers showed lower body weight, a higher

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resting energy expenditure, and higher fatty acid oxidation even when the total calorie intake computed as food intake plus alcohol intake.

Alcohol consumption was implicated as one of the main environmental factors in the development of hypertension (Staessen et al. 1996) as it reduced red blood cell deformability(Chmiel et al. 1999), stimulated sympathetic neuron and increased entry of calcium into the cells(Kim 1994). Kim (1998) also reported that the risk of hypertension was increased 2.5 times when the ethanol consumption was more than 30g/day in Koreans. In addition to hypertension, alcohol consumption was associated with breast cancer(Fegelson et al. 2003) atherosclerosis, dementia or diabetes(Suter 2004).

In Korea there was not enough information about the general view of dietary pattern of adults with various drinking status. In this study, we identified the differences of nutrient intakes, blood pressures and plasma lipid profiles by drinking status for Korean adults.

Subjects and Methods

1. Subjects

This study was based on the 2001 Korean National Health and Nutrition Examination Survey(KNHNES). The KNHNES is divided into 4 parts : the Health Interview Survey, the Health Behavior Survey, the Nutrition Survey, and the Health Examination Study.

Adult men and women aged 20 ≤ <65y were of interest in current research. To minimize potential bias due to special dietary intakes, women in pregnancy, lactation or on a special diet were excluded. The resulting sample included 2789 for adult men and 3031 for adult women.

The subjects were categorized into 3groups based on the ethanol intake estimated with a 24-hr dietary recall. Because it was assumed that one drink includes 12g of ethanol, adults men reporting less than 2drinks(<24g alcohol/day) were classified as a light alcohol consumption group, 2 ≤ <4drinks (24 ≤ <48g/day) as a moderate alcohol consumption group and more than 4drinks(≥ 48g/day) as a heavy alcohol consumption group.

Women consuming less than one drink(<12g alcohol/day) were categorized as a light alcohol consumption group, 1 ≤ <3drinks(12 ≤ <36g/day) as a moderate alcohol consumption group and more than 3drinks(≥ 36g/day) as a heavy alcohol consumption group.

2. Nutrition survey

Daily energy, nutrient intake and alcohol consumption were assessed by using a 24-hr recall method.

3. Health examination study

Height and weight were measured during the Health Examination study. Height was measured to the nearest 0.1cm on a Seriter stadiometer(Holtain Ltd, Crymych. UK).

Body weight was measured to the nearest 0.1kg on a balanced scale(Giant 150N ; HANA Co Ltd, Seoul, Korea) while the subjects wore a light weight gown or underwear. Blood pressure was measured with a mercury sphygmomanometer(Baumanometer, WA Baum Co Inc, New York) after the subjects had rested for 5min in a sitting position. Blood samples were collected from the antecubital vein to measure serum concentrations of serum cholesterol, TG, HDL-C, and serum glucose after 10 - 12hr of fasting.

Serum cholesterol, TG, HDL-C and glucose were measured by enzymatic methods with a Hitachi 747 autoanalyzer (Hitachi Instruments Inc, Tokyo) and commercial kits(Auto T-18 cholesterol kit, Auto Tag Kit, cholestest HDL kit (Embiel Co Ltd, Gunpo, Korea) and Sicadia Glzymekit (Shinyang Chemical Co Ltd, Busan, Korea).

4. Statistics

All values were expressed as group mean ± SD. ANOVA and Duncan's multiple range test were used to determine differences for the 3groups. All the analyses were done using SAS statistic software. Less than 5% error was considered as statistically significant.

Results and Discussion

1. Nutrient intakes by alcohol consumption

Table 1 shows nutrient intakes according to the alcohol consumption in men. Subjects who reported moderate alcohol consumption(≥ 2drinks but <4drinks) showed higher energy , protein, fat and with B complex(vitamin B_1, B_2, niacin) than the ones who consumed less than 2drinks. Drinkers classified as the heavy drinking group showed mean alcohol intake of 99.2g, about 8drinks and revealed 3207.2 kcal of energy intake(130% of Korean RDA). They also showed significantly elevated intakes in most macro or micro nutrients.

