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THE ANALYSIS OF HIGH-LEVEL ATHLETES' NUTRITION AND DIET

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ABSTRACT
This paper compared research works of sports nutrition to other countries, Comparing the intakes of vitamins by female wrestlers and boxers in a particular province and the recommended amounts of vitamins for Chinese athletes, the results show that the average intakes of Vitamin A, PP and E by athletes are obviously higher than the correspondingly recommended amounts for Chinese athletes. The intake of Vitamin B2 happens to fall into the recommended range. Although the intake of Vitamin B1 hasn't reached the recommended standard, the gap is small. The intake of Vitamin C is simply less than the recommended standard for Chinese athletes.

1. Introduction

Nutrition refers to the whole process in which human organism ingests, digests, absorbs and utilizes the nutrients in the food so as to maintain the normal physiological, biochemical and immunologic function and life activities including the growth development and metabolism. Nutrients refer to beneficial substances the diet contains (Maughan, 2002). These substances can maintain life and promote human organism's growth development and health. For example, seven nutrients required in the human body are protein, fat, carbohydrates, vitamin, mineral element, dietary fiber and water. Neurology is the science of researching human organism's nutrition law and improvement measures, which is to study food components which are beneficial to the human body and the law and mechanism of the human body's ingesting and utilizing these components to maintain and improve health. On this basis, people can take various measures to enhance the human health and improve life quality (Jamaluddin et al. 2014). Nutrition and diet are both closely related to people's daily life. People must ingest a certain amount of food to meet their body's nutritional requirements and maintain their own activities and health.

Sports nutrition refers to an academic discipline which studies how athletes enhance their body functions' athletic ability, eliminate fatigue and regain their strength in a short time through ingesting, absorbing and utilizing various nutrients. At the same time, it also helps athletes prevent several diseases to improve sport achievements (Panza et al., 2007). This discipline mainly conducts reasonable collocation based on athletes' training conditions at different periods and dietary nutrition during the competition and provides sports nutritional supplements as the auxiliary supply. Its main purpose is to provide athletes with required energy and various nutrients for adapting to the intensive training and reasonable diet collocation to improve training effects (Grahampaulson et al., 2015).

Our country has started the research of sports nutrition since the late 1950s. The Sports Nutrition Research Center was established in National Research Institute of Sports Medicine which was founded in 1987. This research center is used for studying athletes' nutritional problems.

Compared to research works of sports nutrition of other countries, those of our country are started relatively late. However, we have also made impressive achievements in this field. For example, the distinguished sports nutritionist Professor Jidi Chen is the father of China's sports nutrition and is the first person to establish the sports nutrition biochemical laboratory in China. She has dedicated his life to researching in the field of sports nutrition. Besides, her research achievements have won the First Award of State Physical Culture and Sports Commission's Scientific and Technological Progress for several times. It is observed that the development prospect of sports nutrition is quite bright (Lloyd et al., 1987).

In recent years, as the key component of athletes' nutrition, the diet has been an emphasis of sports nutrition researches. Among them, reasonable dietary and nutritional requirements of athletes in various sports have become a research focus in recent years (Potgieter, 2013). For example, The Survey and Countermeasures of High-level Throwing Athletes' Meal and Nutrition Supplementation, Analysis of Dietary Nutrition, Body Composition and Blood Biochemical Indexes of Female Wrestling Athletes during Weight Control Period and The Comprehensive Analysis of Dietary Status of Male Athletes in Heavy Athletics Team of Hubei Province (Mountjoy et al., 2014).

Nowadays, the level of sports competition in China has been rapidly improved and Chinese athletes have repeatedly accomplished splendid works in various competitions around the world. China is now marching from a sports power into a sports giant. This can not be separated with the scientific guidance of sports nutritional knowledge and the proper use of methods and means. Along with the continuous social improvement and the booming development of sports undertakings, sports nutrition will surely accomplish more stupendous achievements in the future.

2. Materials and methods

(1) Research object

Taking 13 female wrestlers and 14 women boxing athletes of one province as examples. Among 13 female wrestlers, there are 1 National Master Athlete, 1 National First-Level Athlete and 11 National Second-Level Athlete. Among 14 women boxing athletes, there is 1 International Master Athlete, 5 National Master Athletes, 4 National First-Level Athletes and 4 newly entered athletes whose levels have not been recognized yet. The basic information of research objects is as follows.

