

Dietary Intake of Korean Adults Is Not Significantly Affected by Sleep Duration

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Abstract

This study investigated the effect of sleep duration on food and nutrient intake among adult Koreans. The effects of sleep duration on dietary patterns was studied in 7,370 Korean adults, aged 20 and older, who participated in the 1998 Korean National Health and Nutrition Survey in which the 24 hour recall method was used to estimate dietary intake. Sleep duration data from individual subject were collected by interview as a part of a behavior survey. Analysis of variance and Duncan's multiple range test were used to test the differences in food and nutrition intake and sleep duration. Food intakes of the male subjects were not significantly different among three groups. However, there were significant differences observed in intakes of beverage and alcohol among female subjects among the three groups. There were no significant differences observed for nutrient intake by sleep duration for either gender. Unlike the observation from European and American studies, food and nutrient intake of Korean subjects, in general, were not greatly affected by duration of sleep. This result may suggest that dietary habits of Koreans, as affected by sleep, are quite different from those of Europeans & Americans.

Key words: food, nutrient, sleep duration, Korean Health and Nutrition Survey

INTRODUCTION

Sleep is commonly viewed as one of the important health related behaviors along with smoking, drinking, exercise, stress and diet (1-9). Sleep is viewed as a restorative process that influences the homeostatic regulation of autonomic, neuroendocrine (10-12) and immune systems (13-19). Therefore, sleep deprivation and disorders can influence health-related quality of life and morbidity as much as other chronic medical conditions (20-22). Many epidemiologic studies from Europe and America have demonstrated a relationship between habitual sleep deprivation and eating disorders. The short sleepers scored twice as high and were five times more likely to exhibit abnormal eating patterns than the longer sleeping group (23). Another study showed that short sleeping college students tended to eat more small meals or snacks than long sleepers (24). This disrupted pattern of larger meals was predicted by the research of Johansson and Elomaa (25) with rats partially deprived of REM (rapid eye movement) sleep. However, during early 1990's, Lucero and Hicks (26) found no reliable evidence that sleep habits were linked to any major dietary variables. Nevertheless, speculation and indirect evidence have suggested a relationship between habitual sleep deprivation and food intake. Therefore, we tested this hypothesis by

analyzing data of 7,370 Korean adults, aged 20 years and older, from the 1998 Korean National Health and Nutrition Survey.

MATERIALS AND METHODS

Study subjects

The study subjects participated in the Korean National Health and Nutrition Survey (27) which was conducted in November and December, 1998. The survey sample was comprised of 11,525 persons (3,799 households) representing the Korean population of 1 year and older.

For this study we analyzed data from a sub-set of 7,370 adults aged 20 years and older.

Data collection and processing

The 1998 Korean National Health and Nutrition Survey (KNHANS) consisted of four parts: 1) a health interview survey on disease prevalence and health care service utilization, 2) a health examination survey on 6 major degenerative diseases, 3) a health behavior survey on smoking, drinking, exercise and sleeping, and 4) a nutrition survey. Specially trained interviewers conducted health behavior surveys on drinking, smoking, exercise and sleeping with a structured questionnaire.

For the nutrition survey, the 24 hour recall method was used by trained dietitians. Subjects were interviewed

at their homes. Food portions were converted into weight units according to standard estimators. Foods were subsequently grouped into 18 categories. Nutrient consumption was estimated using the food composition table published by the National Rural Living Science Institute (28).

Statistical analysis

To facilitate comparisons, subjects were categorized into three different sleep duration groups; less than 6 hours, 7~8 hours and more than 8 hours. This classification was adopted from a previously published report (27). The data were approximately normally distributed for most measures. Age variables had been adjusted with standardization of subject number in each age group. Following Duncan's multiple range test for the difference among the three groups by sleep duration, the chi-square test was used to test the association between the dietary habit and smoking status. In all statistical testing performed, the null hypothesis was rejected at $p < 0.05$.

RESULTS AND DISCUSSION

Age and sex distribution of study subjects

Table 1 shows the distribution of study subjects by

age and gender. Out of 7,370 subjects, 46.5% were male and 53.5% were female. This gender distribution agrees, within a 3% error, with the gender distribution of the Korean population in this age group (29). The strength of the 1998 Korean National Health and Nutrition Survey is that this survey is representative of the Korean population with respect to gender, age and socio-demographic characteristics. Therefore, data used in this study reflect the actual characteristics of Korean dietary habits and smoking status.