Women drinkers showed similar patterns in nutrients intakes to men(Table 2). When the alcohol consumption was more than 1drink but less than 2drinks(12g ≤ alcohol < 24g), the energy intake rose to 2188.9kcal(100% of RDA) and with more than 3drinks(alcohol ≥ 36g/day), 2627.5 kcal(130% of RDA).

The other nutrients, except carbohydrates, fiber and vitamin A and C, were also higher in moderate consumer group or

Table 1. Energy and nutrition intakes by alcohol consumption in adult men

	Alcohol consumption			F-value
	<24g(n = 2301)	24 ≤ <48g(n = 191)	<48g(n = 297)	
Energy(kcal)	2277.3 ± 865.2$^{1)c}$	2549.9 ± 792.5$^{2)b}$	3207.2 ± 1080.5^{a}	148.1$^{3)**}$
Water intake from foods	903.3 ± 459.0^{c}	1220.1 ± 525.7^{b}	1700.8 ± 1070.5^{a}	280.3***
Protein(g)	86.7 ± 44.3^{c}	100.8 ± 43.4^{b}	108.2 ± 52.8^{a}	35.6***
Fat(g)	46.3 ± 37.0^{c}	55.9 ± 40.4^{b}	62.1 ± 45.4^{a}	26.3***
Carbohydrate(g)	371.0 ± 138.4^{a}	347.9 ± 119.7^{b}	373.3 ± 152.7^{a}	2.6
Fiber(g)	8.3 ± 4.6	8.8 ± 4.7	8.8 ± 4.3	2.5
Calcium(mg)	554.2 ± 360.7^{b}	598.6 ± 334.7^{ab}	630.4 ± 362.80^{a}	6.8**
Iron(mg)	14.9 ± 9.1^{b}	16.0 ± 8.8^{ab}	16.7 ± 9.6^{a}	5.9**
Sodium(mg)	6145.7 ± 3340.2^{b}	6565.1 ± 3302.7^{ab}	6686.8 ± 3577.2^{a}	4.4*
Potassium(mg)	3388.4 ± 1598.9^{b}	3585.3 ± 1321.5^{b}	3859.5 ± 1606.2^{a}	12.4***
Vitamin A(R.E)	761.0 ± 1162.6	867.2 ± 804.5	922.7 ± 902.4	3.3*
β-carotene(μg)	3781.7 ± 4473.6^{b}	4198.7 ± 2975.4^{ab}	4515.1 ± 4592.9^{a}	4.2*
Retinol(μg)	94.8 ± 878.0	137.2 ± 608.2	137.4 ± 414.6	0.5
Thiamin(mg)	1.47 ± 0.84^{b}	1.70 ± 1.06^{a}	1.83 ± 1.12^{a}	26.6***
Riboflavin(mg)	1.30 ± 0.79^{c}	1.45 ± 0.68^{b}	1.62 ± 0.88^{a}	23.8***
Niacin(mg)	20.7 ± 11.3^{c}	24.9 ± 17.2^{b}	27.4 ± 15.1^{a}	46.2***
Vitamin C(mg)	138.9 ± 112.4	138.9 ± 102.1	130.5 ± 96.3	0.8
Alcohol(g)	1.0 ± 3.8^{c}	33.5 ± 6.1^{b}	99.2 ± 56.6^{a}	3691.1***

1) Mean ± SD
2) Means with superscript not sharing the same letter are significantly different with Duncan's multiple range test at p <0.05
3) Significantly different with ANOVA *** : p <0.001, ** : p <0.01, * : p <0.05

