Food Alone May Not Provide Sufficient Micronutrients for Preventing Deficiency[1]

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ABSTRACT

The American Dietetic Association (ADA) has stated that the best nutritional strategy for promoting optimal health and reducing the risk of chronic disease is to wisely choose a wide variety of foods. Seventy diets were computer analyzed from the menu of athletes or sedentary subjects seeking to improve the quality of micronutrient intake from food choices. All of these dietary analyses fell short of the recommended 100% RDA micronutrient level from food alone. Therefore, based on diets analyzed for adequacy or inadequacy of macronutrients and micronutrients, a challenging question is proposed: "Does food selection alone provide 100% of the former RDA or newer RDI micronutrient recommended daily requirement?" ***Journal of the International Society of Sports Nutrition*. 3(1):51-55, 2006**

Key Words: nutrition, RDA, RDI, micronutrients

INTRODUCTION

Reference Daily Intakes (RDI) is a new term that replaces the familiar U.S. Recommended Daily Allowances (U.S. RDA). RDIs are based on a population-weighted average of the latest RDAs for vitamins and minerals for healthy Americans over 4 years old. RDIs are not recommended optimal daily intake figures for any particular age group or sex. Government-established Reference Daily Intake guidelines (RDI) are designed to prevent nutrient-deficiency diseases. Most nutritionally oriented professionals imply that a balanced variety of foods selected from the Food Guide Pyramid (FGP) will supply all micronutrients at the RDA or new RDI levels necessary to maintain optimal health and prevent nutrient-deficiency diseases. The American Dietetic Association (ADA) has proposed a conservative strategy for managing dietary micronutrient deficiency and sufficiency:

> "It is the position of the American Dietetic Association (ADA) that the best nutritional strategy for promoting optimal health and reducing the risk of chronic disease is to wisely choose a wide variety of foods. Additional nutrients from fortified foods and/or supplements can help some people meet their nutritional needs as specified by science-based nutrition standards such as the Dietary Reference Intakes. This position paper addresses increasing the nutrient density of foods or diets through fortification or supplementation when diets fail to deliver consistently adequate amounts of vitamins and minerals."

Between 1996 and 2005, 70 diets were computer analyzed from the menu of athletes or sedentary subjects seeking to improve the quality of micronutrient intake from food choices. Surprisingly, all of these dietary analyses fell short of the recommended 100% RDA micronutrient level from food alone. Therefore, based on diets analyzed for adequacy or inadequacy of macronutrients and micronutrients, a challenging question is proposed: "Does food selection alone provide 100% of the former RDA or newer RDI micronutrient recommended daily requirement?"

METHODS

From 70 computer-generated dietary analyses, 20 subjects' diets were selected based on the highest number of foods analyzed from 10 men (ages 25-50y) and 10 women (ages 24-50y). A First Data Bank

Nutritionist IV computer-program default was utilized, defaulted to apply the Harris-Benedict equation, a formula that determines energy expense against RDA micronutrient requirement, by age, gender, and body mass index (BMI). The purpose of this study was to determine if food intake alone provided the Recommended Daily Allowances (RDA) requirements for 10 vitamins and 7 minerals. The ten vitamins analyzed were Vitamin A, Vitamin D, Vitamin E, Vitamin K, Vitamin B-1, Vitamin B-2, Vitamin B-3, Vitamin B-6, Vitamin B-12, and Folate. The seven minerals analyzed were Iodine, Potassium, Calcium, Magnesium, Phosphorus, Zinc, and Selenium.

The 20 Individual Diets analyzed originated from the following subjects:

1. Two professional cyclists athletes (A)
2. Three amateur cyclists athletes (A)
3. Three amateur triathletes athletes (A)
4. Five eco-challenge amateur athletes (A)
5. One amateur runner athlete (A)
6. Six sedentary non-athletes (S)

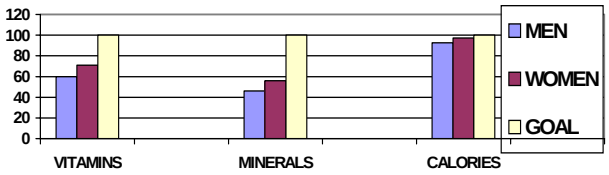
Hence, fourteen (14) athletes' (A) and six (6) sedentary subjects' (S) diets were analyzed for calorie and RDA-micronutrient adequacy or inadequacy.

RESULTS

Based on each subject's activity level (caloric expense), age, gender, and body mass index (BMI), 10 of the diets were found calorie-excessive, above energy requirements (4 men and 6 women), but the remaining 10 diets were found calorie-deficient, not meeting 100% of their energy requirements (6 men and 4 women). When total calorie intake percents were averaged by gender, men consumed only 92.6% of the calories required for their total energy requirements, while women consumed only 97.3% of the calories required to meet their energy requirements. Of the 20 diets analyzed, 50% were calorie-sufficient and 50% calorie-deficient resulting in an overall -7.4% deficiency for men and a -2.7% deficiency in women (Table 1.).

