



Supplementation Increases Physical Activity and Selected Behaviors in Rural Kenyan Schoolchildren

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Research Brief O5-O4-CNP

January 2005

Previous observational studies in Kenyan children have shown that diet quality, particularly increased meat consumption, is positively associated with child cognitive development, physical activity and behaviors. These findings stimulated a study on the effects of a school feeding intervention with animal source foods on activity level, emotional state and social interactions of a group of Kenyan schoolchildren during free play in the schoolyard. Five hundred forty children in rural Embu district participated in the study. Twelve schools were randomized to three types of feedings and a control group and fed for 21 months. A local maize/bean dish, githeri, was used as the vehicle to supply either meat, milk or plain githeri with added oil. Children who were provided with any of the school feedings (extra calories) were physically more active and showed more leadership behavior and initiative than non-supplemented (control) children. Moreover, although these behaviors decreased over time, children in the Meat groups showed the least decrease in percent of time spent in high levels of physical activity, leadership behaviors and initiative, and the greatest decrease in percent of time spent in low levels of activity compared to the other groups. These results support our previous findings from observational studies in the same community that both diet quantity and quality are important for children's physical activity and positive social behaviors.

Background

This research was stimulated by a set of parallel, longitudinal studies the Human Nutrition Collaborative Research Support Program (NCRSP) carried out in Kenya, Egypt and Mexico to examine the associations between children's energy intake and level of function and development. The results of the NCRSP studies showed that there were positive differential associations of food quantity (total energy intake) and food quality (micronutrient intake) on children's cognitive development and behavior, the marker for food quality being the amount of animal source food in the children's diets. Because animal foods are so limited in the diets of children in developing countries, children could have adequate or near adequate intake of kcals, but very poor intake of micronutrients such as vitamin B₁₂ and iron and zinc in absorbable form. The cognitive abilities were more highly associated with the level of meat intake than with overall energy intake. For physical activity, leadership and initiative during free play in the schoolyard both food quantity and diet quality was important, particularly diet quality. The above associations persisted even when family socioeconomic status (SES), parental literacy, and duration of schooling were taken into account.

The study reported in this Brief employed an experimental design with a randomized, controlled school feeding trial using three different nutrition interventions so as to be able to establish cause and effect of diets and outcomes.

The study was implemented in Embu District where the earlier study had been conducted, offering enormous advantages of available experienced well-trained staff in the cognitive and observational assessments, appropriateness of the measures and their established reliability and validity in the study, and community-wide acceptance of the research team and study.

Measures and Data Analysis

Feedings consisted of *githeri* with either added meat, added milk, or oil added to the plain *githeri* to ensure equal caloric content. Pre-weighed food was provided in labeled bowls for each child and all leftovers were measured. Feedings were provided on each school day. Baseline assessments for all of the children in participating schools were performed between May and July, 1998. Following the baseline assessments, 12 schools were randomized into one of three feeding interventions or a control group. In the first year of supplementation, all groups except for the control group were given 240 kcal/day with an increase in the second year to 313 kcal to match the greater food needs of the growing children. Meat was increased to 85-90 g/d and milk to 250 ml/d.

Playground observations were carried out on all children at baseline and terms 1, 2, 4, and 6 of feeding. The behavioral observations focused on activity level, emotional state and social interactions with peers and

Figure 1: Change in leadership over time by feeding group.

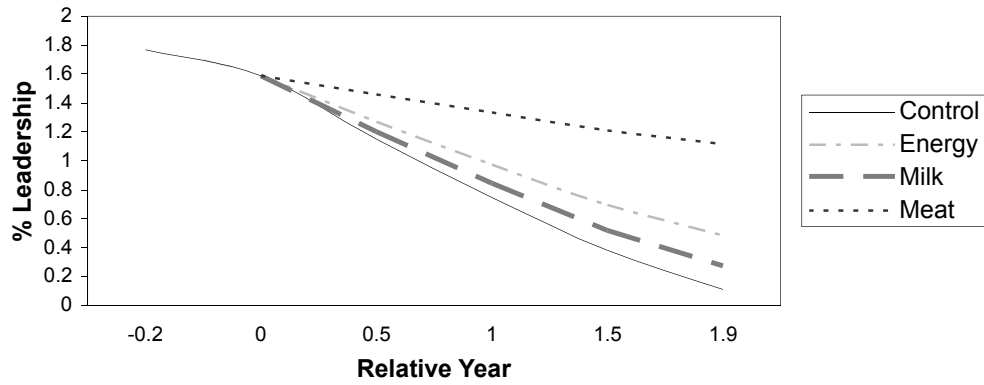


Figure 2: Change in initiating behavior over time.

