Impact of a Temporary Food Shortage on Children and Their Mothers

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In many parts of the world, poverty is accompanied not only by chronic undernutrition but also by temporary food shortages. Drought and other weather conditions that interfere with food production affect poor families more than those with greater financial resources because food prices are inflated and food becomes unaffordable for the poor. Food shortage or famine is most often described as a macro-event summarized with aggregate statistics on extent of drought or other precipitating event, crop failure, and population morbidity and mortality. Little information is available about the changes that occur in the behavior and abilities of children and their parents during such food shortages.

The investigation of the effects of a temporary food shortage is informative in two major ways. First, the study of behavior before, during, and after a food shortage provides a powerful design for understanding malnutrition in that the behavior of the same individual can be compared across periods. Since the subject is used as his or her own control, variables usually associated with the adequacy of food intake, such as social class and education level, do not confound the design. Correlational studies have shown that malnourished children are less social, active, playful, and happy and that caregivers of malnourished children are less responsive (Barrett, Radke-Yarrow, & Klein, 1982; Chavez & Martinez, 1975; Espinosa, Sigman, Neumann, Bwibo, & McDonald, 1992; Galler, Ramsey, Solimano, & Lowell, 1983; Goldberg, 1977; Graves, 1976; Sigman, Neumann, Baksh, Bwibo, & McDonald, 1989). The associations between food intake and behavior persist when correlated factors are covaried; however, uncertainty remains about whether all correlated factors have been adequately considered and measured. Thus, demonstration of behavioral effects of a food shortage would strengthen the evi-

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[Child Development, 1994, 65, 404–415. © 1994 by the Society for Research in Child Development, Inc. All rights reserved. 0009-3920/94/6502-0011$01.00]
idence from correlational studies if the processes involved in temporary and chronic food shortages are similar.

Second, the investigation of the effects of food shortages is important in its own right since such shortages befall families in all parts of the world. It is very difficult to study temporary severe food shortages because these are unanticipated and efforts have to focus on bringing in and distributing food. Studies of seasonal changes in food availability have been carried out (Adair & Pollitt, 1983; Bogin, 1978; Brown, Black, Robertson, & Becker, 1985; Ogbu, 1973; Pollitt & Arthur, 1989; Trowbridge & Newton, 1979). Most of these studies have focused on weight changes and morbidity. Declines in adult social behaviors during periods of food shortage have also been described by ethnographers (Ogbu, 1973) but, to our knowledge, changes in the behaviors of children and their parents have not been investigated. Moreover, the impact of such seasonal changes may be less than that of unanticipated food shortages because some community planning is feasible.

The study discussed here was possible because a severe drought and temporary food shortage occurred in Kenya in 1984 (Cohen & Lewis, 1987; Farmer, 1989) during the course of a large-scale study of the effects of mild malnutrition. The long rains (March–May) of 1984 were insufficient, resulting in almost total failure of the crops usually harvested in July and August (Neumann, Tröstle, Baksh, Ngare, & Bwibo, 1989). Despite substantial food aid, most of which was obtained and distributed by this research project, lifestyles were disrupted as household members scavenged for foods usually considered inedible, ate seeds set aside for next season’s plantings, and consumed livestock. Household members also engaged in temporary labor and sold possessions and livestock so they could purchase food. Fortunately, the short rains (October–December) of 1984 were adequate, and with the harvests from these rains, beginning around January 1985, the food shortage began to abate. This unanticipated and unfortunate event presented our research project with a unique opportunity to investigate the impact of drought and food shortage on those behaviors that were already being observed as part of the ongoing study.

Behaviors and abilities had been selected for the large-scale study because of their importance for the child’s development and/or previous evidence that these behaviors varied as a function of nutritional status. In the current study, we were restricted to looking at those variables that had been measured in the prefamine, famine, and postfamine periods. Behavioral observations of toddlers in interaction with all caregivers, including their mothers, and of schoolchildren on the playground and in the classroom were available, as were cognitive assessments of these schoolchildren. Changes in behavior were expected to be most apparent in those individuals who suffered the most deprivation during the food shortage.

Informal observation suggested that toddler nutritional status did not change too much during the food shortage, so few changes in toddler behaviors were expected. However, the dietary intakes of the mothers and families were adversely affected, so some behavioral change was predicted in the interaction patterns of mothers and toddlers. Declines in maternal responsiveness seemed possible in line with the findings from the correlational studies. Moreover, an inverse association has been found between amount of time invested in farming and in housework activities, including child rearing (Roberts, Paul, Cole, & Whitehead, 1982). If the mothers were attempting to obtain more food for their families during the food shortage, less time may have been available for caretaking of the toddlers.