(2) Investigation methods

A survey is conducted by issuing questionnaire of nutritious diet to investigate athletes' daily diets so that their dietary habits and nutritional knowledge can be comprehensively understood and researched. This research uses 13 female wrestlers and 14 women boxing athletes of Nei Monggol Autonomous Region as the research object and issues 81 return visit questionnaires of 24-hour diet. These questionnaires are issued at three different times in 3 days and 27 questionnaires are issued each time in one day. Among them, there are 81 valid questionnaires and the recovery rate of those valid questionnaires is 100 % (Table 1).

(3) Weighed dietary record method

Researchers use libra to weigh the raw weight and cooked weight of the food that respondents eat every meal each day respectively. At the same time, they should also pay attention to weighing the remaining food to obtain more accurate intake results of the food that respondents eat every meal each day(Dueck et al. 1996). The weighed dietary record method can be conducted in 3, 4, 5, 7 or 20 days continuously. The weighed dietary record method of 3-4 days is the most widely and frequently used and takes the top spot. This method is accurate and reliable, yet its human cost and time cost are relatively high and is not suitable for the large-scale survey (Howe et al., 2014). However, it is still fit for the small-scale population that possesses special nutritional

requirements, for example, the aged, children and athletes.

Varieties and quantities of the food supplied by the canteen every meal per day and the food ingested by athletes should both be precisely weighed and recorded in great details (Beck et al., 2014). Then the software of Athletes and Public Diet Application Analysis and Management System should be applied to conduct the data analysis of various nutrients on acquired data.

(4) Data processing method

Athletes' intake of various food recorded in the related questionnaire survey should be entered into the software of Athletes and Public Diet Application Analysis and Management System which is researched and developed by General Administration of Sport of China to calculate the data of various nutrients. SPSS 17.0 software should be used to conduct the data processing and analysis and all data should be expressed as average ± standard deviation. In the end, a pared-samples T test should be conducted among statistical results, Chinese Resident Dietary Nutrition Recommended Standard and Chinese Athletes Dietary Nutrition Recommended Standard. If $P \leq 0.05$, then the significant difference exists; if $P \leq 0.01$, then non-significant difference exists (Gao and Zhang, 2015).

Table 1. Athletes the material average energy intake

Player number	Energy	Protein	Fat	Sugar
1	3620	120	163	357
2	2625	106	235	623
3	4144	389	223	365
4	3452	236	2361	605
5	3625	402	524	702
6	4421	409	412	554
7	3620	410	925	754
8	4521	312	625	565
9	4120	265	666	236
10	4265	366	485	648
11	4258	331	652	569
12	4520	420	645	668
13	2323	452	611	669
14	3525	306	459	545
15	3958	311	605	658
16	4712	308	695	458
17	4256	369	459	625
18	2565	296	552	474
19	3362	452	454	625
20	4420	268	628	565
21	3362	369	564	352
22	3636	452	268	645
23	4850	245	525	525
24	4421	333	703	664
25	4456	358	625	756
26	2658	542	459	541
27	4012	333	563	762
Average	3621.32	320.32	575.25	602.42
The standard	574.26	101.25	254.23	135.21

