Workers intake too much salt from dishes of eating out and food service cafeterias; direct chemical analysis of sodium content*

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Abstract

The average sodium intake of Koreans was reported to be 5,279.9 mg/day, which is one of the highest intake levels worldwide. The average Koreans intake 19.6% of sodium from kimchi, showing kimchi as the main contributor of sodium in this country (Ministry of Health and Welfare, 2005). The sodium content of dishes that are frequently chosen by workers, and which were served by foodservice cafeterias were chemically analyzed. The average sodium content of one meal provided by 10 foodservice cafeterias was 2,777.7 mg. Twenty-one, one-dish-meals, frequently chosen by workers for a lunch menu, were collected at 4 different restaurants for each menu by one male, aged in the twenties and analyzed chemically also. Workers who eat lunch at a workplace cafeteria everyday could intake about 8 g of salt at a one-time meal and those who eat out for a one-dish-meal would intake 3-8 g of salt without counting sodium content from the side dishes. From these study results, one could estimate that over 10 g of salt could be possible for a single meal for workers who eat out everyday. A nationwide nutrition campaign and education for low salt diets for restaurant owners and foodservice providers should be seriously considered.

Key Words: Chemical analysis, sodium content, eating out menu

Introduction

Most of the sodium consumed by Koreans comes from salt. Sodium is the mineral that causes high blood pressure and is also related to various chronic diseases (Dumier, 2009; Lee et al., 2002; Moon et al., 2009; Ritz et al., 2009; Son, 2007). The INTERSALT study for the subjects of 10,079 among 32 countries found a strong relationship between the amount of salt intake and prevalence of high blood pressure (Stamler, 1991).

Korea shows the highest salt consumption in the world. While the sodium consumed by people from Western countries mainly comes from processed foods, most Koreans consume nearly half of the total sodium through their traditional diet (Lee, 2009; Moon et al., 2009; The Korean Nutrition Society, 2005), including kimchi. According to the National Health and Nutrition Survey results in 2005, the average daily sodium intake of Koreans was reported to be 5,279.9 mg and that of Seoul citizens was 4,891.2 mg (Ministry of Health and Welfare, 2005). This amount is even higher than Japan’s 4,212.6 mg, the U.S.’s 3,375 mg, and even more than double the amount recommended by WHO/FAO, 2,000 mg. This means that Koreans are consuming excessive amounts of sodium everyday. The World Health Organization recommends daily salt intake of 5.0 g (sodium 2,000 mg). The Korean Nutrition Society set the daily intake goal of salt 5.0 g in 2005 (The Korean Nutrition Society, 2005). Furthermore, the Ministry for Health, Welfare and Family Affairs, which sets dietary goals and guidelines for Koreans, argues for the salt intake level of less than 10 g per day. Looking overseas, the USA, USDA, which is responsible for setting dietary guidelines for Americans, set less than 5.75 g of salt for the general public and 3.75 g for hypertensive patients. Additionally, the British Department of Health in 2004 recomm-

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ended 6 g. Meanwhile, Health Japan 21 of the Ministry of Health, Labor and Welfare recommends less than 10 g of salt per day in 2000, and in 2005, a tentative target intake of less than 10 g for male adults and 8 g for female adults were recommended as the nutrition intake standards (Ministry of Health and Welfare, 2005; Park et al., 2008; The Korean Nutrition Society, 2005).

The absorption of salt, which consists of sodium and chlorine, causes water retention from the kidneys, which is normally discharged as urine. Water retained with sodium in the body increases the amount of body fluid, burdening the heart and artery and causes various chronic diseases such as cancer, cardiovascular diseases, hypertension, hyperlipidemia, obesity, etc (Kim & Choi, 2007; Lee et al., 2002; Moon et al., 2009; Ritz et al., 2009). In fact, when sodium consumption is higher than 4,331 mg (salt 11.8 g), the risk of high blood pressure is known to be 1.5 times higher.