The clearest hypotheses could be formulated about the schoolchildren since the food shortage appeared to have diminished their food intake sharply. We expected declines in playground activity level and social involvement, both behavioral patterns requiring fairly high energy. Less task orientation in the classroom also seemed a likely outcome. However, changes in cognitive abilities were not predicted because the food shortage was luckily of short enough duration to spare skills that were already established.

In summary, this article describes the

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1 In response to the acute food shortage, food aid in the form of yellow maize, beans, oil, and seeds was mobilized and was distributed to all the households in the study area. The food aid covered about one-third of household food requirements until food relief channels were established by the government of Kenya.
effects of a food shortage on the behaviors of a group of toddlers and their mothers and of a group of schoolchildren. First, the effects of the drought on the food intake and weight of the toddlers, their mothers, and the schoolchildren are documented. Second, behavioral patterns are compared across the three periods (before, during, and after the food shortage). Finally, associations between the change in food intake and behavior during the famine are examined to determine whether individual patterns correspond to those shown for the groups. The last set of analyses were conducted in order to elucidate the processes underlying whatever group changes were observed.

Method

Study Site and Population

The study took place in Embu District of Eastern Province, Kenya. This is southeast of Mount Kenya and 120 km northeast of Nairobi. Despite rising population, emigration is rare, and most Embu remain small-landholder agriculturalists producing both subsistence and market crops. The principal food crops are maize, beans, millet, sorghum, arrowroot, bananas, and potatoes. The main cash crops are coffee, tobacco, and cotton. Embu households also keep small numbers of cattle, goats, and chickens, and adults sometimes engage in paid labor.

Available in the study area are primary and secondary schools, a mission hospital and health center, and a network of feeder and dirt access roads. There is no electricity, and a gravity-fed water system reaches a minority of the houses. Most houses are two-room structures of mud with supportive wood frames and roofs of thatch or tin. Dwellings are scattered and are usually adjacent to the families' fields.

Subjects

The 60 sq km study region contained 2,059 households. Of these 292 were selected for participation and 247 actually completed the study. Households were selected for study because of the presence of target individuals. For the purposes of the larger study, target individuals were pregnant women and their infants, toddlers, schoolchildren, and their parents. Observations of the infants and their caregivers were not included in the current article because they were generally recruited and studied after the prefamine period.

Of the 247 households, 115 had toddlers who turned 18 months during the course of the ongoing study and were followed until 30 months of age. While 115 subjects were observed in their homes, four subjects were observed only once as their families dropped out of the project, and the observational data from one toddler were eliminated because of missing information in the other domains. Thus, the toddler and mother samples were composed of 110 children (52 males, 58 females) and their mothers. The mothers had a mean age of 30.5 (SD = 6.4). During most of the day, mothers were involved in household chores, farming activities, and caring for animals. Toddlers played around the dwellings in the compounds, usually in view of their mothers or with a group of children including siblings, relatives, or neighbors.

The sample of schoolchildren included 138 individuals (76 males, 62 females). During the time of participation in the study, the children had a mean age of 7 years, 7 months (SD = 4.2), with a range from 7 years, 1 month, to 8 years, 5 months.

Design

All the observations and testing were conducted at the family compounds except for the school observations. The social interactions of the toddlers with all caregivers, consisting of mothers, fathers, older sisters, older brothers, grandparents, other children, and other adults, were observed. Each type of assessment was carried out by an independent group of observers.

Description of Measures

Food intake.—Food intake of toddlers, their mothers, and schoolchildren was assessed each month. A trained observer measured the volume and weight of the food eaten from 7:00 A.M. to 6:00 P.M. each day for 2 successive days. Recall report of foods consumed after 6:00 P.M. was obtained the subsequent morning so that food intake for the entire 48-hour period was recorded. Toddlers were observed between meals so that snacks could be recorded, and schoolchildren were asked about food eaten out of the home.

Food composition tables, based in part on biochemical analyses of main local foods and in part on relevant existing food tables, were used to determine the nutritional constituents of the foods ingested. For the data analyses reported in this paper, average daily energy intake (kcal/day) is reported for three intervals: April 15 through July 31, 1984 (period before food shortage); September 1 to December 15, 1984 (period during
food shortage); and January 15 to April 30, 1985 (period after food shortage). Average daily energy intake was calculated for each interval for toddlers, their caregivers, and schoolchildren. The number of subjects whose data were used in the repeated-measures analyses is smaller than the total number of subjects because of the requirement that data be available for all three time periods.