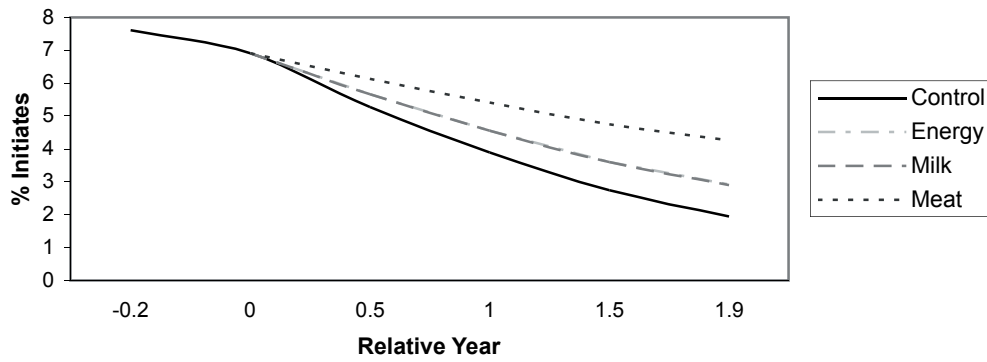
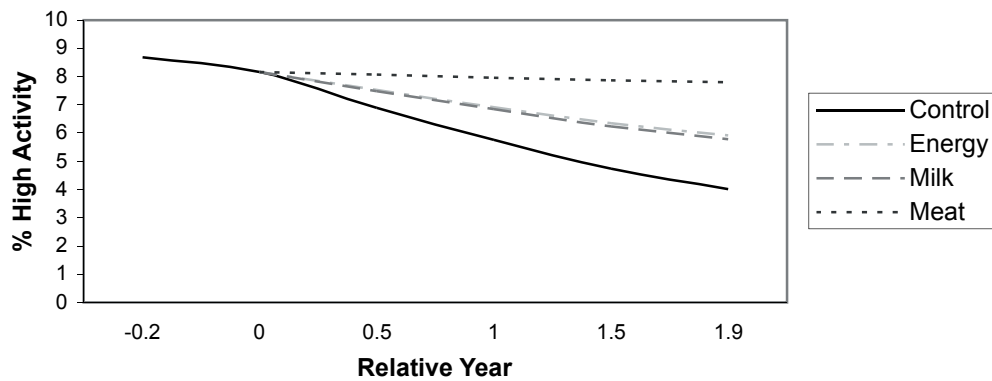


Figure 3: Change in high activity over time by feeding group.



were carried out by a team of 12 enumerators specifically trained by two of the authors (MS and SW) using strictly defined behavior and activity levels. The child observation period consisted of 30 seconds alternated with 30 seconds of recording for a total of 30 minutes per child per term with one enumerator per child. Intra-team and inter-team measurement error was observed with excellent agreement (correlations between 0.91 to 0.99) between observers and supervisors.

Hierarchical linear random effects models and associated methods were used to examine the effects of treatment group on changes in playground activity and behavior over time with the variation in initial status of the children in longitudinal analyses taken into account. The following outcomes: high activity, low activity, leadership and initiative are reported upon in this Brief. The slopes are presented so that positive scores represent increases in behaviors and negative scores represent decreases in behavior. Included in the model are time and treatment by time in the study, as well as sex and baseline age. Child height, maternal reading and writing literacy and family SES (covariates) were taken into account in the analyses.

