of the urine had been lost, as far as could be ascertained, and there was no increase in body temperature. During the day, however, the outside temperature had risen to 102°F., and the patient perspired profusely. The possibility was, therefore, suggested that significant amounts of cevitamic acid may have been lost through the skin in the sweat. We have since found that the sweat may contain appreciable amounts of vitamin C. This problem is being investigated at the present and will be reported upon shortly.

Conclusions. 1. Cevitamic acid, properly buffered, may be administered intramuscularly without discomfort or damage to tissue. 2. Studies of the urinary excretion and the blood content of vitamin C following the administration of cevitamic acid intramuscularly demonstrated that it is used by the body when administered by this route. 3. The height of increase in the blood level following the intramuscular injection of cevitamic acid is reached more slowly and is maintained for a longer time than after intravenous injections. 4. In cases of vitamin C deficiency, where cevitamic acid is improperly absorbed through the gastro-intestinal tract, or where the intravenous mode of administration is not feasible, the intramuscular route may be used.

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Variability of Metabolic Response of Different Children to a Given Intake of Calcium.

HELEN A. HUNSCHER, FRANCES COPE HUMMEL AND ICIE G. MACY.

From the Research Laboratory of the Children's Fund of Michigan, and the Children's Village, Detroit.

As the metabolic balance studies on the "so-called normal" adults[1, 2] and 22 children[3, 4] as well as the growth observations on 530 infants[5] have progressed in this laboratory over several years

[1] Macy, I. G., Hunscher, H. A., Nims, B., and McCosh, S. S., *J. Biol. Chem.*, 1930, **86**, 17.

[2] Hunscher, H. A., Donelson, E., Erickson, B. N., and Macy, I. G., *J. Nutrition*, 1934, **8**, 341.

[3] Hunscher, H. A., Cope, F., Noll, A., Macy, I. G., Cooley, T. B., Penberthy, G. C., and Armstrong, L., *J. Biol. Chem.*, 1932, **97**, LXIV.

[4] Hunscher, H. A., Cope, F., Noll, A., and Macy, I. G., *J. Biol. Chem.*, 1933, **100**, LV.

[5] Unpublished data from this laboratory.

we have grown more and more impressed with the wide physiological variations found. These fluctuations are evident not only among individuals of the same age, body size and living under the same environmental conditions but of the same individual when kept under constant conditions and observed continuously over, not days, but weeks. Obviously, it becomes necessary to build up some knowledge as to how much variation one may expect to find in a healthy individual living under highly standardized conditions before it is possible to interpret the degree of differences of results found under specific experimental conditions or in disease. Moreover, in the case of children, it is exceedingly important to build up some concept of the changes that occur incident to growth and development alone, before one is able to interpret satisfactorily the significant effect of specific food or other amenable factors on the metabolism of the child.

To illustrate not only the degree of variability that may occur among healthy individuals of like age and body size but also the increments and decrements that occur in metabolism from time to time as the observations progress the present report records the calcium balances for only 25 to 65 consecutive days of 6 of the 22* typically healthy children who were maintained on simple diets of 70 to 100 calories per kilo of body weight per day appropriate for the age and size of the child and approximately uniform in mineral and nitrogen content. The dietary furnished one gram of calcium per day for each child.

The growing children under observation had excellent health records and were good eaters with no idiosyncracies. They had become accustomed to the routine management through a dietary control period preceding the study and were happy and interested in their wholesome regularity of personal habits, sleep, work, play in the fresh air and sunshine of the open country and in their healthful living in a home environment where love, security, and serenity abounded. These children were experts in *eating all the food* given to them, in the accurate collecting of urine and separating it from the feces. The study carried no strain for them but on the contrary gave them an opportunity to excel in a fete that gave them social prestige and admiration among their peers and brought praise from the adults in attendance. With as highly standardized a group of children as is humanly possible to secure where heredity and other physiological factors are uncontrollable, with living environ-

* These data are representative of those found in 540 five-day balances for acid-base minerals and nitrogen on 22 children, 10 of whom were observed for 225 continuous days. The complete study will be reported in detail later.

TABLE I.
Metabolic Response of 6 Children to the Same Calcium Intake.
(1 gm. per day).

Subject	Sex	Beginning Age	Height cm.	Weight kg.	Days Studied	Average Daily Retention Total gm.	per kg. gm.	per cm. mg.	% Retained
				5-Year.					
D.P.	M	4-9-3	107.5	19.2	55	0.48	0.024	4.4	48.5
C.L.	F	5-4-18	106.7	17.8	65	0.27	0.015	2.5	27.4
P.S.	M	5-5-23	114.8	22.3	30	0.31	0.014	2.7	31.2
B.C.	M	5-8-15	111.8	19.6	30	0.32	0.016	2.8	31.5
				8-Year.					
S.C.	F	8-2-3	125.1	24.2	25	0.48	0.020	3.8	47.8
J.L.	F	8-10-4	128.3	25.3	30	0.29	0.011	2.2	29.0

ment satisfactory from the scientific point of view, and stimulating happiness as well as serenity for all subjects alike, the results that follow should be of significance in the use of the balance method for determining dietary requirements.