Weight.—Weight of the toddlers, caregivers, and schoolchildren was measured monthly by an independent group of observers. Assessments were conducted by two trained examiners working independently using a portable, battery-operated, digital read-out scale. If the two measurements differed by more than a predetermined amount, both examiners repeated their measurements. The mean of the two or four measurements was recorded. For each of the three intervals, average weight for each subject was recorded, and average z scores for weight/age were calculated based on NCHS reference data (Hamill et al., 1979).

For all the variables, an average over the 3-month period was used to provide more stable, reliable measurements. However, the data were reanalyzed using only the measures collected at the end of each period since the cumulative effects might be greatest at this time. Since the results were the same with both approaches, only the data averaged over each period are presented.

Caregiver and toddler behaviors.—Toddler and caregivers, including mothers, were observed in the home simultaneously for 90 to 120 min every other month. Mothers were asked to behave in their usual manner, and observers attempted to be unobtrusive. Mothers were not required to be present, but previous data showed that they almost always were in the compound. If the toddler was taken to some location where he or she could not be seen for 10 min, the observer stopped recording and returned to the home on another occasion. Percentage scores have been used throughout because of variations in the number of observational intervals.

The observer noted any behavioral category that occurred in a 30-sec interval; the following 30 sec were used for recording. There were 15 observers who were young adults recruited locally and trained by two Kenyan psychologists. These young adults were responsible only for the observations of mothers and toddlers and schoolchildren.

Home observations were used to measure caretaking and social experiences, to assess the child's play with objects, and to evaluate expressive language in an unstructured situation. The six coded caregiver behaviors were: cares for physical needs, holds/carries, touches, interacts socially, talks to child, and responds to child vocalization. Because mothers touched and interacted socially with their toddlers very infrequently (in 3% and 0% of the observational intervals, respectively), these codes were dropped from analyses.

Toddler vocalizations and play with objects were coded simultaneously with the observations of social interactions. Play was divided into three mutually exclusive codes, based on level of sophistication. Simple play included manipulatory play (mouthing, fingerling, throwing) and relational play (non-functional combining of objects such as banging and stacking). Functional play consisted of using objects in conventional ways. Symbolic play included using one object for another or pretending that absent objects or people were present. In every interval, either one of the play codes or "no-play" was recorded. For both maternal and toddler behaviors, percentage scores (percent of observational period with that code) calculated over each of three periods—before, during, and after the food shortage—were calculated.

To determine the reliability of the observational procedures, 17 toddlers were observed by 15 observers, who worked in pairs. Each pair of observers saw two toddlers with each observational period lasting for 40 min. Interrater agreements were calculated with Pearson correlation coefficients and were uniformly high, probably because of the long duration of training (Sigman et al., 1988). The correlations for cares and holds were $r = .98$, for talks was $r = .90$, and for responds to vocalizations was $r = .94$. For toddler vocalizes, the correlation was $r = .89$. Interrater reliabilities for simple, functional, and symbolic play were $r = .87$, .84, and .96, respectively.

Classroom behavior.—The schoolchildren's behavior in the classroom was observed to determine the extent to which the children attended to regularly scheduled classroom activities. The observations were carried out in their usual classes, and teachers were asked to behave in their usual fashion. Using a time-sampling procedure (10 sec observe, 20 sec record) observers coded
whether the child talked to another child, played with an object, or was off-task for the entire 10-sec interval. An observational session included three classes, each on a different subject and lasting 25 to 30 min. The observer alternated between two children every 30 sec during each class so that no single child was looked at continuously. Observations were conducted at 3-month intervals. The data for each class and observation session were converted to percentage scores since the length of observation varied. The percentage of intervals that the child engaged in an off-task behavior for the entire 10 sec for each of the three periods was calculated. Interrater reliability, measured for 18 children over three class periods, was \( r = .93 \).

**Playground behavior.**—Schoolchildren were observed in unstructured, social interactions on the playground. A coding system borrowed from Barrett et al. (1982) and modified as described below was used to record behaviors related to three major areas: activity level, emotional state, and social interaction with peers. Each child was observed individually for a minimum of 40 min every other month. Observations were conducted using a time-sampling procedure with 30 sec of observation followed by 30 sec of recording. For each 30 sec, predominant activity level was recorded as low, medium, high, or very high, and predominant emotional state was coded as happy, anxious, angry, sad, crying, or neutral. During each cycle, observers also coded social interactions, including positive social involvement, leadership behavior, aggression, and no peer involvement. Any one of these social behaviors could be recorded during each 30-sec interval, but each behavior could be recorded only once per cycle.