deviation				
Recommended value	4472	160	115	655

Table 2. Athletes average vitamin intake

Player number	Vitamin A	Vitamin B1	Vitamin B2	Vitamin PP	Vitamin C	Vitamin E
1	751.23	1.6	1.9	37.2	86.3	51.3
2	251.32	1.7	1.9	32.6	71.3	35.2
3	752.36	1.5	2.1	46.9	95.3	119.6
4	4521.3	2.5	1.7	60.2	114.3	356.2
5	4162.3	2.3	2.5	64.3	147.5	312.6
6	2754.1	2.5	7.8	50.3	104.3	247.5
7	4210.6	2.3	3.5	45.3	88.5	225.6
8	2730.6	2.1	1.6	103.6	160.3	278.3
9	3345.3	3.6	2.0	78.6	88.2	256.3
10	4512.3	2.2	2.1	28.6	160.3	225.3
11	5212.2	1.8	1.8	45.6	129.5	541.6
12	3212.2	1.4	2.6	25.3	97.5	352.6
13	1232.3	2.5	3.0	78.3	158.2	298.3
14	4253.3	2.3	2.9	103.6	92.3	295.3
15	2563.3	2.6	3.2	45.6	152.3	365.3
16	5223.6	2.5	3.5	75.0	114.3	525.3
17	3633.2	2.8	3.3	28.5	88.5	264.3
18	3625.3	2.4	2.1	49.3	93.2	232.6
19	3021.3	2.2	2.2	28.6	175.6	336.8
20	3632.2	2.7	1.5	45.3	93.6	284.5
21	5232.6	3.2	2.2	55.3	154.9	452.3
22	4253.3	1.9	2.6	56.3	142.7	254.6
23	2315.2	2.0	3.5	58.6	185.3	295.6
24	4251.3	1.2	2.2	45.3	113.6	269.5
25	3205.2	2.8	1.5	47.3	100.8	365.3
26	2536.4	2.6	1.9	65.3	147.6	266.3
27	3625.3	2.6	2.0	66.8	165.3	298.5
Average	3521.4	2.4	2.3	57.5	115.3	83.6
The standard deviation	1136.3	2.0	1.3	26.3	30.2	85.6
Recommended value	1500	3-5	2-2.5	20	140	30

3. Results and discussions

(1) Athletes' ingestion conditions of three major energy substances and **energy intake**

As seen in Table 2, athletes' daily ADI of protein and fat is higher than the recommended intake standard for the most part. 3 athletes' ADI of protein is lower than the standard, which accounts for 11% of the overall number of athletes. Only 1 athlete's ADI of fat is lower than the standard and other athletes' ADIs are all around 1-9 times higher than the standard value. The intake of 13 athletes' ADI of carbohydrate reaches the recommended standard and accounts for 48% of the overall number of athletes. As for

the energy intake, only 5 athletes' ADIs are higher than the recommended standard, which accounts for 18.5% of the overall number of athletes. We can learn from Table 3 that: athletes' intake conditions of various energy substances exist different levels of inadequate intake phenomenon. Especially, the intake of energy and that of carbohydrate both commonly exists the inadequate intake phenomenon. Carbohydrate is the most easily digested and assimilated substance and plays the vital role in the elimination of athletic fatigue. Research results show that the competitive sports training of large load intensity consumes sugar and uses it as the main energy source. Besides, the inadequate carbohydrate reserve before the training is the most important factor that makes sports fatigue happen in advance and affects training effects. In consideration of the insufficient carbohydrate intake, from now on, athletes should pay attention to ingesting more food which contains high carbohydrate content in the daily diet.

Table 3. Athletes' ADIs of vitamin PP and vitamin E

Player number	Potassium	Calcium	Iron	Zinc	Selenium
1	2540	535	32	34	170
2	1720	452	25	20	100
3	2560	563	128	24	75
4	9256	2112	112	64	256
5	7512	1525	78	64	236
6	8805	1356	58	70	185
7	7152	1852	86	52	156
8	7562	1116	84	56	178
9	9125	1168	82	84	156
10	6235	3625	54	42	156
11	7012	1425	96	26	123
12	9912	1652	54	53	256
13	7025	1563	116	33	207
14	8856	2546	69	69	236
15	8812	2654	83	95	253
16	7025	2512	125	66	117
17	6636	2654	129	68	156
18	7025	1265	136	56	185
19	5623	1525	90	84	235
20	8566	1865	85	53	227
21	8562	1763	75	66	256
22	8152	1140	74	85	196
23	8412	1360	110	65	227
24	6596	1425	96	56	186
25	6032	1565	56	44	200
26	6060	1253	69	36	227
27	7025	1752	69	58	193.2
Average	6563	1632.2	86	56	47.5
The standard deviation	3263	625.3	28.3	13.6	48.2
Recommended value	3000-4000	1000-1500	20-25	20-25	50-150