It is believed that the higher rate of strokes in Korea, despite the lower levels of obesity, is a result of high sodium intake (Kim & Choi, 2007). Park (2007) reported that when the sodium intake was reduced by 7 g, the blood pressure decreased by 9 mmHg accordingly among the subjects of Gyeonggi-Do low salt diet life. There was another report showing that reducing salt intake by 5.8 g caused a decrease in blood pressure by 1.5-3.5 mmHg among Koreans (Son et al., 2007).

Therefore this study analyzing sodium content of dishes for which workers frequently choose as eating out lunch menus or worksite cafeterias serve will provide the basic idea for further research in preventing lifestyle diseases.

Subjects and Methods

Subjects and study period

Eighty-four restaurants and 10 foodservice cafeterias were chosen for the study as the convenience sample. First of all, the purpose of the research was explained to provisional target worksite cafeterias. After this process, 10 sites of worksite cafeterias agreed to cooperate, as did 5 sites in the Gangnam areas and 5 sites in Gangbuk areas. Fifty-eight dishes altogether from these 10 foodservice cafeteria menus were collected and chemically analyzed. And twenty-one one-dish-meals, which are frequently chosen by workers as a lunch menu, were collected. Food sample collection was carried out from the 12th of January to the 23rd of January 2009 and sodium contents were decided by the direct chemical analysis method (Korea Food and Drug Administration, 2009).

Method

The research team consisted of one male in his 20s, who did not know the purpose of the research, and one pre-rained researcher collected the food samples manually. The man responsible for collecting foods at the worksite cafeterias collected in exactly the same way as he would eat normally, which means the portion size would not be changed. At worksite cafeterias all of the menus were served buffet style, except the soup, or jjigae, which were served by cafeteria staff. Most of the meals consisted of rice, soup and 2 or 3 side dishes and kimchi. Collected dishes at the food service cafeteria by the researcher were weighed, serially numbered and recorded.

Popular eating out lunch menus, mostly one-dish-meals for workers also were bought for takeout, weighed, numbered and chemically analyzed for deciding sodium contents. The 21 eating out lunch menus were selected from referring several previous studies. Firstly, by referring to eating out menus of “smart meals in one’s pocket” (KHIDI & MIHWAF, 2006), developed by the Ministry for Health, Welfare and Family Affairs, secondly, people’s frequently chosen menus based on the National Health and Nutrition survey results in 2005, and finally, considering seasonal foods, price and convenience characteristics. Among the collected lunch menus were rice dishes such as fried rice, bibimbap, jajangmyun, and soups such as kimchi jjigae, soybean paste stew, mixed-sausage stew, soft soybean curd stew, dambuk stew, kalbitang, seolleongtang, Korean sausage soup, yookgaejang, etc were included. The amount of sodium added to served soups such as Korean sausage soup, seolleongtang, which were served without salt, was decided according to the food collector’s preference using table salt.

All of the collected foods were analyzed by the direct chemical analysis method and inductively coupled plasma mass spectrometry (ICP-MS, varian, USA) at the Korea Food and Drug Administration-certified Institute and translated to 100 g of each menu.

Results

Sodium contents of served meals from foodservice cafeterias

Table 1 shows sodium contents of served meals as lunch menu for male aged in the twenties from 10 foodservice cafeterias. The sodium content of cafeteria meals varied between minimum of 2,122.9 mg and maximum of 3,518.4 mg for one meal. The meals from the Gangbuk areas showed higher average amount of sodium compared to those of the Gangnam areas. However this tendency could not be generalized because this report was based on a small sample size study and our study did not employ the random sampling method. The average sodium content of served meals from foodservice cafeterias was 2,777.7 mg.
Table 1. Sodium contents of served meals from foodservice cafeterias