Because the number of observational cycles varied within the sample, the frequency of each code divided by the total number of observational cycles in each period was used in analyses. Behaviors reported here are those that occurred in close to 10% or more of all intervals. These were low, medium, and high activity levels, happy and anxious affect, positive social interaction, and no peer involvement. (Medium activity level was dropped from analyses because it was felt that the low and high activity codes presented an adequate description of activity level.) Only data from children with more than 30 min of playground observation for each interval were included in the analyses of playground behaviors. Reliability sessions were interspersed throughout a year-long period so that reliability data were available for 52 sessions. The mean interobserver correlation for the codes used was \( .83 \) (range = \( .77 - .95 \)).

**Cognitive skills.**—Cognitive skills of the schoolchildren were assessed in their homes by experienced testers fluent in English and Kiembu. The Verbal Meaning Test, modeled on the Peabody Picture Vocabulary Test but consisting of objects and concepts appropriate for East Africa, was used to assess verbal comprehension. The child was presented with four pictures and asked to point to the one named by the experimenter. Simpler items involved discrimination between common nouns, whereas more advanced items required knowledge of abstract concepts. The Raven’s Progressive Matrices Test was used to assess performance-type abilities. The child was presented with a matrix-like arrangement of symbols and completed the matrix by selecting the correct missing symbol from a group of symbols. The test required observation of perceptual detail and awareness of sequence. Raw scores were transformed into \( z \) scores (based on five age divisions) for each test. For each child, Verbal Meaning and Raven’s test scores from the three periods were used in analyses.

**Statistical Methods**

The major statistical method used for analysis is repeated-measures ANOVAs with trend analysis (Winer, 1971). With these maturing subjects, a linear trend most likely indicates developmental change, although it may also reflect a change started during the food shortage. A dip (decrement) or peak (increment) in the data during the food shortage period as compared to the other two periods is reflected in a quadratic trend. In this data set a quadratic trend may imply an effect attributable to the food shortage.

**Results**

**Food Intake**

The mean kcal intake per day for the three periods for the toddlers, caregivers, and schoolchildren is shown in Table 1. Male versus female differences in food intake were not significant, so data were combined across sex. During the 3½-month period of food shortage, the food intake of caregivers and schoolchildren was notably below previous and subsequent levels. Caregiver energy intake decreased about 400 kcal/day, and the food intake of the
schoolchild fell about 250 kcal/day. Repeated-measures ANOVAs on the data from the caregivers and schoolchildren showed this decrease in the form of a pronounced quadratic trend (see Table 1).

During the food shortage period the toddlers seemed somewhat protected relative to the caregivers and schoolchildren in that their energy intake did not decline. Energy intake was about the same before and during the food shortage and then increased (by about 100 kcal/day) in the period after the food shortage. While it is probable that the toddlers' food intake increased less than might normally be expected during the famine, food intake did not dip, and only the linear trend in the ANOVA was significant.

**Weight**

Mean weight and mean z scores for weight/age for the toddlers and schoolchildren for each period are shown in Table 2. Again, sex differences in weight were negligible, and data were collapsed across sex. Mean weight of the caregivers is also given. During the food shortage, caregivers' weights declined an average of 0.5 kg. Their weights approached previous levels after the food shortage.

The actual body weight of the schoolchildren did not decline during the food shortage, but rate of weight gain did diminish. Children gained an average of 0.2 kg in the interval between the first two time periods. In an equal time interval, after the food shortage, they gained an average of 1 kg. Thus, while actual body weight increased slightly even during the food shortage, z scores for weight/age fell during the shortage. This is reflected in the significant quadratic trend in the repeated-measures ANOVAs for weight and z score weight/age.

Again, toddlers seemed somewhat protected relative to the caregivers and schoolchildren. Body weight of the toddlers in-

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### TABLE 1

FOOD INTAKES BEFORE, DURING, AND AFTER FOOD SHORTAGE

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>During</th>
<th>After</th>
<th>Linear Trend</th>
<th>Quad Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toddlers (n = 98)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kcal/day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toddlers</td>
<td>792 (309)</td>
<td>793 (280)</td>
<td>879 (288)</td>
<td>196</td>
<td>6.4*</td>
</tr>
<tr>
<td>Caregivers (n = 105)</td>
<td>1696 (500)</td>
<td>1324 (468)</td>
<td>1710 (512)</td>
<td>210</td>
<td>1.1</td>
</tr>
<tr>
<td>Schoolchildren (n = 127)</td>
<td>1489 (342)</td>
<td>1236 (371)</td>
<td>1514 (413)</td>
<td>254</td>
<td>4.1</td>
</tr>
</tbody>
</table>