(2) Athletes' ingestion conditions of vitamin

Table 3 shows that athletes' ADIs of vitamin PP and vitamin E are all 1-10 times higher than the recommended value. 3 athletes' ADIs of vitamin A are insufficient, which accounts for 11% of the overall number of athletes. Only 3 athletes' ADIs of vitamin B1 reach the standard, among them, 1 athlete's ADI of vitamin B1 is more than 2 times higher than the standard. 14 athletes' ADIs of vitamin B2 are lower than the recommended standard, which accounts for 52% of the overall number of athletes. Only 7 athletes' ADIs of vitamin C reach the recommended standard, which accounts for 26% of the overall number of athletes. We can learn from this table that athletes' intake conditions of vitamin A, vitamin B1, vitamin B2 and vitamin C all exist different levels of inadequate intake phenomenon, which indicates that athletes pay no attention to the sufficient vegetables and fruits' intake in their daily dietary nutrition.

(3)Athletes' ingestion conditions of mineral substances

Table 4 shows that athletes' ADIs of mineral nutrientsall reach or exceed the recommended value. Only 3 athletes' ADIs of K and Ca are lower than the recommended standard, which accounts for accounts for 11% and 11% respectively. We can learn from this table that there are great variations between different athletes' intake conditions of mineral elements.

Table 4. Athletes energy substance actual intake with all the Chinese people's energy intake recommendations

Category	Energy	Protein	Fat	Sugar
The actual intake	3625.2	332.3	525.3	602.3
Recommended value	2563.3	80	80	550
difference	1362.1	253.2	456.3	52.3
T value	11.255	12.522	10.233	2.013
P values	0.000	0.000	0.000	0.045

Table 5. Athletes vitamin actual consumption compared with Chinese residents vitamin intake

Category	Vitamin A	Vitamin B	Vitamin C	Vitamin D	Vitamin E
Athletes intake	3252.3	2.7	2.2	57.2	266.3
Residents are recommended	700	1.3	1.2	13	14
difference	2362.3	1.4	1.0	13.2	253.2
T value	11.520	3.363	4.233	2.200	15.261
P values	0.000	0.001	0.000	0.038	0.000

(4) Comparison between Results of Dietary Nutrition Survey and Chinese DRIs

Table 5 shows that the athletes' intake of energy, protein and fat is much higher than the recommended amount for Chinese citizens. Athletes' intake of energy is 1-2 times higher than the recommended amount for Chinese citizens while the protein intake is 1-7 times higher. Besides, athletes' intake of fat is 1-10 times higher than the recommended amount for Chinese citizens. Only one athlete intakes fat over 10 times more than average Chinese citizens, making 3.7% of the total population. The intake of carbohydrate by 10 athletes is less

than the recommended amount for Chinese citizens, covering 37% of the total population. From these data, it can be seen that the intakes of energy, protein and fat by athletes are more than the recommended amounts for Chinese citizens, meaning that athletes' demands for these substances are much larger than that of average Chinese citizens, and the gaps of demands for energy substances between athletes and average Chinese citizens are great. From the data on carbohydrate intake, the percentage of number of athletes whose intakes of carbohydrate have approached or surpassed the amount recommended for average Chinese citizens is only 67%, which means that athletes don't intake enough carbohydrate to different degrees.

It can be seen from Table 5 that the actual energy intake of athletes is higher than the recommended amount for Chinese resident by approximately 1,400 Kcal, and the intake of protein is 4 times higher while the fat intake is about 7 times higher. The intake of carbohydrate is higher than the recommended amount for Chinese citizens by 50g. By applying the comparative T-test to the actual intake of energy substances by athletes and to the Chinese DRIs, it can be found that the difference in carbohydrate intake between by athletes and by Chinese citizens isn't significant ($t=2.015$, $p\geq0.05$). The results of T-test applied to other energy substances (excluding carbohydrate) as well as their corresponding recommended amount for Chinese citizens show that: for energy, $t = 11.781$ and $p < 0.05$; for protein, $t = 12.811$ and $p < 0.05$; for fat, $t = 10.944$ and $p < 0.05$, which means differences between athletes' intake of other two energy substances (excluding carbohydrate) and recommended amount for Chinese citizens are significantly obvious.

