Nutrient Intake of Highly Competitive Male and Female Collegiate Karate Players

Kaori Teshima1), Hiroyuki Imamura2), Yoshitaka Yoshimura1), Seiji Nishimura3), Noriko Miyamoto2), Yoichi Yamauchi4), Hitoshi Hori5), Chinatsu Moriwaki6) and Tomoko Shirota7)

1) Department of Food and Nutrition, Beppu University
2) Laboratory of Nutrition and Exercise Physiology, Department of Food and Nutrition, Nakamura Gakuen University
3) Federation of All Japan Karate-do Organizations
4) Sojo University
5) Nippon Bunri University
6) Department of Food and Nutrition, Beppu University Junior College
7) Department of Food and Nutrition, Nakamura Gakuen Junior College

Abstract Nutrient intake of 29 male (M Group) and 16 female (F Group) highly competitive collegiate karate players were compared. The results were also compared with the daily energy expenditure (DEE), Japanese recommended dietary allowances (RDAs) or adequate dietary intakes (ADIs). Dietary information was collected using a 3-weekday diet record. Although the M Group showed significantly higher mean %RDAs or %ADIs in iron, vitamin B1, phosphorus, magnesium, and sodium than the F Group, many of the mean %RDAs or %ADIs were below RDAs or ADIs in both groups. The subjects who skipped meals tended to show lower mean %DEE, Japanese %RDAs or %ADIs in minerals and vitamins than the subjects who did not skip in both M and F Groups. The consumption of green and other vegetables and milk and dairy products in both M and F Groups were low. It is concluded that the male and female highly competitive karate players studied in the present study may be at risk of sub-optimal nutrient intake, which increases the potential for nutrient deficiency. The subjects were advised not to skip meals, and to consume a balanced high-carbohydrate, moderate-protein, low-fat diet with increasing green and other vegetables and milk and dairy products to increase mineral, vitamin and dietary fiber intakes. J Physiol Anthropol 21 (4): 205–211, 2002 http://www.jstage.jst.go.jp/en/

Keywords: Karate, nutrient intake, body composition

Introduction

Karate is one of the most popular martial arts practiced both inside and outside of Japan. Traditional karate training consists of the practice of basic techniques, kata and sparring. The basic techniques such as punching, kicking, blocking and striking are practiced either in the stationary position or with body movements in various formal stances. Kata are set forms in a pre-established sequence of defensive and offensive techniques and movements. Movements in kata are very formal, systematic and sometimes very slow, in prescribed stances and directions. Sparring is the execution of defensive and offensive techniques while freely moving against an opponent. In addition to the traditional karate training, many competitive practitioners cross train by following strenuous running and weight training programs to increase endurance, muscle development and power.

The American and Canadian Dietetic Associations (1993) stated that the carbohydrate intake should be up to 65% to 70% of the daily energy intake for athletes training at a high intensity on successive days. However, it has been reported that many collegiate athletes consume less than 50% of the energy as complex carbohydrates (Short and Short, 1983). Some body builders follow a high protein and low carbohydrate diet (Faber et al., 1986). Although many competitive karate players follow a strenuous weight training program, the nutrient intake of male and female highly competitive...
Karate players have not been reported in the international literature. Furthermore, the above mentioned studies were reported from the US (Short and Short, 1983) and South Africa (Faber et al., 1986). Japanese people have a higher intake of carbohydrate and lower intake of fat than that in Western countries (Ueshima et al., 1982, Ueshima, 1990).

Although significant differences in nutrient intake between male and female intercollegiate athletes in various sports have been reported (Short and Short, 1983), it has not been clear that comparisons were made between groups with comparable training schedules and levels of competition. Nowak et al. (1988) compared nutrient intake and nutrient supplement of male and female intercollegiate basketball players with comparable training schedules and levels of competition and reported that mean percent recommended dietary allowances (RDAs) of all nutrients except vitamins A and D were greater for men. However, most of the differences were eliminated when the contribution of nutrient supplement, which had a significant effect on the women’s total intake, was considered.

The purpose of this study was: 1) to collect baseline data on nutrient intake in order to advise athletes about nutrition practices that might enhance performance; 2) to compare nutrient intake of male and female highly competitive black belt karate players; and 3) to compare the nutrient intake with daily energy expenditure (DEE), Japanese RDAs or Japanese adequate dietary intakes (ADIs).