| Section | Gangnam Areas | Gangbuk Areas |
|---------|---------------|---------------|
|         | Sodium contents (mg) /100 g | Amount of foods (g) | Sodium (mg) portion (g) | Sodium contents (mg) /100 g | Amount of foods (g) | Sodium (mg) portion (g) |
| 1       | Rice | 28 | 210 | 59.0 | Rice | 28 | 210 | 59.0 |
|         | Seolleongtang* | 299.1 | 475 | 1,420.7 | Ducks stew | 1,027.2 | 281 | 2,886.3 |
|         | Seasoned squid & vegetables | 610.4 | 58.5 | 357.1 | Seasoned egg apple | 299.7 | 72.5 | 217.3 |
|         | Pickled pepper | 1,046.4 | 13 | 136.0 | Fried sweet potato | 41.1 | 86.5 | 35.6 |
|         | Kimchi | 842.4 | 49 | 412.8 | Kotchori Kimchi | 719.5 | 44.5 | 320.2 |
|         | The total | 2,385.6 | | | The total | 3,518.4 | |
| 2       | Rice | 28 | 210 | 59.0 | Rice | 28 | 210 | 59.0 |
|         | Soybean paste soup w/mallow | 410.8 | 190.5 | 782.6 | Gamgatang | 346.8 | 373 | 1,293.4 |
|         | Grilled pacific saury | 697.9 | 107 | 746.7 | Steamed egg | 422.1 | 89 | 375.6 |
|         | Boiled potato | 288.5 | 82.5 | 238.0 | Picked radish | 2,048.3 | 44.5 | 911.5 |
|         | Seasoned bean sprouts | 243.0 | 33 | 80.2 | Seaweeds + vinegared red pepper paste | 386.3 | 52.5 | 202.8 |
|         | Kimchi | 627.3 | 34.5 | 216.4 | Diced radish Kimchi | 688.5 | 74.5 | 512.9 |
|         | The total | 2,122.9 | | | The total | 3,355.2 | |
| 3       | Rice | 28 | 210 | 59.0 | Rice | 28 | 210 | 59.0 |
|         | Soybean paste soup w/shepherd’s purse | 337.7 | 210 | 709.2 | Bean-curd stew | 378.1 | 255.5 | 966.0 |
|         | Seasoned squid & vinegared red pepper paste | 271.4 | 61 | 165.6 | Steamed ribs of pork | 750.6 | 149 | 1,118.3 |
|         | Pancakes buckwheat | 350.6 | 93.5 | 327.8 | Seasoned squid & radish | 612.7 | 48.5 | 297.2 |
|         | Seasoned deo-deog wired pepper paste | 1,395.5 | 71 | 990.8 | Filleted leek | 591.7 | 50.5 | 123.3 |
|         | Kimchi | 740.0 | 52 | 384.9 | Eolgari Kimchi | 244.2 | 53.5 | 316.5 |
|         | The total | 2,637.3 | | | The total | 2,862.3 | |
| 4       | Rice | 28 | 210 | 59.0 | Jajangbap | 290.9 | 357 | 1,038.4 |
|         | Beef & radish soup | 345.3 | 236 | 814.8 | Egg soup | 480.5 | 180 | 865.0 |
|         | Fish cutlet + sauce | 519.9 | 84 | 436.7 | Boiled mandu | 192.9 | 53 | 102.3 |
|         | Seasoned chard | 424.4 | 77.5 | 328.9 | Pasta & vegetable salad (Dressing of mayonnaise ) | 127.1 | 75 | 95.4 |
|         | Seasoned green bean sprouts | 559.4 | 57.5 | 321.6 | Seasoned green bean sprouts | 631.3 | 38.5 | 243.1 |
|         | Kimchi | 920.9 | 86 | 792.0 | Kimchi | 1,039.3 | 63.5 | 660.0 |
|         | The total | 2,753.0 | | | The total | 3,004.3 | |
| 5       | Rice | 28 | 210 | 59.0 | Rice | 28 | 210 | 59.0 |
|         | Soybean paste soup w/mallow | 357.0 | 266.5 | 951.4 | Soybean paste soup w/chard | 245.0 | 229 | 561.1 |
|         | Boiled mackerel & Kimchi | 491.7 | 99 | 486.8 | Boiled pork & egg | 1,499.5 | 63 | 944.7 |
|         | Stir-fried hams & vegetables | 665.3 | 44.5 | 291.6 | Boiled anchovy & peanut | 538.5 | 28 | 150.8 |
|         | Seasoned dried radish leaves | 626.6 | 71 | 444.9 | Seasoned spinach | 465.5 | 43 | 200.2 |
|         | Kimchi | 928.4 | 39.5 | 366.7 | Whole radish Kimchi | 474.6 | 131 | 621.7 |
|         | The total | 2,600.4 | | | The total | 2,537.5 | |
|         | Average | 2,499.8 ± 249.1 | | | Average | 3,055.5 ± 391.3 | |
|         | Total Average | 2,777.69 ± 461.56 | | | | |

