

Potassium Intakes of Some Industrial Workers

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ABSTRACT

This study was undertaken to evaluate the potassium consumption and excretion in forty healthy male workers of a tire company in Seoul. Mean potassium intake for three days in the subjects was 54.5 ± 16.7 mEq/day (2.13 ± 0.64 g) and urinary excretion of potassium in 24 hours was 45.9 ± 10.5 mEq (1.77 ± 0.41 g). Thus 83% of dietary potassium was excreted in the form of urine. Dietary ratio of Na to K was 4.15 ± 0.58 while urinary ratio of Na to K was 5.20 ± 1.11 . The main food source of potassium was cooked rice with soybean in the rice group, potato with soybean paste soup in the part of soup group, and seasoned Spanish mackerel with raddish in the side dish group. There was a strong correlation between dietary protein and dietary potassium ($r=0.694$, $p<0.001$). Urinary sodium and potassium were also strongly associated with each other ($r=0.647$, $p<0.001$).

KEY WORDS : potassium intake · potassium excretion · industrial workers.

Introduction

Potassium is the principal cation in the interior of living cells, while sodium is concentrated in the extracellular fluid. Additionally this potassium ion, as an important constituent in tissues and blood cells, influences transmission of nerve impulses to muscle fibers and to the contractility of the muscle itself, notably cardiac muscle.

Some clinical studies reported that administration of sodium salts to hypertensive patients regularly increased in blood pressure whereas administration of potassium salts just as regularly lowered blood pressure¹⁾²⁾. Furthermore effects of the dietary sodium to potassium ratio in the treatment

of hypertension have been observed in other studies³⁾. Thus, beneficial effect of dietary potassium on hypertension as well as the reciprocal function of sodium to potassium may also play an important role in the development and maintenance of hypertension.

Information on potassium intake of Korean workers in an industry is limited. Previously we reported sodium intakes of industrial workers in Seoul area⁴⁾.

The objectives of this study were to collect analytical data for potassium consumption and excretion in normal healthy Korean industrial workers. Further we were to determine dietary and urinary sodium to potassium ratios of workers. The data from this study will provide the core informations on potassium intake and excretion of healthy Ko-

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rean males.

Subjects and Methods

The same subjects reported previously in the paper⁴⁾ were used. All these male workers lived in a dormitory and ate all three meals for three consecutive days in the cafeteria of the dormitory. A trained nurse took weight, height and blood pressure from each subject. Urine samples were collected for 24 hours. By determination of urinary creatinine level, six subjects were excluded from this study. Since urinary creatinine level were below 800mg, the 24-h urine collection was considered incomplete in six subjects.

1. Diet

Food consumption was calculated by weighing the food items before and after eating. Every subject prepared a duplicate composite of all food they consumed during study periods. 100g of composites were transported to the lab, homogenized and aliquots were kept frozen at -25°C for further analysis. By 24-h dietary recall, information on snacks eaten between meals were obtained. Same types of food items between meals were purchased, prepared and kept frozen for analysis.

2. Analysis

Subjects were given polyethylene bottle containing 10g of boric acid. 24-h urinary collection was made starting on the second day of food consumption. Total urinary nitrogen was determined

by Kjeldahl method⁵⁾. Various food items and urine were analyzed for potassium content by use of an atomic absorption spectrophotometer(Hitach 170-30)⁶⁾.

3. Statistics

Data were expressed as mean ± SD. Correlation coefficients were used to establish relationships among all variables. The variables studied were carbohydrate intake, protein intake, potassium intake and blood pressure.

Results and Discussion

Subjects were between the age of 20–35 yrs. Average height and weight of subjects were similar to those of men in Korean national nutrition survey conducted in 1987⁷⁾. Average systolic blood pressure was 120.3 ± 12.6mmHg and diastolic blood pressure averaged 75.8 ± 7.5mmHg.

As shown in Table 1, mean potassium intake for all subjects was 54.5 ± 16.7mEq/day(2.13 ± 0.64 g). In USA the minimum requirement was estimated to be about 40 to 50mEq/day(1600 to 2000 mg)⁸⁾. Because of the known beneficial role of dietary potassium in hypertension, they recommended 3500mg(90mEq) of potassium intake per day for adults⁸⁾. In Japan, they determined ideal dietary ratio of Na to K for adults was 2–4g : 1g. In Korea we did not yet decide recommended level of potassium intake.