Average sleep duration of the subjects was 6.9 hours for both genders. Average sleep duration decreased with age: 20~29 years (7.2 hours), 30~39 (7.0 hours), 40~49 (6.9 hours), 50~59 years (6.7 hours), 60~69 (6.5 hours), above 70 (6.8 hours). Initially sleep duration was classified into three categories of less than 6 hours, 6~8 hours and more than 8 hours per a day. Table 2 shows that 46.9% of male and 56.2% of the female subjects slept less than 6 hours (placing them in the lack of sleep category). The prevalence of lack of sleep was higher than the 33% reported for Americans (30). However, the American study used a slightly different classification of lack of sleep category (less than 7~8 hours) compared to the classification used in this study. Table 3 shows

Table 1. Distribution of study subject by age, sex, education and occupation

Unit: number (%)

Variable	Male	Female	Total
Age (years)			
20~29	653 (8.86)	766 (10.39)	1419 (19.25)
30~39	922 (12.51)	944 (12.81)	1866 (25.32)
40~49	720 (9.77)	741 (10.05)	1461 (19.82)
50~59	511 (6.93)	593 (8.05)	1104 (14.98)
60~64	242 (3.28)	304 (4.12)	546 (7.41)
65	378 (5.13)	596 (8.09)	974 (13.22)
Total	3426 (46.49)	3944 (53.51)	7370 (100.00)
Income (10,000 won)			
50	710 (9.63)	964 (13.08)	1674 (22.71)
51~150	1698 (23.04)	1857 (25.20)	3555 (48.24)
151~300	884 (11.99)	971 (13.18)	1855 (25.17)
>300	134 (1.82)	152 (2.06)	286 (3.88)
Total	3426 (46.49)	3944 (53.51)	7370 (100.00)
Education			
No schooling	158 (2.14)	689 (9.35)	847 (11.49)
Elementary school	543 (7.37)	829 (11.25)	1372 (18.62)
Middle school	470 (6.38)	543 (7.37)	1013 (13.74)
High school	1325 (17.98)	1221 (16.57)	2546 (34.55)
Above college	930 (12.62)	662 (8.98)	1592 (21.60)
Total	3426 (46.49)	3944 (53.51)	7370 (100.00)
Occupation			
Professional	306 (4.15)	176 (2.39)	482 (6.54)
Sedentary worker	377 (5.12)	224 (3.04)	601 (8.15)
Skilled worker	1088 (14.76)	1113 (15.10)	2201 (29.86)
Semi skilled worker	906 (12.29)	375 (5.09)	1281 (17.38)
Others	749 (10.16)	2056 (27.90)	2805 (38.06)
Total	3426 (46.49)	3944 (53.51)	7370 (100.00)

Table 2. Distribution of male and female subjects by sleep duration

Sleep duration	Sex		Total
	Male	Female	
< 6 hours	1608 (46.94)	2218 (56.24)	3843 (52.14)
6~8 hours	1238 (36.16)	854 (21.65)	2106 (28.58)
> 8 hours	580 (16.90)	872 (22.11)	3203 (19.28)
Total	3426 (100.0)	3944 (100.0)	7370 (100.0)

the mean nutrient intake for the study subjects compared with the recommended dietary allowances (RDA) for Koreans of each age group. Subjects of both genders consumed less than the RDA for energy, calcium and vitamin A. These results are consistent with most studies of Korean adults since 1996 (31-34). Those studies also reported that average intakes of calories and calcium were below the RDA while protein, niacin and vitamin C were consumed over the RDA. For female subjects, energy derived from carbohydrates, protein and fat was 70%, 15% and 15%, respectively. Male subjects also showed similar results. This ratio may imply that the Korean diet still heavily depends on carbohydrates as a source of energy compared to the American with 46%

of energy from carbohydrates (31). Table 4 shows the average consumption of selected food groups by sleeping duration for the male subjects. There was tendency for the intake of most foods (except sugar, nuts, fish and milk) to increase with longer sleep duration, although the tendency was not statistically significant. Table 5 shows the average consumption of selected food groups by sleep duration for the female subjects. Intake of most foods increased with longer sleep duration, but again the tendency was not statistically significant, except for beverage intake. Table 6 shows mean nutrient intake by sleep duration for male subjects. It has been observed that short sleeping subjects (< 6 hours) tend to consume less of most nutrients, except fat, than subjects in the longer sleeping groups (6~8 hours and more 8 hours). In other words, subjects in the long sleeping group tend to consume more nutrients other than fat. Similar results were also observed for the female subjects, as shown in the Table 7. However, the observations for both genders were not statistically significant. Bliwise et al. (35) observed that American subjects who were short-sleepers had serious abnormal eating patterns such as frequent