+Salt was added into the dish by the researcher.  
* P < 0.05 by t-test

(Gangnam area, 2,499.8 mg; Gangbuk area, 3,055.5 mg, respectively). When compared with the Korean’s average daily sodium intake, 5,279.9 mg by the 2005 National Health and Nutrition Examination Survey (Ministry of Health and Welfare, 2005), the sodium content of the served one meal in our study showed a rather higher amount which was 52.6% of Korean’s average daily sodium intake and 56.7% of the average Seoul citizen’s daily sodium intake, 4891.2 mg. This amount was approximately 1.4 times of 2,000 mg, the WHO/FAO recommended daily intake. (Ministry of Health and Welfare, 2005; The Korean Nutrition Society, 2005).

Using the 24-hr dietary recall method, Moon et al. (2009) reported that the most contributing foods for sodium intake for her Korean subjects were kimchies 28.3%, soups and hot soups 22.9%, stews and casseroles 9.8%, and seasonings 8.2%, respectively. Another study by Son & Huh (2002) reported that
the contributing factors of daily sodium intake among certain Korean subjects was kimchies 30%, soups & stews 20%, fish foods 12%, etc. Son (2007) also reported kimchi 27.1%, soup, stew 21.8%, and fish 12.2%. The 2005 Korea National Health & Nutrition Examination Survey reported that kimchi (Ministry of Health and Welfare, 2005) was responsible for 23.1% of daily sodium intake. Son (2007) concluded that kimchi was the highest contributor of sodium consumption for Koreans.

However, our study results showed that kimchi was responsible for the average sodium intake of 460.5 mg, which was 16.6% of the total daily sodium intake of the served meals. This result showed a big difference with the above referred study results, especially Son and Huh (2002). These differences among studies of sodium contributing rates could be caused by the differences in the employed analysis method. All of the above mentioned studies were the results of the 24-hr dietary recall method or food frequency method, which could underestimate the amount of condiments and seasonings, especially the sodium contents, of meals. When employed, the 24-hr dietary recall method, the amounts and kinds of eaten meals are dependent on respondent’s