Methods

Subjects

Twenty-nine male (M Group) and 16 female (F Group) highly competitive black belt karate players volunteered to participate in this study. Each group was divided into 2 groups according to their food style; 9 subjects who skipped 2 or more meals (M1 Group) and 16 subjects who did not skip (M2 Group), and 7 subjects who skipped meals (F1 Group) and 9 subjects who did not skip (F2 Group). They were members of the 4 intercollegiate karate teams in the 3 prefectures in Japan and were recruited through their head coaches. One team usually practiced for at least 2 hours. The other 3 teams usually practiced for at least 3 hours Monday through Saturday. The other 3 teams usually practiced for at least 2 hours. Of the M Group, 2 subjects were former world champion, another subject won the 2nd place in a world competition and the other 14 were national class competitors in Japan. Of the F Group, one subject was a former world champion, another subject won the 2nd place in a world competition and the other 14 were national class competitors in Japan. Men and women trained together in each team, and karate was the only current type of training at least for 5 years in both groups. These players competed in sparring matches all year round, and dietary information was collected in June, which was considered representative of their physiologic status during training for their next competition. All subjects in the present study participated in national intercollegiate karate competition, which was held without any weight divisions. The subjects who represented Japan for the world and international contests competed with weight divisions. However, only one subject needed to lose weight for the weight division.

The study protocol was approved by the Ethics Committee of the Nakamura Gakuen University and informed consent was obtained from each subject.

Anthropometric measurements

The weight and height were measured to the nearest 0.1 kg and 0.1 cm, respectively. The body mass index was calculated as weight/height (kg/m²). The biceps, triceps, subscapular and suprailiac skinfold thicknesses were measured with a Harpenden caliper on the right side of the body with the subject in a standing position. The average of 3 measurements at each site was used to calculate the body density (Durnin and Rahaman, 1967) and percentage of body fat (%Fat) (Siri, 1956).

Dietary information

Dietary information was collected using a 3-weekday diet record. The voluntary recording was made on standard forms given to the players by a dietitian who instructed them in the procedures involved in accurately recording dietary intake. The subjects were asked not to alter their usual diet during this 3-day period. At the end of the 3-day period, accuracy of the records was checked through individual interviews with prescribed equipment including household measuring cups and spoons, serving and eating utensils and food models. Each player was questioned by the investigators as to whether or not he/she was using nutrient supplement, on a diet, and other daily physical activities such as how many hours the subject sit for study and walk to commute and so on. DEE was estimated from the basal metabolic rate, body surface area, and time and relative metabolic rate for various activities (Imamura et al., 2000). The body surface area was calculated according to the following formula: $W^{0.444} \times H^{0.663} \times 88.83$ (Fujimoto et al., 1968). The relative metabolic rate during karate exercises for male (0.130 kcal·kg$^{-1}$·min$^{-1}$) and female (0.075 kcal·kg$^{-1}$·min$^{-1}$) were calculated from the results of two studies (Imamura et al., 1999 and in press). Each food item was coded according to the Tables of the Japanese Foodstuff Composition (The Resources Council of the Science and Technology Agency, 1987). The coded data were computer processed to obtain the daily average intake of the nutrients. Data were compared with the DEE, Japanese RDAs or ADIs. The definition, applications and basis for calculation of...
the Japanese RDAs are translated into English (The Ministry of Health and Welfare, 1991). The Japanese RDAs for minerals and vitamins are available for calcium, iron, vitamins A, B₁, B₂, C and D and niacin. Because of the paucity of scientific data, no Japanese RDAs exist for sodium, phosphorus, potassium, magnesium, dietary fiber and vitamin E. However, these are expressed as ADIs in numerical values similarly as RDAs. Sixty-six percent of the RDAs or ADIs was used as cut-off point for inadequate nutrient intake because a diet can be classified as being inadequate if the diet supplied less than two thirds of the RDA or ADI for one or more of the listed nutrients (Leverton, 1975).

Statistical analysis

Descriptive statistics included means and standard deviations (SD). Differences in mean values between 2 groups were analyzed by 2-tailed t-test.

Results

The characteristics of the subjects are shown in Table 1. There were no significant differences between the M and F Groups in age, body mass index and karate experience. However, as expected, the M Group showed significantly higher mean body height and weight and lean body mass and significantly lower mean %Fat and fat mass than the F Group.