Table 3. Mean nutrient intakes and intake level as percentage of the RDA of study subjects with age adjustment

Nutrient	(RDA=%)			Significance
	Male (n=3426)	Female (n=3944)	Total (n=7370)	
Energy (kcal)	2262.38 ± 16.69 (94.29 ± 0.67)	1782.58 ± 12.17 (92.34 ± 0.61)	2005.62 ± 10.50 (93.25 ± 0.45)	***
Protein (g)	87.45 ± 1.07 (125.82 ± 1.53)	66.88 ± 0.81 (121.61 ± 1.47)	76.44 ± 0.67 (123.57 ± 1.06)	**
Fat (g)	43.41 ± 0.69	32.16 ± 0.44	37.39 ± 0.40	**
Carbohydrates (g)	362.99 ± 2.49	309.01 ± 2.10	334.11 ± 1.64	**
Ratio of C : P : F ¹⁾	66.00 : 15.36 : 16.17	70.56 : 14.89 : 15.20	68.44 : 15.11 : 15.65	
Fiber (g)	7.94 ± 0.09	6.81 ± 0.07	7.34 ± 0.05	*
Calcium (mg)	548.11 ± 7.13 (78.30 ± 1.01)	465.12 ± 5.84 (66.44 ± 0.83)	503.70 ± 4.58 (71.95 ± 0.65)	**
Phosphorus (mg)	1232.27 ± 11.07 (176.03 ± 1.58)	969.90 ± 7.72 (138.55 ± 1.10)	1091.87 ± 6.77 (155.98 ± 0.96)	*
Iron (mg)	14.65 ± 0.15 (122.11 ± 1.31)	11.91 ± 0.13 (82.93 ± 0.96)	13.18 ± 0.10 (101.14 ± 0.83)	*
Sodium (mg)	4668.77 ± 84.53	4378.99 ± 46.78	4978.55 ± 47.18	*
Potassium (mg)	2922.31 ± 27.08	2452.05 ± 23.45	2670.66 ± 17.98	*
Vitamin A (RE)	719.73 ± 13.74 (102.81 ± 1.96)	580.20 ± 11.32 (82.88 ± 1.61)	645.06 ± 8.84 (92.15 ± 1.26)	**
Vitamin B ₁ (mg)	1.49 ± 0.01 (119.67 ± 1.26)	1.18 ± 0.01 (118.02 ± 1.13)	1.32 ± 0.01 (118.78 ± 0.84)	**
Vitamin B ₂ (mg)	1.17 ± 0.01 (80.50 ± 1.07)	0.92 ± 0.01 (77.37 ± 0.87)	1.04 ± 0.01 (78.82 ± 0.68)	*
Niacin (mg)	19.08 ± 0.26 (117.79 ± 1.60)	14.39 ± 0.15 (110.75 ± 1.18)	16.57 ± 0.15 (114.02 ± 0.97)	*
Vitamin C (mg)	127.36 ± 1.82 (181.95 ± 2.60)	129.21 ± 1.91 (184.59 ± 2.73)	128.35 ± 1.33 (183.36 ± 1.90)	*

¹⁾C : P : F stands for carbohydrate : protein : fat.

*, **, *** Significantly different among the three groups at *p < 0.05, **p < 0.01 and ***p < 0.001 level by ANOVA and Duncan's multiple range test.

Table 4. Mean per capita food intake by sleep duration (male)

Food	Sleep duration		
	< 6 hour (n=1608)	6~8 hour (n=1238)	> 8 hour (n=580)
Cereals & grain products	350.08 ± 3.52	378.74 ± 4.83	392.04 ± 7.51
Potato & starches	85.42 ± 4.68	93.03 ± 7.65d	96.05 ± 10.82
Sugars & sweets	10.45 ± 0.36	11.90 ± 0.63	11.18 ± 0.66
Pulse & pulse products	50.44 ± 1.76	60.22 ± 2.89	65.33 ± 3.33
Nuts & seeds	7.09 ± 0.81	8.02 ± 1.35	4.98 ± 0.60
Vegetables	263.00 ± 4.01	374.61 ± 6.43	377.17 ± 7.06
Fungi & mushrooms	19.55 ± 1.20	22.01 ± 2.89	26.15 ± 2.62
Fruits	328.97 ± 8.60	324.34 ± 11.69	354.62 ± 14.98
Seaweeds	12.87 ± 0.66	17.97 ± 1.71	18.25 ± 1.51
Beverages	221.45 ± 11.41	259.28 ± 19.35	255.94 ± 20.75
Seasoning	21.13 ± 0.52	33.36 ± 0.91	35.97 ± 1.24
Oil & fat (vegetable & grain)	8.68 ± 0.35	6.80 ± 1.56	8.50 ± 0.66
Total (vegetable origins)	1172.69 ± 15.09	1191.33 ± 61.29	1222.96 ± 27.77
Meats & meat products	99.62 ± 2.55	120.93 ± 5.08	125.18 ± 5.46
Eggs	49.56 ± 1.36	52.43 ± 2.25	52.00 ± 2.50
Fishes & shellfishes	12.87 ± 0.66	102.86 ± 8.28	96.40 ± 4.61
Milk & milk products	275.24 ± 5.65	213.27 ± 9.06	209.69 ± 20.75
Oil & fat (animal origins)	0.07 ± 0.03	0.05 ± 0.10	0.06 ± 0.05
Total (animal origins)	206.82 ± 5.70	236.16 ± 23.14	223.63 ± 10.48