As Table 5 shows, the actual intakes of Vitamin A, B1, B2, PP, C and E are much higher than their correspondingly recommended amount for Chinese citizens. By applying T-Test analysis into athletes' actual intake of vitamin and the recommended amounts in Chinese DRIs, for Vitamin A, B1, B2, PP, C and E, t is respectively 11.503, 3.551, 4.356, 15.192, 2.200 and 15.616, and p of all these vitamins is < 0.05, which means the differences between athletes' actual intake of each sort of vitamin and the correspondingly recommended amount for average Chinese citizens are significantly obvious.

4. Conclusions

(1) From the distribution proportions of calories for three meals (i.e. breakfast, lunch and dinner) each day from the survey results, compared with the recommended proportions, the intake of calories at breakfast is less than the recommended proportion, so does the intake of calories at lunch. Although the actual intakes at breakfast and lunch aren't enough, they're basically qualified. Meanwhile, the calories intake at dinner surpasses the recommended proportion by 0.3%, which is acceptable.

(2) According to actual intakes of nutrients by athletes, the fat intake has met the recommended standards. However, the intakes of energy, protein and carbohydrate by some athletes aren't enough to different degrees, especially the intake of carbohydrate. Athletes' intakes of vitamin PP and E are above the recommended standards while the intakes of Vitamin A, B1, B2 and C are below the standards to different degrees, especially the intakes of B1, B2 and C. Athletes' intakes of Fe, Zn and Se have already reached the recommended standards while only 11% of athletes don't have enough intakes, which means that a few athletes don't take enough mineral elements.

(3) Comparing the actual intakes of nutrients by athletes and Chinese DRIs, results show that athletes' intakes of energy substances, vitamins and mineral elements are above the recommended intakes for average Chinese citizens, and the in-between gaps are significantly obvious.

(4). Comparing the actual intakes of three energy substances and the ADIs for Chinese athletes, results have made it clear that the average intakes of protein and fat by athletes have approached or even exceeded the recommended amount while the intakes of

energy and carbohydrate are less than the recommended amount.

(5) Comparing the intakes of vitamins by female wrestlers and boxers in a particular province and the recommended amounts of vitamins for Chinese athletes, the results show that the average intakes of Vitamin A, PP and E by athletes are obviously higher than the correspondingly recommended amounts for Chinese athletes. The intake of Vitamin B2 happens to fall into the recommended range. Although the intake of Vitamin B1 hasn't reached the recommended standard, the gap is small. The intake of Vitamin C is simply less than the recommended standard for Chinese athletes.

(6) Comparing the intakes of mineral elements by female wrestlers and boxers in a particular province and the recommended amounts of vitamins for Chinese athletes, results show that the average intakes of all mineral elements by athletes have met and exceeded the recommended standards for Chinese athletes. Only a few athletes may lack some kinds of mineral elements to different degrees.

However, some problems in the survey may affect the results. (1). Due to the limits of manpower and material resources, only 27 athletes from two teams were chosen as subjects which was a relatively small sample. (2). In the surveying process, it has found out many athletes wrongly wrote the words, thus the names of food they ate couldn't be accurately understood. (3). Female athletes may be shy and weren't capable of honestly telling the actual amount of food they consumed. (4). Since a few athletes didn't cooperate well with researchers, some errors may occur to affect the accuracy of the results. (5). It was found out that the restaurant didn't supply fruit. For the above problems, we discussed and coordinated with coaches so that they could persuade the athletes to take this survey seriously and honestly tell the food they consumed each day. Meanwhile, we made every effort in ensuring the accuracy of this survey. During the research, we also found that excellent athletes usually possessed good qualities and had food according to regulated quota, which means they paid much attention to this dietary nutrition survey. On the contrast, athletes with bad performance couldn't have the healthy and reasonable diet, and they may be picky eater, reflecting their lack of understanding the significance of dietary nutrition.

By referring to related literature, we found that many athletes at the province-level or municipal athletic teams had different degrees of misunderstanding of dietary nutrition. Besides, their neglect of dietary nutrition was alarming. Athletes had a bad knowledge of nutrition, especially those about everyday dietary nutrition, for which some measures were proposed:

(1). The managers should find some time to educate the athletes about the knowledge about nutrition.

(2). Posters about dietary nutrition should be placed inside the restaurant, dinner table, training facility and dormitory so that they can learn the related knowledge whenever and wherever they can.

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