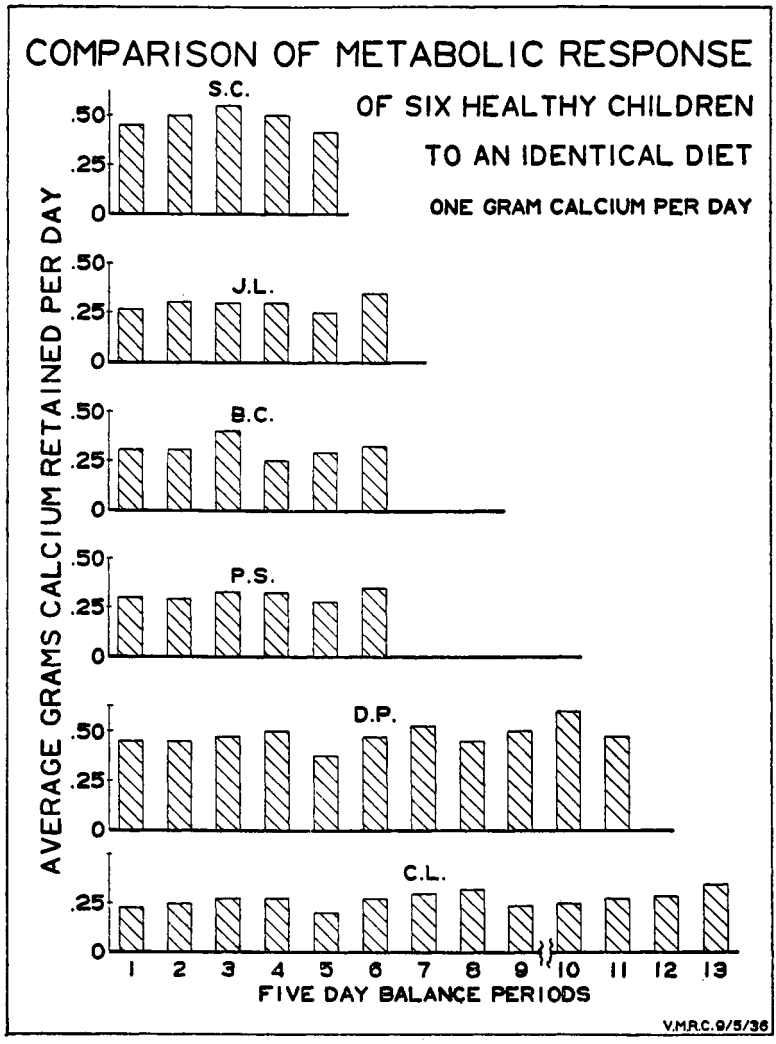
Table I shows the individual metabolic response of 6 children to a dietary intake of one gram of calcium per day. Over an observation period of 30 to 65 consecutive days 4 five-year-olds showed an average total daily retention of calcium ranging from 0.27 to 0.48 gm. and varying from 27.4 to 48.5%. When the average daily storage of calcium is interpreted in terms of body size the individual differences are just as great, varying from 0.014 to 0.024 gm. per kilo body weight and 2.5 to 4.4 mg. per cm. body stature.

Age does not explain these typically wide individual differences in response of children as illustrated by the inclusion and comparison of the metabolic records of 2 eight-year-olds with the 4 five-year-olds in Table I. They, too, showed similar levels of daily retentions of calcium on the same dietary intake but the range of difference is just as great, namely 0.29 to 0.48 gm. per day. Likewise, when body size is considered the same individual trend is evident in all 6 children.

Chart 1 is illustrative of the increments and decrements of storage of calcium that may be observed in many healthy individuals[1-7] maintained under strict metabolic conditions, provided they are followed continuously over a considerable period of time. It has been previously pointed out that the study of consecutive balance periods not only reveals individualities in the response for acid-base mineral elements and nitrogen of different subjects to identical conditions but variations from period to period.

[6] Clark, G. W., *Univ. Calif. Pub. in Physiol.*, 1926, **5**, 195.

[7] Porter, Levin T., *J. Am. Diet. Assn.*, 1933, **9**, 22.



The physiological inconstancy of childhood is distinctively illustrated in Chart 1. Obviously it is necessary to learn throughout a pre-experimental period of several weeks how wide these customary physiological fluctuations may be for a specific child as well as the individual rates of storage under highly standardized and desirable conditions before the effect of any regimen upon the metabolic balance can be satisfactorily understood. Without the inclusion of such controlled data one may be easily misled into false fields of interpretation by the use of this method for determining the subsequent effect of certain foods or other factors on metabolism.