**p < .05.**

**p < .01.**

**p < .001.**

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### TABLE 2

WEIGHT AND WEIGHT/AGE Z SCORES BEFORE, DURING, AND AFTER FOOD SHORTAGE

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>During</th>
<th>After</th>
<th>Linear Trend</th>
<th>Quad Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toddlers (n = 98):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>9.5 (1.2)</td>
<td>10.2 (1.2)</td>
<td>10.8 (1.2)</td>
<td>196</td>
<td>869.5***</td>
</tr>
<tr>
<td>Weight/age z</td>
<td>-1.65 (.9)</td>
<td>-1.58 (.9)</td>
<td>-1.56 (.9)</td>
<td>196</td>
<td>6.3*</td>
</tr>
<tr>
<td>Caregivers (n = 106):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>51.4 (7.4)</td>
<td>50.8 (7.3)</td>
<td>51.1 (7.0)</td>
<td>212</td>
<td>4.4*</td>
</tr>
<tr>
<td>Weight/age z</td>
<td>-1.32 (.8)</td>
<td>-1.47 (.8)</td>
<td>-1.35 (.7)</td>
<td>252</td>
<td>43.2***</td>
</tr>
<tr>
<td>Schoolchildren (n = 126):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>19.6 (2.5)</td>
<td>19.8 (2.6)</td>
<td>20.7 (2.6)</td>
<td>252</td>
<td>43.2***</td>
</tr>
<tr>
<td>Weight/age z</td>
<td>-1.32 (.8)</td>
<td>-1.47 (.8)</td>
<td>-1.35 (.7)</td>
<td>252</td>
<td>43.2***</td>
</tr>
</tbody>
</table>

**p < .05.**

**p < .01.**

**p < .001.**
TABLE 3

FREQUENCY OF TODDLERS’ BEHAVIORS BEFORE, DURING, AND AFTER FOOD SHORTAGE (n = 81)

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>During</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Vocalization</td>
<td>.24 (.14)</td>
<td>.22 (.14)</td>
<td>.26 (.16)</td>
</tr>
<tr>
<td>Simple play</td>
<td>.25 (.17)</td>
<td>.23 (.15)</td>
<td>.18 (.14)</td>
</tr>
<tr>
<td>Functional play</td>
<td>.07 (.08)</td>
<td>.07 (.06)</td>
<td>.09 (.09)</td>
</tr>
<tr>
<td>Symbolic play</td>
<td>.04 (.05)</td>
<td>.06 (.07)</td>
<td>.06 (.09)</td>
</tr>
</tbody>
</table>

(df = 162)

<table>
<thead>
<tr>
<th></th>
<th>Linear Trend</th>
<th>Quad Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocalization</td>
<td>.9</td>
<td>3.4</td>
</tr>
<tr>
<td>Simple play</td>
<td>8.4**</td>
<td>.5</td>
</tr>
<tr>
<td>Functional play</td>
<td>3.0</td>
<td>2.7</td>
</tr>
<tr>
<td>Symbolic play</td>
<td>5.0*</td>
<td>.1</td>
</tr>
</tbody>
</table>

*p < .05.

**p < .01.

***p < .001.

creased smoothly across the three periods. The amount of weight increase seems somewhat less than might be expected in toddlers under normal conditions in this environment. However, z scores for weight/age also increased steadily (became smaller in a negative direction) across time.

**Toddler Behaviors**

Frequency of various toddler behaviors as observed during the three periods is shown in Table 3. Male versus female differences and sex by time interactions were nonsignificant, and data were therefore collapsed across sex. As can be seen from Table 3, only linear trends are evident. The percentage of observational intervals in which more advanced play (symbolic) was observed increased over time. As would be expected with maturation, less simple play was also observed over time. The amount of vocalization and functional play remained stable across time. Since the quadratic trend was nonsignificant for all variables, it may be that none of the behaviors showed any perturbation during the food shortage. However, the possibility cannot be ruled out that the toddlers would have shown greater increases in vocalization and higher-level play if the famine had not occurred.

To examine these data more closely, a subsample of 27 matched pairs of toddlers was created. Subjects were matched so one member of the pair, during either the period before or after the food shortage, was the same age as the other member during the food shortage period. For example, a child aged 20 months at the start of the pre-food shortage period was matched with a child aged 20 months at the start of the food shortage period. Age matches were made to within +15 days, and all matched pairs were of the same sex. Paired t tests were then used to analyze the toddler behaviors explored previously. None of the four t tests was significant, lending some support to the conclusion that toddler vocalizations and play were not affected by the shortage.