Findings

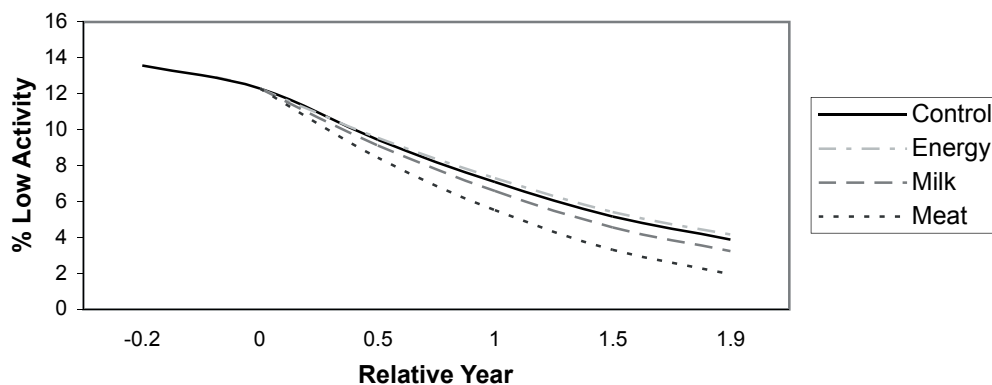
Longitudinal growth curves were calculated for all children for each playground activity and behavior across the five time points at which playground observations were made. All the behaviors discussed in this Brief declined over time. When the significant covariates were considered, there were statistically significant treatment effects for high activity, low activity, leadership and initiative. While behaviors decreased with age, the Meat group showed the least decrease in percent of time spent in both leadership and

initiative behaviors (See Figures 1 and 2). As for physical activity, the Meat group also showed the least decrease in percent of time spent in high levels of activity and also, a significantly decreased percent of time spent in low levels of activity (See Figures 3 and 4). Compared to the control group, all the supplemented children, regardless of the type of supplement, showed smaller decreases over time in percent of time spent in leadership, initiative and high levels of activity. The Meat group showed the highest levels of activity, leadership and initiative behavior of all groups through time.

Practical Implications

The findings in this study demonstrate the positive effects of food quality (meat) on physical activity and leadership and initiative behaviors than children provided with lower quality diets regardless of their earlier levels of under-nutrition. This suggests that leadership and active initiation and organization of social activities depend on diet quality as well as overall energy intake. Although we cannot assume that the differences in levels of behaviors measured in this study will result in differences in future economic outcomes, we do know from longitudinal studies in Guatemala that good nutrition in childhood results positive economic returns to individuals. Longitudinal studies of the Embu children should be conducted to assess directly how the changes in behavior affect long-term economic and social productivity. Because the results of this focused intervention study are consistent with the broader three country correlative work of the Nutrition CRSP, the overall conclusions of the impact of meat on child development are generalizable to developing countries. This is the first randomized, controlled intervention study to show that meat affects the above activities levels and behaviors that may be relevant to future socio-economic development.

Figure 4. Change in low activity over time by feeding group.



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Acknowledgement: Surwinder Grewal, UCLA undergraduate, for editorial assistance.

About the Project: The GL-CRSP Child Nutrition Project (CNP) was established in 1997 and was built on a decade of research conducted by the Nutrition CRSP (USAID) in the 1980s. CNP research addresses food-based approaches to micronutrient deficiencies, particularly of children, with respect to both the quantity and quality of food intake. The Child Nutrition Project was centered on a controlled intervention feeding trial of school children in Embu, Kenya. The Toddler study is a follow-up to the study of school children. The project has been directed by Dr. Charlotte Neumann, Dr. Suzanne Murphy, and Dr. Nimrod Bwibo as Principal Investigators and Dr. Marian Sigman, Dr. Lindsay Allen, and Dr. Shannon Whaley as Co-Investigators. Jonathan H. Siekmann, Ph.D., Ana Zubieta, Ph.D. former doctoral students and Erin Ried, a doctoral candidate, made significant contributions to the nutrition biochemical analyses. Email contact for Dr. C. Neumann is: cneumann@mednet.ucla.edu.



The Global Livestock CRSP is comprised of multidisciplinary, collaborative projects focused on human nutrition, economic growth, environment and policy related to animal agriculture and linked by a global theme of risk in a changing environment. The program is active in East Africa, Central Asia and Latin America.

This publication was made possible through support provided by the Office of Agriculture, Bureau of Economic Growth, Agriculture and Trade, under Grant No. PCE-G-00-98-00036-00 to University of California, Davis. The opinions expressed herein are those of the authors and do not necessarily reflect the views of USAID.

Design by Susan L. Johnson