Energy and nutrient intakes of children with spastic quadriplegia

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In the clinical nutrition outpatient clinic at the Hospital for Sick Children, we observed children with spastic quadriplegia who were gaining weight at normal to above normal rates with energy intakes lower than the recommended dietary allowances. These patients were fed exclusively through a gastrostomy tube with a commercial formula that contained a fixed nutrient/energy ratio. Concerns have been raised about the possibility that specific nutrient deficiencies will cause disease in this type of patient (particularly bone disease). We therefore retrospectively examined the energy and nutrient intakes of a group of 19 normally growing patients with spastic quadriplegia who were attending our clinic, comparing their nutrient intakes to the RDA.

METHODS

All patients with spastic quadriplegia who were fed exclusively by gastrostomy tube were eligible for selection, provided they had been followed in our clinic for 1 year and were gaining weight during that year, at or above the 50th percentile for age and gender. Nineteen patients (12 of them female), ranging in age from 3 to 20 years (9 ± 4 years), were identified. They were followed in the clinic every 3 months for a period of 1 year. Weight and formula intake in milliliters per day were recorded at each visit. Gastrostomy feeding varied from 775 to 1700 ml/day (1139 ± 247 ml/day) of a commercial tube-feeding formula (Isosource; Sandoz Co., Whitby, Ontario, Canada). Parents or guardians were advised to give additional water sufficient to ensure that the patients thoroughly soaked their diapers at least three or four times a day. Weight velocity for each patient was calculated during 1 year of gastrostomy feeding and was compared with the standards of Tanner et al.

The composition of the formula published by the manufacturer was used to calculate individual nutrient intake for each subject. Energy, mineral, trace element, and vitamin intakes were expressed as a percentage of the RDA for age and gender. Energy requirements may also be expressed by weight, age, and gender, as are protein needs. We therefore also expressed protein and energy intakes as a percentage of the RDA per kilogram of body weight. Results were expressed as mean ± SD.

RESULTS

Of the 19 patients, 18 had energy intakes that were <80% of RDA for age and gender (Table), with the mean of 61% ± 15% and a range of 43% to 98%. However, the mean energy intake per kilogram of body weight for the group was 103% ± 32% of the RDA. Fourteen patients exceeded 80% of the RDA for energy intake per kilogram of body weight. The remaining five patients, whose energy intake per kilogram of body weight was less than 80% of RDA, still achieved an annual weight velocity greater than the 50th percentile.

All patients exceeded 100% of the RDA for protein (225% ± 75%; range 119% to 408%). Similarly, all exceeded 100% of the RDA for vitamins A, C, and B12, folic acid, and zinc. As shown in the Table, most patients did not achieve 80% of the RDA for vitamin D (62% ± 14%), calcium (74% ± 20%), and phosphorus (64% ± 17%). For iron, the average percentage of the RDA was 96% ± 25% but was only 67% ± 5% in girls during their adolescent growth spurt. No fluid or electrolyte abnormalities were seen.
DISCUSSION

Several investigators have shown that total daily energy expenditure and resting metabolic rate are lower in nonambulatory subjects with motor dysfunction, presumably because both fat-free body mass and activity are decreased.\(^5,7\) Determining expenditure is one way of approximating the RDA for energy. The main drawback is that even the double labeled–water technique employed by Bandini et al.\(^6\) reflects only the expenditure during a 1- to 2-week period. On the other hand, the relationship between energy intake and growth employed in the present study provides at least a confirmation of energy needs measured for a prolonged period. Our findings are in accord with the reduced total daily expenditures recently reported by Bandini et al.\(^6\) in nonambulatory quadriplegic patients. Because we recognize that energy expenditure relates to lean body mass,\(^2\) we were not surprised to find that most of our patients' energy needs were within 80% of the RDA expressed per kilogram of body weight. Our results point to a need for further study of the relationship between body composition and energy expenditure in this group of patients.

The nutrient intake of our subjects was also a concern because the nutrient/energy ratio in tube-feeding formulas is fixed. In receiving an amount of formula that provided less than 80% of the total daily energy requirements,\(^2\) these subjects received less than 80% of RDA of certain nutrients. In particular, vitamin D, calcium, and phosphorus intakes were low, placing the patients at risk for bone disease. As suggested by Tollman et al.\(^5\) a lower nutrient profile, coupled with long-term use of anticonvulsant medication, also places this patient population at risk for rickets and osteopenia. Intakes of vitamin D, calcium, phosphorus, and iron would have been improved, mostly to within the requirement range, if the subjects had been given a tube formulation designed to meet the nutritional needs of young children (Figure). We had considered providing vitamin D and mineral supplementation to patients on low-intake regimens, but we realized that this would involve significant additional expense and inconvenience to care givers. As an alternative, we thought that using a formula with a higher nutrient/energy ratio might solve the problem; in most instances, it does.

We conclude that the total energy needs of children with spastic quadriplegia who require gastrostomy feeding are reduced and are best considered on a unit-weight basis. These children, who depend entirely on tube feeding to meet their nutritional needs, should be fed a formula designed for young children, in view of the higher nutrient/energy ratios of such formulations.

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REFERENCES