**Maternal Behaviors**

Frequency of various behaviors of the mother toward her toddler, as observed during each of the three periods, is shown in Table 4. Talking to the toddler and response

TABLE 4

FREQUENCY OF CAREGIVERS’ BEHAVIORS BEFORE, DURING, AND AFTER FOOD SHORTAGE

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>During</th>
<th>After</th>
<th>Repeated-Measures ANOVAs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>df</td>
</tr>
<tr>
<td>Caring (n = 81)</td>
<td>.07 (.08)</td>
<td>.03 (.05)</td>
<td>.03 (.04)</td>
<td>162</td>
</tr>
<tr>
<td>Holding (n = 81)</td>
<td>.11 (.17)</td>
<td>.04 (.08)</td>
<td>.03 (.07)</td>
<td>162</td>
</tr>
<tr>
<td>Talking (n = 81)</td>
<td>.14 (.11)</td>
<td>.10 (.11)</td>
<td>.11 (.09)</td>
<td>162</td>
</tr>
<tr>
<td>Responding to vocalization (n = 79)</td>
<td>.59 (.23)</td>
<td>.60 (.21)</td>
<td>.63 (.21)</td>
<td>158</td>
</tr>
</tbody>
</table>

*p < .05.

**p < .01.

***p < .001.
to child’s vocalizations remained stable across the three periods, possibly suggesting that developmental change or perturbation due to the food shortage did not affect these behaviors for the whole sample. Linear trends were evident in basic caregiving and holding. As toddlers matured, mothers spent less time with caregiving activities and carried the toddler less. However, a significant quadratic trend was superimposed on these linear trends. The frequency of holding and basic care behaviors fell off sharply from before to during the food shortage period, but the decrease from during to after the food shortage period was less pronounced. Thus, it seems that the food shortage may have precipitated a decrease in these behaviors beyond the developmental trends.

Given that the frequency of holding and basic care behaviors did not rebound following the famine, it could be argued that the decline was part of a developmental trend. To examine this possibility, the age-matched pairs of toddlers, as described previously, were used to examine maternal behaviors. Paired t tests revealed that during the food shortage, as opposed to before or after that period, mothers cared for and held their toddlers less, \( t(26) = -2.89, p < .01 \) and \( r(26) = -2.03, p < .05 \), respectively. There was also less maternal talk directed to the child, \( t(26) = -3.29, p < .01 \). Thus, mothers directed these behaviors less toward children during the food shortage than toward children of the same age in either the preceding or subsequent period.

Since the behavior of mothers changed as a group, it seemed worthwhile to investigate individual differences in behavior as a function of decline in food intake. Using the log values for the calorie counts, decline was measured by dividing the famine caloric intake by prefamine caloric intake. Pearson product-moment correlations were computed between this percentage, SES, and the four caregiving variables during the famine.

There was a significant association between SES and change in calories in that mothers who were from higher SES backgrounds maintained a higher percentage of their prefamine calorie intake compared to mothers from lower SES backgrounds, \( r(86) = .27, p < .01 \). In fact, SES and maternal kcals were unrelated in the prefamine period, \( r = .04 \), but were correlated during the famine, \( r(87) = .37, p < .001 \). The associations between calorie percentage and caregiving were negative so that mothers who were able to maintain their prefamine food levels were less involved with their toddlers, and this was significant for calorie percentage and amount of talking to the toddler, \( r(86) = -.31, p < .004 \). Mothers who were able to maintain their own calories also were able to maintain those of their infants, \( r(83) = .23, p < .04 \). In fact, there was a significant association between maternal and toddler calories only during the famine, \( r(87) = .38, p < .0002 \), and not in the prefamine period.

Thus, on an individual level, there appeared to be a trade-off between maintaining adequate nutrition for the family and maintaining verbal and social interaction. This raised the question whether the mother delegated her responsibilities for the toddler to others. We addressed this question by examining the associations between the amount that the mother cared for, held, and talked to the infants with the amount that this was done by others in both the prefamine and famine periods. While none of these correlations were significant in the prefamine period, there were negative relations during the famine between the amount the toddler was cared for by the mother and by other individuals, \( r(86) = -.28, p < .001 \), and the amount that the toddler was talked to by the mother and other individuals, \( r(86) = -.41, p < .0001 \). It appears, then, that other caregivers took over some maternal responsibilities during the famine period when the mother spent her time acquiring food.

