The "Ideal" Daily Intake of Threonine, Valine, Phenylalanine, Leucine, Isoleucine, and Methionine

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Introduction

The Food and Nutrition Board of the National Research Council-National Academy of Sciences has not set recommended dietary allowances (RDA) for amino acids. However, they have published estimated human amino acid requirements (Food and Nutrition Board, 1974). The estimated adult needs in milligrams per kilogram of body weight for the amino acids reported here are: threonine—8, valine—14, phenylalanine plus tyrosine—16, leucine—16, isoleucine—12, and methionine plus cystine—10.

Earlier studies have attempted to develop an "ideal" daily consumption level for a variety of nutrients (vitamins A, B, C, and B3, refined and unrefined carbohydrates, magnesium, total protein, and lysine) based on the hypothesis that relatively symptomless and signfree persons are healthier than those with clinical symptoms and signs (Cheraskin et al., 1976a; Cheraskin et al., in press; Cheraskin et al., 1977a; Cheraskin et al., 1976b; Cheraskin and Ringsdorf, 1974; Cheraskin et al., 1977b; Cheraskin et al., 1977c; Cheraskin et al., 1977d; and Cheraskin et al., 1977e). Therefore, the intake of such groups might provide a basis for designating the "ideal" daily consumption of the essential amino acids-threonine, valine, phenylalanine, leucine, isoleucine, and methionine-in this report.

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Methods and Procedures

Eight hundred and seventy-six doctors and their wives were evaluated in terms of their intake of individual amino acids as judged from a food frequency questionnaire. Clinical state was graded by the Cornell Medical Index Health Questionnaire (CMI). The CMI is a self-administered health questionnaire consisting of 195 questions. Each question is answered by circling the word "yes" or "no." The questions are phrased so that the affirmative answers indicate pathology. The clinical findings in this report are the total number of affirmative CMI responses (CMI score).

Results

This paper presents the data for the "ideal" consumption of threonine, valine, phenylalanine, leucine, isoleucine, and methionine in the 876 doctors and their wives.

Tables 1, 3, 5, 7, 9, and 11 present the daily consumption of threonine, valine, phenylalanine, leucine, isoleucine, and methionine, respectively, for the entire group. These data from a food frequency questionnaire were based on food table calculations from Handbook Number Eight of the United States Department of Agriculture.

The reported mean intake for each of these amino acids in the entire sample (line one in each table) is approximately six to sevenfold the estimated needs for a 70 kilogram adult (Food and Nutrition Board, 1974). Thus, they would generally be regarded as "ideal" or "optimal." However, proceeding through the remaining 10 lines of each table, the daily amino acid intake rises as the number of allowable clinical symptoms and signs (CMI score) in each subgroup is reduced.

TABLE 1

relationship of reported daily threonine consumption (food frequency questionnaire) and reported total clinical findings (Cornell Medical Index Health Questionnaire) thy male and female sample

	ndings	daily intake of threonine (mg)	
	ll responses)	range	mean and S.D.
	nean and S.D.		
	15.9±12.9	632-9800	3857±1439
	14.4± 9.8	632-9800	3853±1430
	13.6± 8.7	632-9800	3848±1432
	12.2± 7.0	632-9800	3843±1440
	9.7± 4.9	632-9489	3896±1461
	5.6± 2.4	1350-9489	4035±1445
	2.7± 1.2	1800-7497	4219±1360
	2.1± 0.9	1800-7497	4255±1347
	1.5± 0.7	2425-7497	4306±1257
	0.6± 0.5	2425-7147	4365±1197
	0.0± 0.0	3600-7147	4868±1220

TABLE 2

statistical significance of the relationship of threonine and reported clinical findings (CMI)

	n	t	P
(1) entire sample versus	876		
(2) CMI <10	319	1.893	>0.050
(3) CMI < 5	102	2.528	<0.025*
(4) CMI < 4	68	2.338	<0.025*
(5) CMI < 3	41	2.254	<0.025*
(6) CMI < 2	16	1.676	>0.050
(7) CMI 0	6	2.020	<0.050*

* statistically significant difference of the means

(11) CMI 0 6 0

Tables 2, 4, 6, 8, 10, and 12 present the statistical significance of the relationships between the reported clinical findings (CMI score) and the intake of threonine, valine, phenylalanine, leucine, isoleucine, and methionine, respectively. Statistically significant mean differences in amino acid intake are noted for threonine (Table 2), valine (Table 4), phenylalanine (Table 6), leucine (Table 8), and isoleucine (Table 10) when the consumption of the entire group is compared to those with progressively fewer clinical findings.