Calorie deficient diets tended to record a greater number of micronutrient deficiencies as compared to the calorie-sufficient diets. Of the 340 micronutrient entries generated from 17 micronutrients analyzed,

TABLE 1. MICRONUTRIENT DEFICIENCY FROM DIETS
10 MEN & 10 WOMEN %



all 20 subjects presented between 3 and 15 deficiencies each based on the Recommended Daily Allowances (RDA) value from food intake alone. Males averaged deficiencies in 40% of the vitamins and 54.2% of the minerals required. Females averaged deficiencies in 29% of the vitamins and 44.2% of the minerals Recommended Daily Allowances (RDA) required. The male food intake was RDA-deficient in 78 out of 170 micronutrient entries, or 45.8% of the 10 vitamins and 7 minerals analyzed. The female dietary intake was RDA-deficient in 60 out of 170 micronutrients or 35.2% of the 10 vitamins and 7 minerals analyzed. Both male and females as a single entity recorded 138 micronutrient deficiencies out of the possible 340 micronutrients analyzed, or 40.5% micronutrient RDA-deficiency from food intake alone. (Table 2.)

CONCLUSION

Accuracy of the individual food-weighed measures, accuracy in reporting foods consumed, and the accuracy of the computer-generated software are factors that affect the accuracy of the results reported in this observational study. The effect of activity on calorie deficiency in this contingent demonstrates an increased micronutrient deficiency in athletes (A) and surprisingly, the sedentary subjects (S) in this study also posted food-borne micronutrient deficiencies. Each chronic deficiency proportionately increases the risk of nutrient-deficiency diseases. In highly active athletes (A), micronutrient deficiencies occur at higher rates because calorie deficits are associated with exercise expense. Food alone in all 20 subjects did not meet the minimal Recommended Daily Allowances (RDA) micronutrient requirements for preventing nutrient-deficiency diseases. The more active the person, the greater the need to employ a variety of balanced micronutrient-enriched foods including micronutrient supplementation as a preventative protocol for preventing these observed deficiencies. (Tables 3, 4, 5).

Concern for micronutrient adequacy from food alone is not a new question. Excerpts 70 years ago (1936)

from the 2nd Session of the 74th USA Congressional Record (excerpts) stated:

> "Laboratory tests prove that the fruits, the vegetables, the grains, the eggs and even the milk and the meats of today are not what they were a few generations ago (which doubtless explains how our forefathers thrived on a selection of foods that would starve us today). It is bad news to learn from our leading authorities that 99% of the American people are deficient in these minerals, and that a marked deficiency in any one of the more important minerals actually results in disease. Any upset of the balance, any considerable lack of one or another element, however microscopic the body requirement may be, and we sicken, suffer, and shorten our lives."

This twenty-subject dietary analysis study is not representative of the entire population, however the results supported by the 1936 congressional record, beg the question:

> "Does food selection alone provide 100% of the former RDA or newer RDI micronutrient recommended daily requirement?"

It may be that chronic micronutrient insufficiency from food alone is more fact than fantasy. This study calls for a dietary analysis of a larger contingent of the population to determine if there is an association between chronic suboptimal RDI-micronutrient deficiency and suboptimal health disorders that may digress into disease.

Disclosure: Bill Misner Ph.D. is employed by *E-CAPS & HAMMER NUTRITION*, a manufacturer of dietary supplements for endurance athletes.

Table 2. Total Dietary Micronutrients and Macronutrients

TOTAL	MEN	WOMEN
TOTAL MICRONUTRIENT ENTRIES	170 (100 VITAMIN & 70 MINERAL ENTRIES)	170 (100 VITAMIN & 70 MINERAL ENTRIES)
TOTAL GROUP INDIVIDUAL MICRONUTRIENT DEFICIENCIES	78	60
TOTAL CALORIC AVERAGE DEFICIENCY	92.6% -7.4% DEFICIENCY	97.3% -2.7% DEFICIENCY
TOTAL VITAMIN DEFICIENCIES	40 40% DEFICIENCY	29 29% DEFICIENCY
TOTAL MINERAL DEFICENCIES	38 54.2% DEFICIENCY	31 44.2% DEFICIENCY
TOTAL MICRONUTRIENT DEFICIENCY	78 45.8% DEFICIENCY	60 35.2% DEFICIENCY
GROUP I & II MALE & FEMALE MICRONUTRIENT DEFICIENCY	40.5% DEFICIENCY	

TABLE 3.
Group I (5 Men, 5 Women)