The nutrient intake in the M and F Groups is shown in Table 2. The M Group showed significantly higher energy intake and many other nutrient intakes than the F Group. However, when energy and macro-nutrient intakes were calculated based on the body weight, the M Group only showed significantly higher energy intake.

The nutrient intakes expressed as absolute values as well as percentages of the DEE, RDAs or ADIs are shown in Table 3, in which the number and percentage of the subjects who consumed more than 100%, between 67% and 99%, or less than 66% of the DEE, RDAs or ADIs are also indicated. Although the M Group showed significantly higher mean %DEE, %RDAs or %ADIs in iron, vitamin B₁, phosphorus, magnesium, and sodium than the F Group, many of the mean %DEE, %RDAs or %ADIs were below DEE, RDAs or ADIs in both groups.

The nutrient intakes expressed as percentages of the DEE, RDAs, or ADIs between the M1 and M2 Groups or F1 and F2 Groups during the 3-day diet record period were compared in Table 4. Thirteen subjects (45%) in the M Group skipped a total of 28 meals (12 breakfasts, 13 lunches and 3 suppers), and seven subjects (44%) in the F Group skipped a total of 28 meals (11 breakfasts and 2 lunches). In the M Group, 4 subjects skipped one meal, 6 skipped 2, one each skipped 3, 4, or 5 meals, respectively. The last one who skipped 5 meals was on a diet. In the F Group, 4 subjects skipped one meal, and 3 skipped 3 meals, respectively. None of the subjects used vitamin or mineral supplement. In the M group, there were no significant differences in any nutrients when the 12 subjects who skipped meals as a whole group were compared to the subjects who did not skip. However,
who consumed less than 66% of DEE, RDAs or ADIs in phosphorus. The percentage of the subjects mean %DEE, %RDAs in fat, calcium, iron, and vitamin B2, (M2 Group), the M1 Group showed significantly lower Group) were compared to the subjects who did not skip meals. M1=9 male subjects who skipped 2 or more meals, F1=7 female subjects who %ADI in phosphorus. The percentage of the subjects who did not skip meals. *p<0.05, **p<0.01. 7 subjects who skipped these nutrients and some other nutrients were greater in the M1 Group than the M2 Group. Similar trends were obtained in the F Group when the 7 subjects who skipped meals as a whole group were compared to the subjects who did not skip meals.  

Table 3  Nutrient intakes expressed as a percentage of the daily energy expenditure (DEE), recommended dietary allowances (RDAs) or adequate dietary intakes (ADIs)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Male Group (n=29)</th>
<th>Female Group (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>number of subjects (%)</td>
<td>number of subjects (%)</td>
</tr>
<tr>
<td>Energy (kcal)</td>
<td>3958</td>
<td>20.4</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>90</td>
<td>23.8*</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>110</td>
<td>30.5</td>
</tr>
<tr>
<td>Calcium (mg)</td>
<td>600</td>
<td>30.1</td>
</tr>
<tr>
<td>Iron (mg)</td>
<td>10</td>
<td>10.9</td>
</tr>
<tr>
<td>V.A (IU)</td>
<td>2000</td>
<td>17.8</td>
</tr>
<tr>
<td>V.C (mg)</td>
<td>50</td>
<td>10.3</td>
</tr>
<tr>
<td>Phosphorus (mg)</td>
<td>1300</td>
<td>12.3</td>
</tr>
<tr>
<td>Magnesium (mg)</td>
<td>300</td>
<td>17.6</td>
</tr>
<tr>
<td>Sodium (mg)</td>
<td>4000</td>
<td>15.2</td>
</tr>
<tr>
<td>Potassium (mg)</td>
<td>2000</td>
<td>30.1</td>
</tr>
<tr>
<td>DF (g · 1000 kcal–1)</td>
<td>10</td>
<td>12.3</td>
</tr>
</tbody>
</table>

V=vitamin, DF=dietary fiber. *p<0.05, **p<0.01, ***p<0.001.