Specifically, there are significant increases in amino acid intake for the entire sample versus those subjects with a CMI score of < 5, < 4, and < 3 in Table 2 (threonine), Table 4 (valine), Table 8 (leucine), and Table 10 (isoleucine).

Table 6 (phenylalanine) has only one significant relationship (CMI < 4) and Table 12 (methionine) has none. Methionine consumption, however, in Table 11 shows a much smaller mean rise from line one through line 11 (635 mg) than for the consumption of threonine (1,011 mg), valine (1,819 mg), phenylalanine (1,094 mg), leucine (2,135 mg), and isoleucine (1,659 mg).

This would indicate that the mean intake of methionine by the entire sample is already at the "ideal" or "optimal" level. The data for phenylalanine similarly indicate that the entire group consumption is near the "ideal" level of intake.

These data demonstrate that the healthier the sample, the greater the intake of essential amino acids. Under the experimental conditions in this study, the "ideal" allowance may be five to tenfold the estimated adult amino acid requirements of man. However, the true essential amino acid intake is likely less than the calculated figure we reported since considerable protein destruction occurs as foods are heated (Cheraskin et al., 1968). More severe heat damage to proteins results when moist heat is used. The presence of reducing sugars during the heat processing causes a true destruction of amino acids and has been repeatedly corroborated with a loss of the essential amino acids. Cooking and other processing methods together can account for a 20 to 50 percent loss of many essential amino acids.

TABLE 3

relationship of reported daily valine consumption (food frequency questionnaire) and reported total clinical findings (Cornell Medical Index Health Questionnaire) in a presumably healthy male and female sample

	sample size	clinical findings (affirmative CMI responses) range	clinical findings (affirmative CMI responses) mean and S.D.	daily intake of valine (mg) range	daily intake of valine (mg) mean and S.D.
(1) entire sample	845	0-125	15.4±12.2	1394-22788	5500±2130
(2) CMI < 50	829	0- 49	14.4± 9.8	1394-22788	5460±2126
(3) CMI < 40	807	0- 39	13.6± 8.6	1394-22788	5465±2125
(4) CMI < 30	754	0- 29	12.2± 7.1	1394-22788	5481±2141
(5) CMI < 20	615	0- 19	9.7± 4.9	1500-22788	5548±2174
(6) CMI < 10	310	0- 9	5.6± 2.3	1836-13491	5715±2027
(7) CMI < 5	99	0- 4	2.8± 1.2	2182-11587	5970±1955
(8) CMI < 4	67	0- 3	2.1± 0.9	2800-11587	6046±1937
(9) CMI < 3	40	0- 2	1.6± 0.7	3950-10652	6187±1754
(10) CMI < 2	13	0- 1	0.7± 0.5	4300-10139	6399±1629
(11) CMI 0	4	0	0.0± 0.0	5400-10139	7319±2012

TABLE 4

statistical significance of the relationship of valine and reported clinical findings (CMI)

	n	t	P
(1) entire sample versus	845		
(2) CMI < 10	310	1.578	> 0.100
(3) CMI < 5	99	2.245	< 0.025*
(4) CMI < 4	67	2.203	< 0.050*
(5) CMI < 3	40	2.394	< 0.025*
(6) CMI < 2	13	1.515	> 0.100
(7) CMI 0	4	1.704	> 0.050