The consequences of this substitution of caregivers is unknown. We have shown previously that toddlers who were talked to and interacted with socially more by all caregivers over the period from 18 to 30 months had higher Bayley scores at 30 months, regardless of earlier Bayley score (Sigman et al., 1988). Since almost all sustained social interactions and most verbal exchanges of toddlers in this culture involve other children, particularly older sisters and brothers, the lessening of maternal involvement may not be too important. To examine this possibility, correlations were calculated between the amount of talking and social involvement with the mother and other caregivers with the Bayley scores at 30 months. There were significant correlations between the amount of social interaction with mother and with other caregivers and Bayley scores, both \( r's(105) = .23, p < .02 \). However, only the amount of talking that occurred with
Table 5

Frequency of Schoolchildren’s Behaviors and Cognitive Scores Before, During, and After Food Shortage

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>During</th>
<th>After</th>
<th>Repeated-Measures ANOVAs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>df</td>
</tr>
<tr>
<td>Off-task (n = 80)</td>
<td>.17 (.15)</td>
<td>.19 (.17)</td>
<td>.14 (.11)</td>
<td>160</td>
</tr>
<tr>
<td>Low activity (n = 76)</td>
<td>.34 (.20)</td>
<td>.41 (.22)</td>
<td>.43 (.25)</td>
<td>152</td>
</tr>
<tr>
<td>Happy (n = 76)</td>
<td>.14 (.15)</td>
<td>.08 (.11)</td>
<td>.08 (.12)</td>
<td>152</td>
</tr>
<tr>
<td>Anxious (n = 76)</td>
<td>.77 (.22)</td>
<td>.75 (.25)</td>
<td>.74 (.21)</td>
<td>152</td>
</tr>
<tr>
<td>Positive peer (n = 76)</td>
<td>.11 (.13)</td>
<td>.13 (.18)</td>
<td>.12 (.16)</td>
<td>152</td>
</tr>
<tr>
<td>Alone (n = 76)</td>
<td>.40 (.19)</td>
<td>.41 (.21)</td>
<td>.45 (.21)</td>
<td>152</td>
</tr>
<tr>
<td>Raven’s z (n = 122)</td>
<td>.00 (1.0)</td>
<td>.03 (1.0)</td>
<td>-.01 (1.0)</td>
<td>244</td>
</tr>
<tr>
<td>Verbal z (n = 122)</td>
<td>.01 (1.0)</td>
<td>.01 (1.0)</td>
<td>-.01 (1.0)</td>
<td>244</td>
</tr>
</tbody>
</table>

* p < .05.
** p < .01.
*** p < .001.

Caregivers other than the mother were associated with 30-month Bayley scores, r(105) = .20, p < .04. Thus, other caregivers influence the development of toddlers in this group, so the replacement of mother care with sibling care may have been inconsequential for toddler development.

Behaviors of Schoolchildren

The before, during, and after food shortage behaviors of the schoolchildren are shown in Table 5. In all instances, male versus female differences and sex by time interactions were nonsignificant, and data were therefore collapsed across sex. As can be seen from Table 5, linear trends were significant only for the activity and positive peer interaction codes. Over time, children tended to spend less time in high-activity play and positive interaction with peers. As evidenced by significant quadratic trends, during the food shortage period, schoolchildren were less active and were often off-task in the classroom. Affective and social behaviors on the playground and cognitive performance did not change during the food shortage period.

The clearest effect of the famine on the schoolchildren as a group was on task-focused behavior in the classroom in that off-task behavior peaked during the famine and then declined. High activity did not rebound, so it could be argued that this is just the start of a linear decline with age. However, there were no significant correlations between age and amount of high activity on the playground for each individual observation period, so the linear trend noted in longitudinal data may have been precipitated by the effects of the food shortage.

Individual differences for the schoolchildren were examined in the same way as reported for the mothers of the toddlers. Calorie values in the prefamine and famine periods were converted to log values, and a percentage score was computed by dividing famine calorie level by prefamine calorie level. Preliminary analyses showed that SES was associated with this percentage score in the same way as for the caregivers so that higher SES schoolchildren maintained a higher percentage of their previous calorie level, r(86) = .23, p < .03. Since SES was also correlated with some of the schoolchildren’s behavior and cognitive scores, the correlations between calorie percentage and behavioral variables were calculated with SES covaried.

As hypothesized, there were significant associations between caloric decline and activity levels and social involvement but not between caloric decline and affect in the playground or cognitive scores. The significant correlations were for amount of high activity, r(86) = .23, p < .03, low activity, r(86) = -.29, p < .01, positive involvement, r(86) = .29, p < .01, and time alone, r(86) = -.38, p < .001. Thus, children whose caloric intake declined the most were more inactive and isolated on the school playground. Contrary to the hypothesis, there was no association between decline in calories and attentiveness in the classroom. Cognitive scores also did not vary with change in food intake.
To determine whether declines in involvement and activity were a function of pre-famine levels, Spearman correlations were calculated between change in activity and involvement and caloric level in the pre-famine period. There were no significant associations suggesting that the changes in playground social interaction affected the schoolchildren regardless of the adequacy of their diet before the food shortage began.