Table 2. Energy and nutrients intake by alcohol consumption in adult women

	Alcohol consumption			F-value
	<12g(n = 2836)	12 ≤ <36g(n = 118)	≥ 36g(n = 77)	
Energy(kcal)	1848.4 ± 700.8$^{1)c}$	2188.9 ± 787.0$^{2)b}$	2627.5 ± 951.7^{a}	56.4$^{3)***}$
Water intake from foods	831.1 ± 428.3^{c}	1226.0 ± 515.5^{b}	1696.6 ± 967.5^{a}	174.8***
Protein(g)	67.1 ± 37.0^{c}	80.2 ± 41.4^{b}	93.4 ± 50.8^{a}	24.4***
Fat(g)	35.8 ± 29.3^{b}	48.9 ± 38.2^{a}	55.0 ± 46.7^{a}	25.1***
Carbohydrate(g)	311.6 ± 115.6	315.3 ± 128.7	292.2 ± 105.7	1.1
Fiber(g)	7.3 ± 4.4	7.7 ± 5.3	7.6 ± 4.3	0.6
Calcium(mg)	479.4 ± 304.5^{b}	476.9 ± 269.3^{b}	601.7 ± 357.8^{a}	6.1**
Iron(mg)	12.5 ± 10.0^{b}	12.9 ± 7.8^{b}	15.3 ± 10.9^{a}	3.1*
Sodium(mg)	5103.1 ± 3258.0	5091.5 ± 3403.9	5705.8 ± 3145.9	1.3
Potassium(mg)	2909.0^{b} ± 1444.1^{b}	3171.5 ± 1296.1^{b}	3475.5 ± 1616.0^{a}	7.4***
Vitamin A(R.E)	631.6 ± 675.3	691.2 ± 674.3	773.5 ± 550.1	2.1
β-carotene(μg)	3166.0 ± 3356.0	3477.6 ± 3779.3	3945.5 ± 3043.1	2.4
Retinol(μg)	67.9 ± 253.6	84.6 ± 194.4	88.9 ± 105.3	0.5
Thiamin(mg)	1.21 ± 0.74^{b}	1.62 ± 1.00^{a}	1.50 ± 1.06^{a}	21.7***
Riboflavin(mg)	1.05 ± 0.57^{c}	1.28 ± 0.68^{b}	1.44 ± 0.77^{a}	25.4***
Niacin(mg)	16.4 ± 10.3^{b}	22.2 ± 13.3^{b}	23.6 ± 11.0^{a}	33.82***
Vitamin C(mg)	153.5 ± 128.4	156.7 ± 130.5	147.8 ± 121.6	0.1
Alcohol(g)	0.2 ± 1.2^{c}	22.0 ± 6.7^{b}	81.7 ± 56.4^{a}	33267.1***

1) Mean ± SD
2) Means with superscript not sharing the same letter are significantly different with Duncan's multiple range test at p <0.05
3) Significantly different with ANOVA *** : p <0.001, ** : p <0.01, * : p <0.05

heavy group. In Korea, alcohol is commonly consumed around meal times with fat rich side dishes like roasted beef, pork or eels. It was reported that moderate alcohol consumption before meals leads to short-term increase in food intake (Yeomans et al. 2003)

The stimulatory effect of alcohol on short-term increase of food intake is not apparent. It seems associated with the findings that alcohol suppresses fatty acid oxidation, increase short-term thermogenesis and stimulates a number of neurochemical and peripheral systems implicated in appetite control (Yeomans et al. 2003).

In this study, the heavy drinking men group showed 99.2g of mean alcohol intake, providing 693.0kcal as alcohol and 2514.2kcal as foods. It appears the heavy drinking group did not reduce their food intakes even with taking 20% of energy as alcohol. A similar trend was found in female heavy drinkers showing 567.0kcal as alcohol and 2060.5 kcal as foods.

2. Anthropometric and biochemical indices

The heavy drinking men did not show any significant difference in BMI even with higher energy and nutrient intakes (Table 3). However the systolic and diastolic blood pressure were significantly higher than the group with alcohol consumption of more than 48g/day.

The result of non-significant difference of BMI in the heavy drinkers was supported by the finding of Westerterp et al. (2004). It was reported that alcohol intake did not increased body weight because of positive association of alcohol intake with physical activity. Raben et al. (2003) also reported that diet- induced thermogenesis was larger after the alcohol rich meal compared with carbohydrate or fat rich meal.