Table 2. Sodium contents of frequently chosen dine out menus by workers

| Ranking | Name of food | Average sodium (mg) | Restaurant 1 | Restaurant 2 | Average sodium (mg) | Restaurant 1 | Restaurant 2 |
|---------|-------------|---------------------|--------------|--------------|---------------------|--------------|--------------|
|         |             | Sodium contents (mg) | Amount of foods (g) | Sodium contents (mg) | Amount of foods (g) | Sodium contents (mg) | Amount of foods (g) |
| 1       | Jjambbong   | 3,553.0 ± 132.2      | 3,836.7       | 1,005.0      | 2,381.1             | 1,104.0      | 3,108.9 ± 1,029.3 |
| 2       | Soybean pasta stew | 3,005.3 ± 1,587.5 | 4,729.6 | 526.5 | 3,881.2 | 546.0 | 4,305.4 ± 599.9 |
| 3       | Japchaeabap | 2,669.5 ± 950.7      | 2,529.3       | 799.0        | 3,761.6             | 696.5        | 3,145.5 ± 671.4 |
| 4       | Korean sausage soup | 2,624.4 ± 1,116.0 | 2,812.0 | 734.5 | 3,558.2 | 1,083.0 | 3,185.1 ± 527.6 |
| 5       | Kimch stew  | 2,315.8 ± 894.8      | 2,209.7       | 537.0        | 1,874.8             | 537.5        | 2,042.2 ± 236.8 |
| 6       | Yookgaejang | 2,260.7 ± 696.2      | 1,897.2       | 539.0        | 2,789.6             | 651.0        | 2,343.4 ± 631.0 |
| 7       | Mandu soup  | 2,189.7 ± 959.2      | 1,953.6       | 721.5        | 3,564.4             | 840.5        | 2,759.0 ± 1,139.0 |
| 8       | Mixed-sausage stew | 2,217.4 ± 709.2 | 2,867.5 | 514.0 | 2,512.3 | 556.0 | 2,589.9 ± 392.6 |
| 9       | Jajangmyon  | 2,015.5 ± 179.8      | 2,137.9       | 650.5        | 1,847.8             | 662.5        | 1,992.8 ± 205.1 |
| 10      | Kalbitang   | 1,958.8 ± 782.9      | 2,900.1       | 1,250.0      | 1,012.3             | 604.5        | 1,956.2 ± 1,334.9 |
| 11      | Wheat noodles | 1,802.2 ± 464.9     | 1,246.2       | 875.5        | 2,368.7             | 826.0        | 1,807.5 ± 793.7 |
| 12      | Dambuk stew | 1,752.1 ± 806.1      | 2,876.8       | 695.0        | 1,507.5             | 450.0        | 2,192.1 ± 968.2 |
| 13      | Fried-rice  | 1,718.1 ± 767.2      | 1,165.1       | 488.5        | 2,512.3             | 461.0        | 1,838.7 ± 952.6 |
| 14      | Seolleongtang* | 1,704.0 ± 846.3 | 1,743.3 | 728.0 | 2,740.9 | 1,015.5 | 2,242.1 ± 705.4 |
| 15      | Soft soybean curd stew | 1,583.9 ± 806.9 | 1,291.0 | 423.5 | 2,784.5 | 520.0 | 2,037.7 ± 1,056.1 |
| 16      | Rice topped with spicy stir-fried pork | 1,561.3 ± 557.0 | 2,368.5 | 708.0 | 1,328.3 | 543.0 | 1,848.4 ± 735.5 |
| 17      | Squid over rice | 1,396.5 ± 126.3 | 1,496.7 | 484.0 | 1,497.2 | 590.0 | 1,496.9 ± 0.4 |
| 18      | Curry rice  | 1,384.3 ± 370.7      | 1,150.9       | 497.0        | 1,228.6             | 609.0        | 1,189.8 ± 54.9 |
| 19      | Bibimbap    | 1,283.3 ± 110.4      | 1,340.7       | 440.0        | 1,119.6             | 358.0        | 1,230.2 ± 156.3 |
| 20      | Sweet-and-sour pork | 794.6 ± 331.8 | 438.5 | 598.5 | 1,236.0 | 798.5 | 837.3 ± 563.9 |
| 21      | Kimbap      | 640.0 ± 312.2        | 897.6         | 246.5        | 913.0               | 241.5        | 905.3 ± 10.9  |

*Salt was added by the researcher using table salt.
memory and could vary according to one’s memory lapse (Seo et al., 2008). The success of the 24-hr recall depends on the subject’s memory, the ability of the respondent to convey accurate estimates of portion sizes consumed, the degree of motivation of the respondent, and the persistence of the interviewer (Acheson et al., 1980). Therefore, the amount of condiments and seasonings, which mainly affect the one’s sodium intake, is likely to be inaccurately measured, mostly underestimated. Our study used the weighing method and the direct chemical analysis method. However in our adopted method, it is more likely that one would not eat all of the foods or sauces that were taken by an individual diner and the sodium intake level would be overestimated to some extent.