* statistically significant difference of the means

TABLE 5

relationship of reported daily phenylalanine consumption (food frequency questionnaire) and reported total clinical findings (Cornell Medical Index Health Questionnaire) in a presumably healthy male and female sample

	sample size	clinical findings (affirmative CMI responses) range	clinical findings (affirmative CMI responses) mean and S.D.	daily intake of phenylalanine (mg) range	daily intake of phenylalanine (mg) mean and S.D.
(1) entire sample	862	0-125	15.5±12.5	182-10262	4247±1512
(2) CMI < 50	843	0- 49	14.4± 9.8	182-10262	4243±1508
(3) CMI < 40	821	0- 39	13.6± 8.7	182-10262	4229±1504
(4) CMI < 30	766	0- 29	12.2± 7.1	182-10262	4220±1509
(5) CMI < 20	627	0- 19	9.6± 4.9	182-10262	4272±1515
(6) CMI < 10	320	0- 9	5.6± 2.3	182-10262	4373±1541
(7) CMI < 5	101	0- 4	2.7± 1.2	645- 8127	4531±1451
(8) CMI < 4	67	0- 3	2.1± 0.9	1955- 7637	4597±1354
(9) CMI < 3	41	0- 2	1.5± 0.7	2705- 7637	4563±1288
(10) CMI < 2	16	0- 1	0.6± 0.5	3100- 7637	4759±1224
(11) CMI 0	6	0	0.0± 0.0	4000- 7637	5341±1236

TABLE 6

statistical significance of the relationship of phenylalanine and reported clinical findings (CMI)

	n	t	P
(1) entire sample versus	862		
(2) CMI <10	320	1.250	> 0.250
(3) CMI < 5	101	1.854	> 0.050
(4) CMI < 4	67	2.019	< 0.050*
(5) CMI < 3	41	1.521	>0.100
(6) CMI < 2	16	1.346	>0.100
(7) CMI 0	6	1.768	> 0.050

* statistically significant difference of the means

TABLE 7

relationship of reported daily leucine consumption (food frequency questionnaire) and reported total clinical findings (Cornell Medical Index Health Questionnaire) in a presumably healthy male and female sample

	sample size	clinical findings (affirmative CMI responses) range	clinical findings (affirmative CMI responses) mean and S.D.	daily intake of leucine (mg) range	daily intake of leucine (mg) mean and S.D.
(1) entire sample	851	0-125	15.5±12.4	1498-18021	7588±2791
(2) CMI < 50	834	0- 49	14.5± 9.9	1498-18021	7585±2781
(3) CMI < 40	812	0- 39	13.7± 8.8	1498-18021	7583±2779
(4) CMI < 30	756	0- 29	12.3± 7.1	1498-18021	7570±2768
(5) CMI < 20	614	0- 19	9.6± 4.9	1626-18021	7694±2818
(6) CMI < 10	312	0- 9	5.6± 2.4	1645-18021	7933±2860
(7) CMI < 5	102	0- 4	2.7± 1.2	1645-15034	8249±2734
(8) CMI < 4	67	0- 3	2.1± 0.9	1645-15034	8350±2623
(9) CMI < 3	42	0- 2	1.5± 0.7	4580-15034	8501±2412
(10) CMI < 2	15	0- 1	0.6± 0.5	4580-14372	8602±2366
(11) CMI 0	6	0	0.0± 0.0	7200-14372	9723±2460

TABLE 8

statistical significance of the relationship of leucine and reported clinical findings (CMI)

	n	t	P
(1) entire sample versus	851		
(2) CMI < 10	312	1.834	> 0.050
(3) CMI < 5	102	2.300	< 0.025*
(4) CMI < 4	67	2.279	< 0.025*
(5) CMI < 3	42	2.375	< 0.025*
(6) CMI < 2	15	1.398	> 0.100
(7) CMI 0	6	1.868	> 0.050