In contrast with the non-significant difference of BMI among groups in men, women showed significantly higher weight and BMI in heavy drinker group (>36g of alcohol/day) (Table 4).

It is uncertain why heavy drinking was associated with higher BMI only in women. Addolorato et al. (1998) reported that excess alcohol consumption can be a risk factor for obesity or malnutrition. It was found that chronic alcohol drinkers, compared to social drinkers, showed a lower body weight due to a higher REE value and a preferential utilization of lipids as energy substrate (Addolorato et al. 1998). Whereas, addition of total calorie with alcohol consumption and failure to reduce food intake in response to energy from alcohol makes moderate alcohol consumption a risk factor for obesity (Yeomans et al. 2003). It looks like the differential effects of heavy alcohol intake on the BMI by sex may be associated with whether the alcohol consumption was chronic or social.

In this study, heavy drinking men showed significantly elevated systolic and diastolic blood pressure. It is well known that the amount of ethanol drinking is highly correlated with higher blood pressure (Moreira et al. 1998 ; Saremi et al. 2004) by stimulating the sympathetic nervous system, increasing the resistance to insulin and calcium entry into the

Table 3. Anthropometric and biochemical data by alcohol consumption in adult men

	Alcohol consumption			F-value
	<24g (n = 2301)	24 < ≤ 48g (n = 191)	≥ 48g (n = 297)	
Weight (kg)	69.0 ± 1.0[1)]	68.0 ± 10.3	68.9 ± 10.3	0.7
Height (cm)	170.2 ± 6.2	169.6 ± 6.3	169.8 ± 5.6	0.9
BMI (body mass index) (kg/m^2)	23.8 ± 3.0	23.6 ± 3.0	23.9 ± 3.0	0.3
1st systolic blood pressure (mmHg)	123.9 ± 16.0[2)b]	124.2 ± 16.2[b]	127.5 ± 17.1[a]	4.6[3)*]
1st diastolic blood pressure (mmHg)	80.2 ± 11.3[b]	80.0 ± 10.6[b]	82.6 ± 11.5[a]	4.1[*]
2nd systolic blood pressure (mmHg)	123.7 ± 15.8[b]	122.7 ± 16.4[b]	127.0 ± 17.3[a]	4.2[*]
2nd diastolic blood pressure (mmHg)	80.1 ± 11.1[b]	80.2 ± 10.3[b]	82.5 ± 11.1[a]	4.0[*]
SGOT	24.3 ± 8.8[b]	26.1 ± 8.7[b]	27.2 ± 10.2[a]	11.3[***]
SGPT	25.5 ± 13.5	26.5 ± 12.3	26.6 ± 13.4	0.8
Total cholesterol (mg/dl)	187.4 ± 38.4[ab]	189.1 ± 36.3[a]	181.2 ± 51.2[b]	2.6[*]
HDL-cholesterol (mg/dl)	43.6 ± 10.0[b]	43.8 ± 9.1[b]	46.5 ± 11.6[a]	7.2[***]
Triglyceride (mg/dl)	155.5 ± 83.4	159.8 ± 88.6	164.2 ± 92.8	1.0

1) Mean ± SD
2) Means with superscript not sharing the same letter are significantly different with Duncan's multiple range test at p <0.05
3) Significantly different with ANOVA *** : p <0.001, ** : p <0.01, * : p <0.05

Table 4. Anthropometric and biochemical data by alcohol consumption in adult women