No significant differences were observed among the three groups at the $p < 0.05$ level by ANOVA and Duncan's multiple range test.

Table 5. Mean per capita food intake by sleep duration (female)

Food	Sleep duration		
	< 6 hour (n=2218)	6~8 hour (n=854)	> 8 hour (n=872)
Cereals & grain products	289.52 ± 2.88	317.87 ± 4.61	317.69 ± 4.85
Potato & starches	98.00 ± 4.80	112.82 ± 8.95	117.31 ± 9.96
Sugars & sweets	8.54 ± 0.34	10.60 ± 0.67	9.52 ± 0.49
Pulse & pulse products	41.48 ± 1.46	47.39 ± 2.37	48.36 ± 2.46
Nuts & seeds	5.89 ± 0.59	6.48 ± 0.99	7.85 ± 1.28
Vegetables	225.90 ± 6.62	308.36 ± 6.88	295.77 ± 5.88
Fungi & mushrooms	20.15 ± 1.25	25.50 ± 3.34	18.94 ± 1.78
Fruits	330.54 ± 7.33	367.41 ± 12.38	366.31 ± 13.30
Seaweeds	13.02 ± 0.86	14.58 ± 1.07	15.46 ± 1.17
Beverages*	117.59 ± 6.72 ^b	116.14 ± 8.66 ^{ac}	120.09 ± 9.20
Seasoning	20.05 ± 0.40	26.11 ± 0.89	24.41 ± 0.71
Total (vegetable origins)	967.14 ± 34.59	1118.63 ± 27.77	1109.08 ± 27.65
Meats & meat products	74.93 ± 2.28	93.24 ± 3.90	87.31 ± 3.73
Eggs	40.88 ± 1.18	41.27 ± 2.04	42.17 ± 1.99
Fishes & shellfishes	61.03 ± 2.06	74.95 ± 3.52	74.91 ± 4.17
Milk & milk products	58.37 ± 5.28	47.11 ± 7.59	49.88 ± 8.73
Total (animal origins)	150.02 ± 11.74	143.80 ± 17.87	146.04 ± 17.96

*Significantly different among the three groups at $p < 0.05$ level by ANOVA and Duncan's multiple range test.

consumption of snacks and fried foods as compared with the longer-sleeping group. They showed a higher consumption of fat for short-sleepers than for long sleepers. Golan et al. (36) found that Israeli subjects with sleep disturbance were more likely to also have symptoms of anorexia nervosa, bulimia nervosa and non-specific eating disorders. They also found that these disorders are associated with high morbidity and life threatening complications. In addition, the article reviewed data suggesting that night eating syndrome should be considered

a combination of eating and sleeping disorders. Eiber and Freidman (37) observed from their French subjects that night eating syndrome was associated with insomnia, binge eating and morning anorexia. The prevalence of night eating syndrome was 1.5% in the French general population. The sleep related eating syndrome was also characterized by compulsive binge eating while awake. The night eating syndrome patient consumed high caloric food and fluids but never alcohol and purging did not occur. These finding may imply that, unlike the Euro-

Table 6. Mean per capita nutrient intake by sleep duration (male)