Table 4  Nutrient intakes expressed as a percentage of the daily energy expenditure (DEE), recommended dietary allowances (RDAs) or adequate dietary intakes (ADIs)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>M1 (n=9)</th>
<th>M2 (n=16)</th>
<th>F1 (n=7)</th>
<th>F2 (n=9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>%DEE (± SD)</td>
<td>64.3 ± 21.8</td>
<td>90.5 ± 23.8*</td>
<td>64.4 ± 12.3</td>
<td>83.5 ± 17.8*</td>
</tr>
<tr>
<td>%RDAs (± SD)</td>
<td>78.7 ± 24.4</td>
<td>105.0 ± 34.7</td>
<td>71.7 ± 17.2</td>
<td>92.8 ± 27.4</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>27.5 ± 18.0</td>
<td>48.8 ± 27.1*</td>
<td>33.3 ± 13.0</td>
<td>42.7 ± 21.5*</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>46.0 ± 15.5</td>
<td>74.8 ± 38.8*</td>
<td>64.6 ± 9.3</td>
<td>86.5 ± 22.9</td>
</tr>
<tr>
<td>Calcium (%)</td>
<td>68.1 ± 16.9</td>
<td>109.0 ± 29.2**</td>
<td>59.3 ± 16.0</td>
<td>75.0 ± 15.0</td>
</tr>
<tr>
<td>Iron (%)</td>
<td>84.1 ± 39.4</td>
<td>116.2 ± 122.2</td>
<td>106.4 ± 75.6</td>
<td>106.2 ± 56.5</td>
</tr>
<tr>
<td>V.A (%)</td>
<td>82.5 ± 26.5</td>
<td>112.7 ± 56.9</td>
<td>71.4 ± 15.2</td>
<td>91.5 ± 27.2</td>
</tr>
<tr>
<td>V.B1 (%)</td>
<td>48.5 ± 16.3</td>
<td>95.8 ± 61.1**</td>
<td>67.0 ± 17.6</td>
<td>100.3 ± 30.3*</td>
</tr>
<tr>
<td>V.C (%)</td>
<td>114.4 ± 64.8</td>
<td>154.7 ± 83.0</td>
<td>99.6 ± 30.1</td>
<td>229.7 ± 152.6</td>
</tr>
</tbody>
</table>

M1=9 male subjects who skipped 2 or more meals, M2=16 male subjects who did not skip meals, F1=7 female subjects who skipped more than one meal, F2=9 female subjects who did not skip meals. *p<0.05, **p<0.01.
are shown in Table 5. There were no significant differences in any parameters between M1 and M2 Groups or F1 and F2 Groups.

The foodstuff intake in the M and F Groups is shown in Table 6. The M Group showed significantly higher mean foodstuff intakes in rice, noodles and other cereals, soybeans and soybean products, green vegetables and algae and significantly lower intakes in breads, sugars and confectionaries, fruits and fruits juice, milk and daily products than the F Group.

### Discussion

**Anthropometric data**

The mean body height, weight, and body mass index for the M and F Groups were 2.1 and 0.8 cm, 3.6 and 4.6 kg, and 0.72 and 1.63, respectively, higher than the reference person for 20 years of age (The Ministry of Health and Welfare, 1991). The M Group showed the lower mean %Fat than the value reported for the sedentary men of similar age (12.4 ± 3.0% v.s. 14.0 ± 4.2%) (Takami et al., 1993). The F Group also showed the lower mean %Fat than the value reported for the sedentary women of similar age (24.1 ± 5.5% v.s. 27.8 ± 4.2%) (unpublished data collected with the same method in this laboratory). Although the M1 or F1 Group showed significantly lower mean %DEE than the M2 or F2 Group, respectively, their mean body weight and other physical characteristics did not differ significantly between the M1 and M2 Groups or F1 and F2 Groups. These results, at least in part, could be explained by the finding that over-nutrition increases the resting metabolic rate and thermic effects of feeding, while under-nutrition decreases them (Van Zant, 1992).

**Nutrient intake**

Brotherhood (1984) suggested that at least 55% of calories should come from carbohydrate, less than 30% from fat, and about 12% from protein for a healthy or prudent diet. The results of the national nutrition survey in Japan showed that diet compositions of men (56.0%, 25.7%, and 14.1%, respectively) and women (56.5%, 27.7%, and 14.3%, respectively) for 20–29 years of age...
compare favorably with this standard (The Ministry of Health and Welfare, 1991). Diet compositions of the M and F Groups in the present study showed that these karate players ate a typical Japanese diet. The lower intake of carbohydrate and higher intake of fat has been reported from the other countries. Ellsworth et al. (1985) investigated the nutrient intake of 13 male and 14 female members of the US Nordic Ski Team and noted that these skiers ate a typical American diet: high in fat and relatively low in carbohydrate. The mean values of the dietary records showed that carbohydrate intake for men was 45% of total energy intake and for women was 46%, and fat intake for men was 39% and for women was 38%. Similar results were reported in university athletes in various other sports in the US (Short and Short, 1983) and South African national level throwing field athletes (Faber and Benade, 1991). For athletes, the American and Canadian Dietetic Associations (1993) stated that the carbohydrate intake should be up to 65% to 70% of the daily energy intake for athletes training at a high intensity on successive days. The carbohydrate consumption of the M and F Groups were lower than this recommended target (59.2 ± 8.4% of total calories for the M Group and 52.3 ± 7.0% for the F Group).