	Alcohol consumption			F-value
	<12g(n = 2836)	12≤ <36g(n = 118)	≥36g(n = 77)	
Weight(kg)	57.5 ± 8.3[1)b]	57.8 ± 9.1[2)b]	60.5 ± 8.9[a]	4.0[3)*]
Height(cm)	157.4 ± 5.6	158.0 ± 5.9	157.7 ± 4.8	0.7
BMI(body mass index) (kg/m^2)	23.2 ± 3.3[b]	23.2 ± 3.5[b]	24.4 ± 3.7[a]	3.5[*]
1st systolic blood pressure(mmHg)	116.3 ± 16.6	116.1 ± 16.8	116.6 ± 16.9	0.0
1st diastolic blood pressure(mmHg)	73.9 ± 10.8	74.0 ± 11.2	74.7 ± 11.3	0.2
2nd systolic blood pressure(mmHg)	116.0 ± 16.6	116.1 ± 16.6	116.4 ± 17.2	0.0
2nd diastolic blood pressure(mmHg)	73.8 ± 10.7	74.1 ± 11.1	74.7 ± 11.2	0.2
SGOT	20.2 ± 7.4	20.2 ± 7.5	21.0 ± 6.5	0.4
SGPT	17.0 ± 9.6	16.5 ± 8.4	17.4 ± 9.5	0.2
Total cholesterol(mg/dl)	182.2 ± 39.4	184.3 ± 34.6	188.0 ± 29.9	0.8
HDL-cholesterol(mg/dl)	48.3 ± 10.2[b]	50.1 ± 11.1[ab]	51.9 ± 12.0[a]	5.1[**]
Triglyceride(mg/dl)	115.5 ± 67.1	122.1 ± 76.1	130.5 ± 72.5	1.9

1) Mean ± SD
2) Means with superscript not sharing the same letter are significantly different with Duncan's multiple range test at p <0.05
3) Significantly different with ANOVA *** : p <0.001, ** : p <0.01, * : p <0.05

cells(Kim 1994). It was also reported that ethanol drinking of more than 30g/day was associated with the increased risk of hypertension(Kim 2001 ; Stassen et al. 1996).

Higher HDL-C was found in the heavy alcohol drinking group in both gender, which is supported by the reports of Ellison et al.(2004). In this study significantly lower serum cholesterol was observed in only heavy alcohol drinking men (Table 3), even though their energy, fat and other nutrients were significantly higher than those of the light alcohol group.

It looks like heavy alcohol consumption is associated with a reduced risk of cardiovascular disease(CVD) in men. But many authors suggested not using alcohol to reduce CVD. Whang et al.(2003) reported that alcohol abuse was an important risk factor of hyperlipidemia through changing the level of LDL-C and apo B. Yoon et al.(2004), also reported that although alcohol consumption had a significant inverse relation with the odds ratio for low HDL-cholesterol, an increasing dose-response relation was found between alcohol consumption and the odds ratio for the metabolic syndrome.

Summary and Conclusion

This study was conducted to investigate the nutritional status associated with alcohol consumption in Korean adult men and women. The data was derived from the 2001 Korean National Health and Nutrition Survey. Adult men and women aged 20 - 65 were of interest in current this research .

1) Men consuming moderate alcohol(≥ 24g but <48g/day) showed higher energy, fat, vitamin B groups than the ones consuming less than 24g alcohol/day. Heavy drinking men reporting more than 48g alcohol/day revealed 3207.2 kcal of energy intake(130% of Korean RDA) and significantly elevated levels in most of the nutrients.

2) Women drinkers showed similar patterns in nutrients intakes by alcohol consumption status to men. When the alcohol consumption was moderate(≥ 12g alcohol/day), the energy intake rose to 2188.9kcal(100% of RDA) and when heavy(≥ 36g alcohol/day) to 2627.5kcal(130 % of RDA). The other nutrients, except carbohydrates, fiber and vitamin A, were also significantly higher in moderate or heavy alcohol consumption group.

3) In contrast with the non-significant difference of BMI among groups with different alcohol intake in men, women showed significantly higher weight and BMI in the heavy drinking group.

4) Heavy drinking men showed significantly elevated blood pressure, HDL-C and lower serum cholesterol. Whereas heavy drinking women were observed as having a only higher HDL-C.

It appears heavy drinking in men(≥ 48g alcohol/day) and women(≥ 36g alcohol/day) is associated with overnutrition particularly in energy, fat and protein intakes. Heavy alcohol consumption brought about higher BMI in women and higher blood pressure in men although it was associated with some lower CVD risk(higher HDL-C, lower serum cholesterol).

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