However, even after all these factors have been taken into consideration, it is clear that the sodium content of the average of one meal from food service cafeterias was very high. When one dines out, kimchi would not be the main contributor of the high sodium intake. Restaurant owners or cooks, usually use higher amounts of salt compared to homemade dishes to make food more tasty. This tendency is not exceptional for foodservice cafeterias of worksites.

Foods collected at Gangbuk showed higher amounts of sodium compared to those of Gangnam (\(P < 0.05\)). However since foods were not collected based on the random sampling method but on the convenience sampling method and did not collect enough numbers of cases, those selected cafeterias would not represent the different two areas. Consequently one cannot insist that the tastes of Gangbuk residents are more salty compared to Gangnam residents and these results cannot be generalized.

Sodium contents of frequently chosen dining out menus by workers

A total 21 menus were analyzed employing ICP-MS, varian, USA. The selected menus included 11 kinds of rice applied menus, 9 kinds of soups, stews and hot soups, etc. The frequently chosen dishes by workers as lunch menus were collected at 4 different restaurants for each menu, which totaled 84 dishes. For each popular lunch menu for workers, two restaurants from the Gangbuk areas (Gwangjin-gu, Seongdong-gu) and two other restaurants from the Gangnam areas of Seoul (Gangnam-gu and Seocho-gu) were chosen.

The amounts of a served meal and the sodium content are shown in Table 2. Jjambbong had the highest sodium content (3,553.0 mg) followed by soy bean paste stew (3,005.3 mg), then japchaeap (2,669.5 mg). Japbap had the lowest sodium content (640.0 mg). It is presumed that in the case of jjambbong with 8.9 g of salt consumed at one meal and when jjambbong was eaten with pickle-raddish, over 10 g of salt consumption would be possible.

In the case of eating foods such as jjambbong or soybean paste stew with side dishes, the amount of sodium included in rice (about 59 mg) and kimchi (about 458 mg) will be added to the amount of the main dish and one can intake sodium of 4,070 mg from one meal, which is over 10 g of salt.

Depending on the composition of meals, soup, stew type meals reach the highest sodium content and the next highest were pickles, then boiled foods and steamed foods. So when dining out, choosing menus with lower sodium contents is the healthy way of reducing sodium intake. However, Koreans, especially males and middle-aged males were not aware of the 29 kinds of typical salty dishes as being salty (Park et al., 2008). And this kind of information should be delivered to workers via nutrition education.

Discussion

The average sodium content of served dishes for one meal from foodservice cafeterias was 2,777.7 mg, which was about 7 g of salt. The average salt intake from restaurant dishes for one meal was about 8 g. These amounts of salt were much higher than those of typical home made meals. The menu for one meal with the largest amount of sodium was jjammbong (3,553.0 mg), then soybean paste stew (3,005.3 mg) followed by japonbap (2,669.5 mg), and kimbap (640.0 mg) which showed the least.

Workers should choose menus with less amounts of salt in order to control one’s sodium intake. The average salt contents of dishes which are popular and convenient for workers ranges from 3 g to 8 g and when salt from side dishes such as kimchi were added, the salt intake could increase to over 10 g for one meal. To reduce the amount of salt intake, Son insisted to reduce serving size of soup, to eat raw vegetables instead of kimchi, and to develop low sodium recipes for restaurant owners, etc (Son, 2007). The study results imply that kimchi would not be the primary contributor of high sodium intake for workers who frequently eat out.

Considering this study results of nutrition education for restaurant owners and for food service providers is needed to achieve healthy eating environments. Low salt diet campaign and promotion are also needed for workers who mostly eat out at the same time. For this purpose, an appropriate nutrition policy should be established and delivered to people to prevent life style diseases.

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