The American and Canadian Dietetic Associations (1993) stated that providing 12% to 15% of total energy from protein may be excessive for athletes with exceptionally high energy intake or may be inadequate for athletes with very low energy intake. In these cases, providing 1.0 to 1.5 g · kg⁻¹ · day⁻¹ may be a more appropriate guide. In Japan, the protein RDA for the adult population is 1.08 g · kg⁻¹ · day⁻¹ and for sports people is from 1.2 to 1.4 g · kg⁻¹ · day⁻¹. The protein intake needs to be adjusted if animal protein ratio is below 40%. However, animal protein ratio for male was 48.5% and for female was 50.1%, so that these values were not adjusted in the present study. The protein consumption of the M and F Groups compare favorably with these recommendations (1.38 ± 0.46 g · kg⁻¹ and 13.2 ± 2.2% of total calories for the M Group and 1.17 ± 0.35 kg · kg⁻¹ and 13.3 ± 2.1% for the F Group). Although we cannot draw any conclusions as to what the optimum protein requirement for highly competitive karate players, these athletes may require more protein than the Japanese RDA for sports people to build and repair tissue because many competitive karate players follow a strenuous weight training program to increase muscle development and power and spar quite often which might cause muscular damage. Tarnopolsky et al. (1992), using the leucine kinetic and nitrogen balance methods, investigated the dietary protein requirements of strength athletes compared with sedentary subjects. They reported that the protein intake for zero nitrogen balance for sedentary subjects was 0.69 g · kg⁻¹ · day⁻¹ and for strength athletes was 1.41 g · kg⁻¹ · day⁻¹; with a safety margin of ± 1 SD, the suggested recommended intake were 0.89 and 1.76 g · kg⁻¹ · day⁻¹, respectively.

In Japan, the recommended fat energy ratio is from 25 to 30% for sports people (The Ministry of Health and Welfare, 1991). The mean fat consumption of the M and F Groups was within the range of this recommendation (26.8 ± 5.8% of total calories for the M Group and 30.0 ± 5.6% for the F Group). In the present study, it was not possible to determine if the subjects observed were suffering from any nutrient deficiencies in minerals and vitamins. However, the Japanese RDAs or ADIs for minerals and vitamins are specified for reference individuals with average body heights and weights and are not specified for sports people. Thus, karate players may require more minerals and vitamins than the Japanese RDAs. The subjects were advised to not skip meals because subjects who skipped meals tended to show lower mean Japanese %RDAs or %ADIs in minerals and vitamins, and the percentage of the subjects who consumed less than 66% of the RDAs or ADIs in these nutrients and some other nutrients were greater in the subjects who skipped meals than who did not in both M and F Groups.

To increase mineral, vitamin and dietary fiber intakes, the Japanese Ministry of Health and Welfare (1991) recommended the consumption of 200 g of milk and dairy products, 100 g of green vegetables and 200 g of other vegetables. According to these recommendations, consumption of these foodstuffs in both M and F Groups were low. The American and Canadian Dietetic Associations (1993) stated that athletes at risk for low mineral and vitamin intake are those who consume a low-calorie diet. The increased requirement for some minerals and vitamins through physical activity can be met by consuming a balanced high-carbohydrate, moderate-protein, low-fat diet.

### Conclusion

It is concluded that the male and female highly competitive karate players studied in the present study may be at risk of sub-optimal nutrient intake, which increases the potential for nutrient deficiency. The subjects were advised not to skip meals, and to consume a balanced high-carbohydrate, moderate-protein, low-fat diet with increasing green and other vegetables and milk and dairy products to increase mineral, vitamin and dietary fiber intakes.

### References


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Correspondence to: Kaori Teshima, Department of Food and Nutrition, Beppu University, 82 Kita-Ishigaki, Beppu-shi 874-8501, Japan
e-mail: kaoteshi@mc.beppu-u.ac.jp