In the present study, the concentration of potas-

Table 1. Dietary intakes and urinary excretion of potassium of the subjects

	Intake		Excretion		
	mEq/day	g/day	concentration (mEq/L)	(mEq/day)	(g/day)
1st day	58.5 ± 16.2	2.28 ± 0.63	—	—	—
2nd day	49.2 ± 16.2	1.92 ± 0.63	32.9 ± 10.1	45.9 ± 10.5	1.77 ± 0.41
3d day	56.0 ± 15.7	2.18 ± 0.61	—	—	—
Average	54.5 ± 16.7	2.13 ± 0.64	32.9 ± 10.1	45.9 ± 10.5	1.77 ± 0.41

* Mean ± SD(n=40)

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sium in the urine was $32.9 \pm 10.1 \text{mEq/L}$ (Table 1). This concentration level was lower than that of Park's ($41.6 \pm 21.1 \text{mEq/L}$)⁹⁾ but higher than that of Suh's ($23.7 \pm 10.85 \text{mEq/L}$)¹⁰⁾.

The daily urinary potassium excretion was estimated to be $45.9 \pm 10.5 \text{mEq}$ ($1.77 \pm 0.41 \text{g}$). This result was similar to the findings in the male college students obtained by Park⁹⁾. Also Kim estimated the daily urinary potassium excretion of her adolescent subjects to be 43.6mEq ¹¹⁾. Her finding was similar to ours too. However, Chun¹²⁾ in 1964 estimated level of urinary potassium excretion to be $37.8 \pm 10.8 \text{mEq}$. In the present study, daily intake of potassium was $2.13 \pm 0.64 \text{g}$ ($54.5 \pm 16.7 \text{mEq}$) and urinary potassium excretion was estimated to be $1.77 \pm 0.41 \text{g}$ ($45.9 \pm 10.5 \text{mEq}$). Therefore 83% of dietary potassium was excreted in the form of urine in our subjects.

When main food sources were concerned, amount of average intake of potassium from one serving size was calculated (Fig. 1). In the part of rice, cooked rice with soybean contained the highest potassium. In soup group, potato with soybean paste soup was found to contain the highest amount of potassium. Conversely, sea mustard with clam soup, contained the lowest potassium. In the part of side dish, seasoned Spanish mackerel with raddish was the source of the highest amount of potassium.

Table 2 showed potassium content in main food items. Unsurprisingly cooked rice with soybean contained the highest potassium in the rice group. Additionally potassium content of cabbage Kimchi was $260.3 \text{mg}/100 \text{g}$ and that of Kagduki raddish Kimchi was $186.7 \text{mg}/100 \text{g}$.

Dahl¹³⁾ reported the reciprocal relationship be-

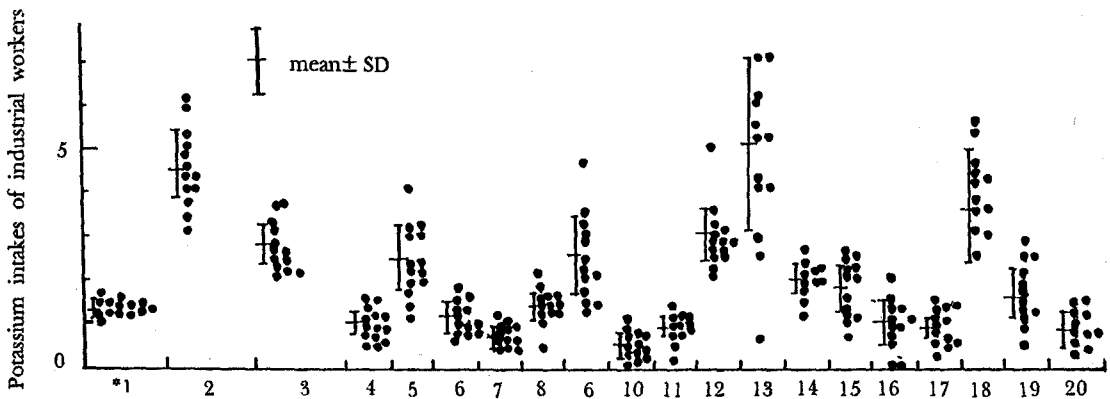


Fig. 1. Amount of average intake of potassium from one serving size in main food.