MICRONUTRIENT	MEN % Reference Daily Intake (RDI)					WOMEN % Reference Daily Intake (RDI)				
MALE (M) WOMEN (W) ACTIVE (A) SEDENTARY (S)	M1 (A)	M2 (A)	M3 (S)	M4 (A)	M5 (A)	W1 (A)	W2 (A)	W3 (A)	W4 (A)	W5 (A)
TOTAL CALORIES INTAKE REPORTED	55%	59%	53%	161%	112%	64%	77%	138%	104%	103%
VITAMIN A	71%	116%	69%	445%	49%	241%	1617 %	203%	95%	807%
VITAMIN D	19%	59%	63%	30%	32%	10%	38%	1%	70%	8%
VITAMIN E	43%	135%	18%	76%	66%	146%	95%	154%	64%	206%
VITAMIN K	19%	311%	11%	122%	61%	18%	511%	44%	78%	155%
VITAMIN B-1	71%	103%	140%	290%	183%	64%	168%	334%	389%	264%
VITAMIN B-2	69%	95%	67%	209%	342%	77%	146%	183%	382%	183%
VITAMIN B-3	155%	87%	64%	294%	123%	117%	267%	256%	270%	214%
VITAMIN B-6	90%	144%	55%	137%	77%	81%	231%	143%	180%	213%
VITAMIN B-12	99%	156%	123%	193%	357%	119%	140%	78%	99%	328%
FOLATE	55%	235%	76%	255%	233%	73%	130%	249%	174%	311%
IODINE	0%	58%	0%	0%	36%	0%	25%	31%	0%	58%
POTASSIUM	124%	212%	67%	253%	144%	94%	206%	217%	201%	238%
CALCIUM	53%	90%	77%	179%	111%	65%	84%	118%	182%	99%
MAGNESIUM	51%	124%	44%	175%	73%	82%	140%	207%	119%	156%
PHOSPHORUS	105%	169%	138%	175%	248%	89%	113%	411%	218%	249%
ZINC	35%	55%	48%	124%	97%	35%	78%	144%	67%	164%
SELENIUM	30%	44%	24%	159%	97%	3%	120%	256%	117%	174%
INDIVIDUAL MICRONUTRIENT DEFICIENCIES	14	7	15	3	9	13	5	4	7	3

TABLE 4.
Group II (5 MEN, 5 WOMEN)

MICRONUTRIENT	MEN % Reference Daily Intake (RDI)					WOMEN % Reference Daily Intake (RDI)				
MALE (M) WOMEN (W)	M6 (S)	M7 (A)	M8 (A)	M9 (A)	M10 (A)	W6 (A)	W7 (S)	W8 (S)	W9 (S)	W10 (S)
TOTAL CALORIES INTAKE REPORTED	42%	161%	56%	93%	134%	125%	118%	76%	104%	64%
VITAMIN A	248%	445%	105%	129%	117%	533%	318%	326%	216%	130%
VITAMIN D	75%	30%	66%	13%	125%	86%	43%	60%	6%	16%
VITAMIN E	1%	76%	0.2%	123%	93%	19%	195%	9%	173%	39%
VITAMIN K	205%	122%	104%	95%	73%	341%	110%	197%	189%	28%
VITAMIN B-1	101%	290%	95%	137%	187%	255%	206%	98%	176%	155%
VITAMIN B-2	100%	209%	106%	167%	189%	219%	191%	113%	143%	84%
VITAMIN B-3	119%	294%	126%	130%	198%	204%	207%	163%	186%	167%
VITAMIN B-6	97%	137%	73%	117%	167%	168%	141%	125%	133%	128%
VITAMIN B-12	146%	193%	179%	216%	224%	111%	191%	182%	161%	98%
FOLATE	151%	255%	137%	190%	260%	327%	156%	131%	209%	171%

IODINE	0%	0%	18%	0%	0%	0%	0%	0%	0%	0%
POTASSIUM	136%	253%	99%	137%	260%	206%	135%	171%	122%	73%
CALCIUM	59%	179%	77%	127%	193%	178%	95%	103%	114%	69%
MAGNESIUM	75%	175%	72%	92%	146%	167%	125%	110%	130%	77%
PHOSPHORUS	119%	321%	135%	193%	254%	213%	148%	149%	144%	65%
ZINC	41%	124%	71%	68%	96%	98%	98%	67%	63%	56%
SELENIUM	55%	159%	47%	74%	122%	125%	85%	173%	146%	115%
INDIVIDUAL MICRONUTRIENT DEFICIENCIES	8	3	10	6	4	4	5	5	3	11

TABLE 5. MICRONUTRIENT DEFICITS

MICRONUTRIENT	MICRONUTRIENT RDA %	MEN # DEFICIT	WOMEN # DEFICIT
IODINE *	100%	10	10
VITAMIN D	95%	9	10
ZINC	80%	8	8
VITAMIN E	65%	8	5
CALORIES	50%	6	4
CALCIUM	50%	5	5
SELENIUM	45%	7	2
VITAMIN K	45%	5	4
MAGNESIUM	40%	6	2
VITAMIN B-6	30%	5	1
VITAMIN B-2	25%	3	2
VITAMIN A	25%	3	2
VITAMIN B-1	20%	2	2
VITAMIN B-12	20%	1	3
POTASSIUM	20%	2	2
FOLATE	15%	2	1
VITAMIN B-3	10%	2	0
PHOSPHORUS	10%	0	2

* Iodine is present in sea vegetation, but not in most foods unless iodized salt is added. An iodine intake of less than 20 micrograms (ug) per day is considered severe deficiency; 20-50 micrograms (ug) per day.

REFERENCES

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