* statistically significant difference of the means

TABLE 9

relationship of reported daily isoleucine consumption (food frequency questionnaire) and reported total clinical findings (Cornell Medical Index Health Questionnaire) in a presumably healthy male and female sample

	sample	clinical findings (affirmative CMI responses)		daily intake of isoleucine (mg)	
	size	range	mean and S.D.	range	mean and S.D.
(1) entire sample	862	0-125	15.6±12.5	1100-16730	5202±1961
(2) CMI < 50	843	0- 49	14.5± 9.8	1100-16730	5190±1955
(3) CMI < 40	821	0- 39	13.9± 8.6	1100-16730	5171±1995
(4) CMI < 30	765	0- 29	12.3± 7.1	1100-16730	5173±1962
(5) CMI < 20	622	0- 19	9.7± 4.9	1100-16730	5239±1990
(6) CMI < 10	316	0- 9	5.6± 2.4	1842-12388	5371±1940
(7) CMI < 5	99	0- 4	2.7± 1.2	2086-10835	5628±1877
(8) CMI < 4	67	0- 3	2.1± 0.9	2600-10835	5736±1860
(9) CMI < 3	41	0- 2	1.5± 0.7	2900- 9986	5732±1630
(10) CMI < 2	15	0- 1	0.7± 0.5	3900- 9691	5881±1680
(11) CMI 0	5	0	0.0± 0.0	5100- 9691	6861±1709

TABLE 10

statistical significance of the relationship of isoleucine and reported clinical findings (CMI)

	n	t	P
(1) entire sample versus	862		
(2) CMI < 10	316	1.325	> 0.100
(3) CMI < 5	99	2.130	< 0.050*
(4) CMI < 4	67	2.254	< 0.050*
(5) CMI < 3	41	2.016	< 0.050*
(6) CMI < 2	15	1.334	> 0.100
(7) CMI 0	5	1.889	> 0.050

* statistically significant difference of the means

TABLE 11

relationship of reported daily methionine consumption (food frequency questionnaire) and reported total clinical findings (Cornell Medical Index Health Questionnaire) in a presumably healthy male and female sample

	sample size	clinical findings (affirmative CMI responses) range	clinical findings (affirmative CMI responses) mean and S.D.	daily intake of methionine (mg) range	daily intake of methionine (mg) mean and S.D.
(1) entire sample	856	0-125	15.5±12.5	306-9062	2379±1139
(2) CMI <50	839	0- 49	14.5± 9.9	306-9062	2379±1146
(3) CMI <40	817	0- 39	13.7± 8.8	306-9062	2380±1152
(4) CMI <30	759	0- 29	12.2± 7.1	306-9062	2382±1152
(5) CMI <20	620	0- 19	9.6± 4.9	435-9062	2435±1177
(6) CMI <10	315	0- 9	5.5± 2.4	791-9062	2528±1192
(7) CMI < 5	105	0- 4	2.7± 1.2	882-9062	2586±1260
(8) CMI < 4	71	0- 3	2.1± 0.9	1200-9062	2689±1403
(9) CMI < 3	43	0- 2	1.5± 0.7	1200-9062	2744±1420
(10) CMI < 2	15	0- 1	0.7± 0.5	1200-4162	2587± 788
(11) CMI 0	5	0	0.0± 0.0	2500-4162	3014± 657

TABLE 12

statistical significance of the relationship of methionine and reported clinical findings (CMI)

	n	t	P
(1) entire sample versus	856		
(2) CMI <10	315	1.922	>0.050
(3) CMI < 5	105	1.601	>0.100
(4) CMI < 4	71	1.811	>0.050
(5) CMI < 3	43	1.656	>0.050
(6) CMI < 2	15	0.705	>0.400
(7) CMI 0	5	1.245	>0.200

Summary

To determine the optimal intake of several essential amino acids (threonine, valine, phenylalanine, leucine, isoleucine, and methionine), 876 dentists and their wives were evaluated in terms of their clinical symptomatology and the intake of these amino acids.

In a progressive selection of healthier subgroups (those with fewer and fewer symptoms and signs), the intake of each amino acid rose. These data suggest that the "ideal" consumption of threonine, valine, phenylalanine, leucine, isoleucine, and methionine may be five to tenfold the estimated adult requirements.

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