* Food items

- | | |
|------------------------------------|--------------------------------------|
| 1. Cooked rice with barley | 11. Beef soup |
| 2. Cooked rice with soybean | 12. Seasoned pork with vegetable |
| 3. Cooked rice with small red bean | 13. Seasoned Spanish mackerel |
| 4. Soybean sprout soup | 14. Seasoned spinach boiled |
| 5. Cabbage with soybean paste soup | 15. Seasoned Alaska pollack |
| 6. Sea mustard with chicken soup | 16. Seasoned soybean sprout |
| 7. Sea mustard with beef soup | 17. Fried hair tail |
| 8. Chicken soup | 18. Seasoned buckwheat and vegetable |
| 9. Potato with soybean paste soup | 19. Kimchi, cabbage |
| 10. Sea mustard with clam soup | 20. Kagduki kimchi, raddish |

Table 2. Potassium contents in main food items

Food name	K (mg/100g)	Food name	K (mg/100g)
Cooked rice with barley	30.6	Beef soup	24.3
Cooked rice with soybean	97.7	Seasoned pork with vegetable	190.4
Cooked rice with small red bean	57.4	Seasoned Spanish mackerel with raddish	471.9
Soybean sprout soup	45.7	Seasoned spinach boiled	228.5
Cabbage with soybean paste soup	91.2	Seasoned Alaska pollack	678.0
Sea mustard with chicken soup	31.7	Seasoned soybean sprout	169.4
Sea mustard with beef soup	21.8	Fried hair tail	158.3
Chicken soup	28.8	Seasoned buckwheat and vegetable	243.8
Potato with soybean paste soup	108.1	Kimchi, cabbage	260.3
Sea mustard with clam soup	18.8	Kagduki kimchi	186.7

tween sodium and potassium in the development and maintenance of hypertension. He suggested that high sodium : potassium ratio in the diet tended to influence the development of hypertension while reduction of sodium : potassium ratio to 1 was effective in prevention and improvement of hypertension. In the present study, our subjects consumed 225.3±75.2mEq of sodium and 54.5±16.7mEq of potassium. Thus their dietary ratio of Na to K was 4.15±0.58 (Table 3), which was higher than that of Dahl's⁽¹³⁾. On the other hand, Kanesawa et al⁽¹⁴⁾ reported the dietary ratio of

Na to K in 20 Japanese adults was 5.5±0.77 which was higher than ours.

Since urinary excretion of Na was 232.8±63.8 mEq and that of K was 45.9±10.5mEq respectively, it was shown that urinary sodium : potassium ratio was 5.20±1.11 (Table 3). Suh⁽¹⁰⁾ reported that this urinary sodium : potassium ratio was 7.2±4.54 while values of Park's⁽⁹⁾ (4.67±2.42) and Kim's⁽¹¹⁾ (4.7±2.1) showed similar findings. Hence our values were in the range of the findings of these researchers.

It was estimated, in the present study, subjects consumed 20.35g of nitrogen, whereas they excreted 12.90±2.72g of nitrogen in the urine. Correlations between dietary and urinary analysis on sodium, potassium and nitrogen were shown in Table 4. Significant correlations were existed among

Table 3. Na/K ratio in the diet and urine excreted per day

Diet		Urine	
g ratio	mEq ratio	g ratio	mEq ratio
2.45±0.34	4.15±0.58	3.10±0.64	5.20±1.11

Table 4. Correlation between dietary and urinary analysis on sodium, potassium and nitrogen.

	Dietary Analysis			Urinary Analysis		
	Na(r)	K(r)	Protein(r)	Na(r)	K(r)	Urinary N(r)
Dietary Analysis						
Na		0.651***	0.611***	0.435**	0.312	0.367**
K			0.694***	0.411**	0.528***	0.459**
Protein				0.446**	0.448**	0.389*
Urinary Analysis						
Na					0.647***	0.472***
K						0.351*

* p<0.05, ** p<0.01, *** p<0.001

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Table 5. Correlation coefficient between blood pressure and related variables

	S.B.P.	D.B.P.	Sodium excretion	Creatinine excretion	Potassium excretion	Weight	Height
S.B.P.		0.602***	0.061	0.145	0.136	0.467**	0.184
D.B.P.			0.168	0.241	0.050	0.293	0.020

S.B.P. : Systolic blood pressure
D.B.P. : Diastolic blood pressure

all the variables, except for association between Na intake and K excretion. There was a strong correlation between dietary protein and dietary potassium ($r=0.694$, $p<0.001$). In addition urinary sodium and urinary potassium were strongly associated with each other ($r=0.647$, $p<0.001$).

