TECHNICAL COMMENT

Comment on "Obesity and the Environment: Where Do We Go from Here?"

Hill *et al.* (*1*) estimated that a deficit of 100 kcal/day could prevent weight gain in most of the U.S. population. Based on an average 8-year weight gain of 14 to 16 pounds, or 1.8 to 2 pounds/year, in adults enrolled in the Coronary Artery Risk Development in Young Adults (CARDIA) study and an energy content of 3500 kcal per additional pound, the median energy storage was estimated to be 15 kcal/day and the 90th percentile was estimated to be 50 kcal/day. Accounting for an energetic efficiency of 50%, Hill *et al.* arrived at 100 kcal/day to prevent weight gain in 90% of the population. Closing the energy gap of 100 kcal/day, they concluded, could be achieved by "small changes" in food intake, physical activity, or both. They also pointed out that childhood obesity is increasing at a disturbing rate.

Contrary to their conjecture, our data indicate that the energy gap in many children is much greater than 100 kcal/day and will require correspondingly greater efforts to close. We measured 1-year weight gains and estimated energy storage from precise body composition measurements using dual-energy x-ray absorptiometry in 337 Hispanic children (mean age 11.9±3.6 years; range 5 to 19 years). Median 1-year weight gain of all the children was 12±9 pounds/year; however, weight gain differed by body mass index (BMI) status (Table 1). The median weight gain in normal-weight children who remained normal-weight (n = 141) was 9 pounds/year (range –11 to 22 pounds/year); the median weight gain in overweight children (defined as having a BMI in the 95th percentile; n = 167) was 16 pounds/year (range –12 to 39 pounds/year), in contrast to the 14 to 16 pounds gained in 8 years in adults (Fig. 1A). Some normal-weight children converted to overweight (n = 19), gaining 15 pounds/year, and fewer (n = 10) converted from overweight to normal weight, with a weight loss of 1 pound/year.

Naturally, healthy children are expected to grow and deposit energy in new tissues. For most ages, BMI in a given percentile channel increases annually by ~1 unit. Although the degree of weight gain that indicates risk has not been defined, an annual increase of 3 to 4 BMI units probably reflects a rapid increase in body fat (*2*). The median BMI change for the normal-weight children who remained so was 0.85 (in a range of –2.3 to 3.2), and therefore their weight gains would be considered within expected limits. For the children with BMI in the 95th percentile, weight loss is recommended (*2*), and therefore their weight gains would be considered excessive.

Based on the assumptions used by Hill *et al.* (*1*), the median energy storage in normal-weight children was 75 kcal/day and the 90th percentile was 137 kcal/day (Fig. 1B). The median energy storage in overweight children was 144 kcal/day and the 90th percentile was 251 kcal/day. The median energy storage in normal-weight children who became overweight was 133 kcal/day and the 90th percentile was 171 kcal/day. At an energetic efficiency of 50%, a deficit of 342 to 502 kcal/day would be required to prevent further weight gain in 90% of the overweight children, more than the 100 kcal/day suggested by Hill *et al.*

Alternatively, energy storage can be calculated from our measurements of changes in body composition (Fig. 1C). Based on assumptions of 0.19 g protein/g fat-free mass, 5.6 kcal/g protein, and 9.25 kcal/g fat gained, the median energy storage in normal-weight children was 45 kcal/day, with a 90th percentile of 108 kcal/day. In overweight children, the median was 113 kcal/d and the 90th percentile was 203 kcal/day; in normal-weight children who became overweight, the median was 104 kcal/day and the 90th percentile was 164 kcal/day. At more conventional energetic efficiencies of 85% for fat and 42% for protein storage (*3*), the total cost of energy storage would be 64 kcal/day (90th percentile, 135 kcal/day) in normal-weight children and 130 to 144 kcal/day (90th percentile, 204 to 263 kcal/day) in overweight children. A deficit of 204 to 263 kcal/day would thus be required to prevent further weight gain in 90% of the overweight children.

As National Center for Health Statistics surveys (*4*) show, the prevalence of over-

Table 1. Weight gain and loss by BMI status, and energy storage and energy gap calculations based on assumptions of Hill *et al.* (*1*), versus energy storage calculations based on actual body composition (BC) changes and energy gap calculations based on energetic efficiencies of 85% for fat and 42% for protein storage [as reported by Roberts and Young (*3*)], for population of 337 Hispanic children studied. Median values are shown, with 90th percentile in parentheses; n is number of children in each BMI status group. OW, overweight (defined as BMI above the 95th percentile).

BMI status at beginning/end of year	n	Weight gain, lb/year	Energy storage based on		Energy gap based on	
			Assumptions in (*1*)	BC changes	Assumptions in (*1*)	Assumptions in (*3*)
Normal/Normal	141	9 (16)	75 (137)	45 (108)	150 (274)	64 (135)
Normal/OW	19	15 (20)	133 (171)	104 (164)	267 (342)	130 (204)
OW/OW	167	16 (29)	144 (251)	113 (203)	288 (502)	144 (263)
OW/Normal	10	−1 (12)	−13 (100)	−7 (31)	−25 (201)	−9 (45)

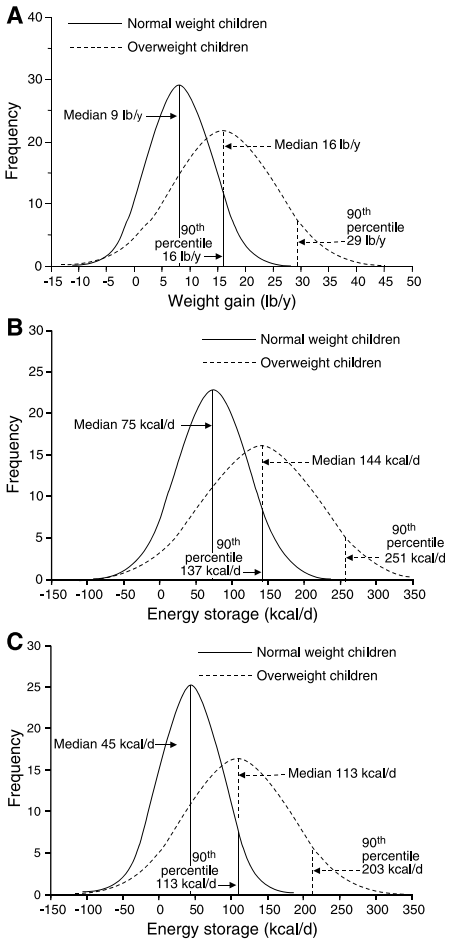

Fig. 1. (**A**) Distributions for weight gain over a 1-year period in normal-weight and overweight children. (**B**) Energy storage in normal-weight and overweight children based on the assumptions of Hill *et al.* (*1*). (**C**) Energy storage in normal-weight and overweight children based on changes in body composition.

weight in U.S. children is increasing at alarming rates. Rates of weight gain were eightfold higher in our overweight pediatric subjects than adults followed in the CARDIA Study. Closing the energy gap in children, however, cannot be achieved with "small changes" in diet or physical activity. The deficit of 502 kcal/day as estimated using the assumptions of Hill *et al*. or 263 kcal/day as estimated from body composition changes would be equivalent to walking ~60 to 120 min/day or ~3 to 6 miles/day, and certainly amounts to more than "a few less bites of food at each meal." Halting the epidemic of childhood obesity will require a significant and concerted societal effort to change the way our children are eating and to increase their physical activity.

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