Discussion

In summary, the food shortage in Kenya in 1984 during data collection for a large-scale project on mild malnutrition provided an unprecedented opportunity to study the effects of a decline in food availability on the behavior of young children and their mothers. Changes in food intake and in behavior differed for children of varying ages. Toddlers were spared the most in that their food intake and weight for age did not decline. Moreover, the amount of time that the toddlers devoted to play and vocalizing was not significantly reduced, and they continued to show developmental gains in the sophistication of their play skills during the famine.

The mothers of these toddlers were not spared at all. They had less to eat and less to feed the rest of their families. As a group, the amount of time that they spent caring for, holding, and talking to their toddlers was reduced. The burden appears to have been heaviest for the mothers of the poorest families in that the decline in food intake for them and their toddlers was steeper than for mothers from families with more economic resources. Mothers from families with more resources fed themselves and their toddlers better but talked less to their toddlers. At the same time, these families seem to have protected the toddlers in that other caregivers substituted for the mother.

The temporary food shortage seemed to have the most profound effects on the schoolchildren. The schoolchildren suffered much more food deprivation during the famine than the toddlers. As a group, they showed a small decline in their attentiveness to classroom tasks, which went up in the period following the famine, and a reduction in activity on the playground which did not rebound very much. On an individual level, those schoolchildren whose food intake declined the most also had the biggest reductions in activity and social involvement. While poorer children had larger reductions in food intake than children from families with better resources, the declines in activity and involvement were independent of SES and of nutrition level prior to the famine.

Several explanations for the behavioral changes across groups and individuals can be considered. Perhaps the most obvious is that energy intake was insufficient to sustain normal activities during the period of food shortage. Mothers may have had less energy to devote to toddler care and verbal interaction. Schoolchildren may have had less energy to sustain activity levels on the playground and concentration levels in school.

A related explanation for the changes in behavior may be that individuals were engaged in other sets of activities requiring their time and energy. Both mothers and schoolchildren may have been involved in attempting to obtain food. Schoolchildren may also have been assigned more responsibilities for younger siblings. A third plausible explanation would be increases in anxiety during the famine. Both mothers and schoolchildren were undoubtedly aware of their precarious state, and this may have interfered with their ability to be socially involved and cognitively focused. The fact that classroom attention declined for the group but was unrelated to change in food intake may be evidence for this third explanation, although the children did not seem more anxious on the playground. Whatever the explanation for the changes in behavior, the consequences for the children’s activities in school would seem to be the same.

The behavioral changes shown by the schoolchildren may have had deleterious effects on their skill development. Active exploration, social involvement, and classroom attentiveness were important for cognitive development in this sample. High activity level, as measured over the school year, was associated with better cognitive outcomes (based on a combined score from the Verbal Meaning and Raven’s tests), $r(109) = .29$, $p < .05$, while the correlation between low activity and the cognitive composite score was $r(109) = -.35$, $p < .05$. In addition, off-task behavior in the classroom was associated with poorer cognitive skills (Sigman, Neumann, Jansen, & Bwibo, 1989). That the cognitive scores remained stable during the drought period suggests that short-term decrease in food intake did not immediately affect cognitive skills. However, the effects on behaviors important for learning may
have led to secondary losses in cognitive development.

It seems unlikely that the changes that occurred in food intake, weight, and behavior were due to seasonal variations rather than the drought and food shortage. Although we do not have sufficient data for the following year to examine whether the same trends reoccurred, the food shortage occurred in the period that usually follows the biggest harvest. In addition, it should be pointed out that the group changes in behavior were very small just as the period of food shortage was mercifully brief, partly because of the efforts of this research team. While poor children undoubtedly suffer longer periods of severe food shortages, which may have greater effects on their behavior, the possibility of this being documented seems unimaginable for ethical reasons.

In sum, the results suggest that temporary food shortages can modify the behaviors of children and their parents. In this study, the schoolchildren seemed to be affected most severely. The impact of the food shortage was greatest for poor children and their families. Before the food shortage, there was no association between SES and caloric intake, suggesting that most families were able to provide themselves with sufficient energy intakes. During the food shortage, caloric intake and SES were correlated so that poor families had less to eat. While the food shortage was most severe for schoolchildren from poor families, declines in activity and involvement were independent of previous levels of food intake, activity, or SES. This suggests that temporary food shortages may have similar effects in many communities, including those in developed countries, and that nutritional status need to be taken more seriously when the welfare of poor children is being considered.

References


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