As shown in Table 5 systolic blood pressure was significantly correlated with weight of subjects ($r=0.467$, $p<0.01$). However, there were no associations among other variables. Park et al⁹⁾ also reported the college students in their study showed no relationships among urinary sodium, potassium and blood pressure. More research using Korean subjects should be done to elucidate this association clearly.

Acknowledgement

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Literature Cited

- 1) Meneely RL, Battarbee HD. The high sodium-low potassium environment and hypertension. *Am J Cardiol* 38 : 768-785, 1976
- 2) Holly JM, Goodwin FJ, Evans SJ, Vandenberg MJ, Ledingham JM. Reanalysis of data in two Lancet papers on the effect of dietary sodium and potassium on blood pressure. *Lancet* 2 : 1384-1386, 1981
- 3) Meneely GR, Battarbee HD. Sodium and potassium. *Nutr Rev* 34 : 225-235, 1976
- 4) Yoon YO, Kim ES, Ro HK. Sodium intakes of

- industrial workers. *Korean J Nutr* 23 : 37-43, 1990
- 5) Kenneth H. Official methods of analysis of the association of official analytical chemists. 15th ed. AOAC, 1990
- 6) Pharmaceutical society of Japan, Standard methods of analysis for hygienic chemists-with commentary, p.270, Kumwon publishing co, Tokyo, 1990
- 7) Ministry of health and social affairs, Republic of Korea, Nation-wide nutritional survey. Seoul, 1987
- 8) National research council. Recommended dietary allowances, 10th ed National Academy press Washington, DC. 1989
- 9) Park TS, Lee KY. A study on the sodium and potassium intakes and their metabolism of university students in Korea. *Korean J Nutr* 18 : 201-208, 1985
- 10) Suh SK. Sodium(salt) intake-urinary excretion and its reference to hypertension in Korea. *Human Science* 4 : 833-862, 1980
- 11) Kim SK, Mun BS. A study on the sodium chloride urinary excretion of adolescents in Korea. *Korean J Nutr* 19 : 355-362, 1986
- 12) Jun KY. Sodium, potassium and chloride concentrations in serum and urine and volume of 24 hours urine in normal Korean adults. *Sudo Medical School J* 1 : 149-164, 1964
- 13) Dahl LK, Leitl G, Heine M. Influence of dietary potassium and sodium/potassium molar ratios on the development of salt hypertension. *J Exp Med* 136 : 318-330, 1972
- 14) Kanazawa H, Muto S. Sodium and potassium intakes through habitual diet and its urinary excretion. *J Jap Soc Nutr and Food Sci* 37 : 165-170, 1984

일부 산업체 근로자의 Potassium 섭취에 관한 연구

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산업체 근로자의 potassium 섭취상태와 배설상태를 평가하기 위하여 서울시내 H 타이어 공장에 근무하는 건강한 성인남자 40명을 대상으로 3일간 식사 분석과 뇨 분석을 행하였다.

대상자들의 3일동안 평균 potassium 섭취량은 $54.5 \pm 16.7 \text{mEq/day}$ ($2.13 \pm 0.64 \text{g}$) 이었고, 24 시간동안 뇨 중의 potassium 배설량은 $45.9 \pm 10.5 \text{mEq/day}$ ($1.77 \pm 0.41 \text{g}$) 로 소변중 배설은 83% 정도였다. Na와 K의 섭취비율은 4.15 ± 0.58 인 반면에, 뇨 중 배설비율은 5.20 ± 1.11 이었다. 1일 섭취하는 potassium의 주요 급원은 밥 중에서 콩 밥, 국 종류에서는 감자된장국, 반찬 류에서는 삼치무조림과 묵야채무침이었다.

단백질 섭취량과 K 섭취량, N 배설량과 K 배설량, N 배설량과 Na 배설량, K 섭취량과 Na 섭취량, 그리고 K 배설량과 Na 배설량간에 모두 유의적인 상관을 나타내었다.