Nutrient	Sleep duration		
	< 6 hour (n=1608)	6~8 hour (n=1238)	> 8 hour (n=580)
Energy (kcal)	2097.52 ± 18.13	2282.43 ± 30.25	2314.54 ± 30.28
Protein (g)	75.97 ± 0.86	89.97 ± 2.31	89.31 ± 1.78
Fat (g)	46.48 ± 0.69	45.19 ± 1.49	44.23 ± 1.08
Carbohydrates (g)	336.67 ± 2.92	362.97 ± 3.95	370.44 ± 4.71
Energy from carbohydrates (%)	65.20 ± 0.22	65.73 ± 0.37	65.91 ± 0.41
Energy from protein (%)	14.62 ± 0.14	15.47 ± 0.23	15.35 ± 0.22
Energy from fat (%)	19.27 ± 0.18	16.49 ± 0.26	16.31 ± 0.27
Fiber (g)	6.41 ± 0.10	7.94 ± 0.16	8.19 ± 0.18
Calcium (mg)	522.28 ± 6.79	550.99 ± 10.60	576.44 ± 16.41
Phosphorus (mg)	1121.65 ± 10.44	1267.80 ± 22.58	1255.95 ± 19.32
Iron (mg)	12.19 ± 0.15	15.28 ± 0.31	14.82 ± 0.28
Sodium (mg)	4507.69 ± 62.96	5528.93 ± 99.02	6067.84 ± 229.45
Potassium (mg)	2479.36 ± 26.42	3014.28 ± 50.91	2954.54 ± 47.92
Vitamin A (RE)	608.24 ± 13.38	733.81 ± 23.60	737.53 ± 25.30
Vitamin B ₁ (mg)	1.44 ± 0.02	1.53 ± 0.03	1.53 ± 0.03
Vitamin B ₂ (mg)	1.15 ± 0.01	1.23 ± 0.04	1.20 ± 0.02
Niacin (mg)	15.66 ± 0.19	20.29 ± 0.65	19.06 ± 0.38
Vitamin C (mg)	111.93 ± 1.98	128.77 ± 2.99	129.26 ± 3.41

No significant differences were observed among the three groups at the $p < 0.05$ level by ANOVA and Duncan's multiple range test.

Table 7. Mean per capita nutrient intake by sleep duration (female)

Food	Sleep duration		
	< 6 hour (n=2218)	6~8 hour (n=854)	> 8 hour (n=872)
Energy (kcal)	1685.95 ± 13.68	1842.06 ± 21.81	1819.45 ± 23.31
Protein (g)	60.81 ± 0.82	68.83 ± 1.24	69.59 ± 1.65
Fat (g)	34.78 ± 0.51	34.40 ± 0.81	34.35 ± 0.83
Carbohydrates (g)	284.76 ± 2.32	315.21 ± 3.70	312.44 ± 4.09
Energy from carbohydrates (%)	68.49 ± 0.20	69.66 ± 0.34	69.88 ± 0.33
Energy from protein (%)	14.42 ± 0.17	14.84 ± 0.19	15.14 ± 0.32
Energy from fat (%)	17.74 ± 0.17	15.87 ± 0.26	15.99 ± 0.26
Fiber (g)	5.59 ± 0.08	7.06 ± 0.14	6.84 ± 0.13
Calcium (mg)	449.63 ± 6.66	482.64 ± 10.27	471.90 ± 9.73
Phosphorus (mg)	908.03 ± 8.47	1010.78 ± 14.17	987.36 ± 14.44
Iron (mg)	10.40 ± 0.14	12.46 ± 0.24	11.98 ± 0.25
Sodium (mg)	3660.75 ± 49.14	4525.69 ± 83.68	4455.85 ± 85.77
Potassium (mg)	2140.18 ± 24.50	2541.69 ± 40.70	2470.11 ± 42.34
Vitamin A (RE)	501.94 ± 10.34	618.73 ± 21.49	602.92 ± 21.83
Vitamin B ₁ (mg)	1.140 ± 0.01	1.25 ± 0.02	1.20 ± 0.02
Vitamin B ₂ (mg)	0.918 ± 0.01	0.99 ± 0.02	0.96 ± 0.02
Niacin (mg)	12.49 ± 0.16	15.16 ± 0.29	14.44 ± 0.26
Vitamin C (mg)	112.46 ± 2.01	136.32 ± 3.69	129.12 ± 3.34

No significant differences were observed among the three groups at the $p < 0.05$ level by ANOVA and Duncan's multiple range test.

pean and American studies, dietary patterns of Koreans are not significantly affected by sleep duration.

CONCLUSION

This study was conducted to investigate the effects of sleep duration on food and nutrient intake from a representative sample of the Korean population. Subjects aged 20 years and older from the 1998 Korean National Health and Nutrition Survey were used for the analysis. There was a tendency observed for food and nutrient

intakes to increase with longer sleep duration for both genders. However, the tendency was not statistically significant. Therefore, it seems that unlike the European and American studies, dietary patterns of Koreans were not significantly affected by sleep duration.

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