

Insufficient intake of certain micro-nutrients in adults with drug resistant epilepsy treated with modified Atkins diet

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INTRODUCTION

It is anticipated that a high-fat, low-carbohydrate modified Atkins diet contains less micro-nutrients than needed. Therefore the standard of care is to supplement all patients with multivitamin and minerals.

Our aim was to investigate dietary intake of micro-nutrients in adults with drug-resistant epilepsy treated with a food-based (i.e. with no added supplements and no medical nutrition products) modified Atkins diet (MAD) in adults diagnosed with drug-resistant epilepsy.

METHODS

Participants (n = 52) were admitted for a short stay including education on how to prepare the diet.

At 4- and 12-weeks after starting the diet, they handed in a 3-day dietary record where all foods and drinks were weighed using household scales with precision of 1 g. They received individual dietary advice from a dietitian (MK) accordingly. Diet adherence was assessed by blood and urine ketones.

Participant's dietary intake was limited to 16 grams of carbohydrates per day. They were encouraged to consume high-fat foods and adequate amounts of protein. Fibers were eaten in free amounts.

Dietary intake of micronutrients were calculated using the Norwegian Food Composition Table and compared to (i) the Nordic Nutrition Recommendations 2023 (NNR2023) and (ii) a national reference population (Norkost4, n = 1964) eating an unspecified Norwegian diet.

	Mean (range)
Age (y)	37 (16-65)
Female sex	36 (61%)
Age at first seizure (y)	12 (0-55)
Years with epilepsy (y)	25 (5-58)
Intellectually disabled	22 (37%)
Numbers of ASMs tried	8.6 (3-20)
Number of current ASMs	2 (0-4)

Participant characteristics

RESULTS

Mean intakes of the fat-soluble vitamins A, D and E were significantly higher, while intakes of the water-soluble vitamins thiamine, riboflavin, vitamin B₆ and vitamin C were significantly lower than the reference population.

Intakes of calcium, magnesium, sodium, potassium and phosphorous were significantly lower on treatment. Also, iron, zinc and iodine were significantly lower on treatment, selenium was significantly increased, while copper did not differ significantly compared to the reference population.

On MAD, for both genders, mean dietary intakes of folate, vitamin C, calcium, magnesium, potassium, selenium and zinc were lower than NNR2023 recommendations. In addition, for women the mean intakes of riboflavin, vitamin B₆, vitamin D, iron, and iodine, were lower than recommended.

	NNR 2023	4 w MAD (SD) (n=52)	12 w MAD (SD) (n=44-45)
Energy, MJ		8.3 (2.6)	8.3 (3.0)
Protein, g		88 (28)	88 (36)
Protein, E%	10 - 20	18 (4)	18 (5)
Fat, g		171 (59)	169 (68)
Fat, E%	25 - 40	77 (5)	76 (6)
SFA, g		53 (21)	51 (26)
SFA E%	<10	24 (5)	23 (7)
MUFA, g		67 (29)	66 (29)
MUFA E%	10 - 20	30 (6)	29 (6)
PUFA, g		31 (13)	30 (16)
PUFA E%	5 - 10	14 (4)	13 (4)
Carbohydrate g		14 (5)	14 (3)
Carbohydrate E%	45 - 60	3 (1)	3 (1)
Fibre, g	≥25 - 35	22 (11)	24 (13)
Fibre, E%		2 (1)	2 (1)

Macronutrient intake

Micronutrients	Female			Male			Nordic Nutrition recommendations 2023	
	Ref. pop. n = 1049	MAD 4 w n = 30	MAD 12 w n = 28	Ref. pop. n = 915	MAD 4 w n = 22	MAD 12 w n = 16	Recommended/adequate Intake Men/ Women	Upper Intake limit
Vitamin A, RE	↓	✓	✓	✓	✓	✓	800 / 700	3000
Vitamin D, µg	↓↓	↓	↓↓	↓↓	✓	✓	10 / 10	100
Vitamin E, µg	✓	✓	✓	✓	✓	✓	11 / 10	300
Thiamine, mg	✓	✓	✓	✓	✓	✓	0.1 / 0.1 /MJ	-
Riboflavin, mg	✓	↓	↓	✓	✓	✓	1.6 / 1.6	-
Vitamin B6, mg	✓	↓	↓↓	✓	✓	✓	1.8 / 1.6	25
Vitamin B12, µg	✓	✓	✓	✓	✓	✓	4 / 4	-
Folate, µg	↓↓	↓	↓↓	↓	↓	↓	330 / 330	1000
Vitamin C, mg	✓	↓↓	↓↓	↓	↓↓	↓↓	110 / 95	1000
Calcium, mg	↓	↓↓	↓↓	✓	↓	↓	950 / 950	2500
Iron, mg	↓↓	↓↓	↓↓↓	✓	✓	✓	9 / 15	60
Magnesium, mg	✓	↓	↓	✓	↓	↓	350 / 300	250
Sodium, g	✓	✓	✓	✓	✓	✓	1.5 / 1.5	2.3
Potassium, g	↓	↓↓	↓↓	✓	↓↓	↓	3.5 / 3.5	-
Phosphorous, g	✓	✓	✓	✓	✓	↓	0.52 / 0.52	3.0
Zinc, mg	✓	↓	↓	✓	↓	↓	12.7 / 9.7	25
Copper, mg	✓	✓	✓	✓	✓	✓	0.9 / 0.9	5
Iodine, µg	↓	↓↓	↓↓	✓	↓	✓	150 / 150	600
Selenium, µg	↓↓	↓	↓↓	↓↓	↓	↓	90 / 75	255

- ↓ - 0 - 25% lower than recommended intake
- ↓↓ - 25% - 50% lower than recommended intake
- ↓↓↓ - > 50% lower than recommended intake
- ✓ - According to recommended intake

CONCLUSION

Treatment with MAD resulted in lower intakes of several water-soluble vitamins, electrolytes, and minerals compared to both a reference population and nutritional recommendations, highlighting the need for careful dietary monitoring and supplementation during MAD treatment.