Use of the multiple-day weighed record for Senegalese children during the weaning period: a case of the "instrument effect"[1–3]

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ABSTRACT In West Africa, the multiple-day weighed record is the most widely used technique for measuring children's food intakes. The children's eating behavior might be disrupted by the frequent weighings and the presence of a field-worker in the home. We explored the possibility of such an "instrument effect" in a 7-d food survey of 70 Senegalese children aged 10–13 mo. Energy intakes decreased significantly during the food survey ($P < 0.0001$). The decrease affected both daytime breast milk intake (8%) and solid food intakes (15%). The children's weight gain also decreased from a presurvey value of 6.9 to 2.1 $g \cdot kg^{-1} \cdot wk^{-1}$, indicating that their intakes during the food survey were lower than their usual intakes. The food-survey methodology was responsible for this "instrument effect." Policy decision-makers should be aware that data collected with the multiple-day weighed record technique might not reflect African children's usual food intakes. *Am J Clin Nutr* 1994;59(suppl):266S–8S.

KEY WORDS Dietary methodology, multiple-day weighed record, Senegal, weaning period

Introduction

The so-called "Hawthorne effect," defined by Liu et al (1) as "the act of being measured influences behavior and reporting of behavior . . . ," is often mentioned in the literature on dietary assessment methods. When such an instrument effect is present, measured food intakes do not reflect the subjects' true intakes. As Todd et al (2) point out, when policy decisions are to be made on the basis of food intake data, the quality and relevance of the dietary information collected should be examined carefully.

In developing countries, the multiple-day weighed record, based on the precise weighing technique, is the most widely used method for assessing children's diets. Because of the low level of literacy, the presence of a field-worker in the home for the duration of the survey is often necessary. The survey is time consuming for mothers and the family's usual dietary behavior might be disrupted. The possibility that an instrument effect might occur with this method has seldom been explored. Ferro-Luzzi showed that no day-of-the-survey effect occurred in a 7-d weighed survey of adults in New Guinea (3). But in the literature on African children's dietary intakes, we have found no mention of the instrument effect.

The study reported here was part of a program of validation of dietary assessment techniques for estimating Senegalese children's food intakes during the weaning period.

Subjects and methods

The food survey technique was derived from the Food and Agricultural Organization (FAO) methodology (4). Solid foods eaten individually were weighed. When children were fed from the family common pot, mothers were asked to duplicate their child's portion. Breast milk intake was measured by test-weighing (5).

The study took place in Pikine, the densely populated suburb of the capital, Dakar. Seventy children, 39 boys and 31 girls, aged 10–13 mo, participated in the 7-consecutive-day food survey. Fifty families also agreed to a two-night survey. Fieldworkers were women of the same area with a high school education. They were instructed to be as unobtrusive as possible and the families were asked not to modify their eating behavior. The food composition table for West Africa and the FAO table for use in Africa were used to compute energy intakes (6, 7). In addition to the food survey, the children's weight and morbidity were monitored weekly for a period of 2 mo. The food survey took place on week 5 of the study.

Analysis of variance with a repeated-measures design was used to test day-of-the-week, day-of-the-food-survey and week-of-study effects (program 2V of *BMDP;* BMDP Statistical Software Inc., Los Angeles). The number of days of diarrhea and poor appetite per week were used as covariates of food intake and weight gain. Contrast analysis was used to compare particular days or weeks. Results are given as means ± SE.

Results

All the children were breast-fed, and all but two received solid foods regularly. The girls' mean weight (8.4 ± 0.7 kg) was lower

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TABLE 1
Energy intake by day of food survey*

	Day of survey							
	1	2	3	4	5	6	7	*P*
				$kJ \cdot kg^{-1} \cdot d^{-1}$				
Breast milk†	149.6 ± 6.3	142.7 ± 5.3	143.2 ± 6.1	134.3 ± 6.0	131.4 ± 5.7	133.9 ± 6.0	137.2 ± 5.6	0.001
Solid foods	116.7 ± 9.6	121.7 ± 11.6	114.1 ± 9.9	108.8 ± 9.8	100.6 ± 10.0	103.5 ± 9.6	99.4 ± 8.7	0.02
All foods‡	266.3 ± 10.3	264.4 ± 10.3	257.3 ± 8.5	243.0 ± 8.8	232.0 ± 8.9	237.4 ± 8.2	236.6 ± 6.6	< 0.0001

* $\bar{x}$ ± SE; n = 70. ANOVA.
† Daytime breast milk.
‡ Solid foods and daytime breast milk.

than that of the boys (8.9 ± 1.0 kg, $P = 0.04$), but their overall weight gain was similar (6.8 ± 0.7 and 6.3 ± 0.5 $g \cdot kg^{-1} \cdot wk^{-1}$ for boys and girls, respectively, $P = 0.66$). The mean weekly prevalence of diarrhea was 23% and of poor appetite, 19%. Twenty-four–hour breast milk intake represented two-thirds of the energy intake. Total energy intake was similar in girls and boys: 344.3 ± 15.4 and 348. ± 13.0 $kJ \cdot kg^{-1} \cdot d^{-1}$, respectively ($P = 0.86$). Because no differences in food intakes or weight-gain were found between girls and boys in all the following analyses, results are presented for the sexes combined.

Food intakes did not vary according to ethnic group, field worker, or date of survey. No day-of-the-week pattern of energy intake was found, either from breast milk ($P = 0.82$) or solid foods ($P = 0.38$). There was a significant day-of-the-food-survey effect (**Table 1**). Energy intake decreased regularly from day 1 to 5. Daytime breast milk intake decreased until day 5 and then started to increase slightly on days 6 and 7, but did not regain its initial value (**Fig 1**). The mean number of daytime feedings decreased from 7.7 ± 0.3 on day 1 to 6.2 ± 0.3 on days 4–7. Energy intake from solid foods decreased regularly throughout the food survey (Fig 1). The overall decrease between the beginning and the end of the food survey amounted to 8% of daytime breast milk intake and 15% of solid food intake. When solid foods were analyzed according to the method of measurement, ie, weighing vs duplication, a significant decrease was observed for energy intake from weighed ($P = 0.01$) but not from duplicated foods ($P = 0.10$). Nighttime breast milk intake also showed a day-of-survey effect as intake decreased significantly between night 1 (102.9 ± 6.2 kJ/kg) and night 2 (90.4 ± 5.8 kJ/kg) ($P = 0.01$).

Mean weight gain by week of study is shown in **Fig 2.** Significant variations were observed ($P = 0.02$). From week 1 to week 4, mean weight gain remained constant with minor nonsignificant fluctuations about a mean of 6.9 ± 0.8 $g \cdot kg^{-1} \cdot wk^{-1}$. On week 5, the week of the food survey, mean weight gain dropped to 2.1 ± 2.0 $g \cdot kg^{-1} \cdot wk^{-1}$. There was an increase above the pre-survey level, indicating a period of catch-up growth, on week 7. Finally, on week 8 weight gain returned to the pre-food survey value. The comparison by contrast analysis of the presurvey weeks (1–4) to weeks 5 and 6 showed that weight gain was significantly lower during the food survey and the following week ($P = 0.01$).

Discussion

This study was well accepted by the families. They were eager to participate because medical care and treatment were provided to the study children. None of the families dropped out.

The observed decrease in intakes as the food survey progressed can be interpreted as a measurement bias, ie, an underestimation of the actual intake of the children or can indicate a change in the children's diet during the food survey. The reduction in weight-gain observed at the same time as the food survey indicates that children's intakes were in fact lower than their usual

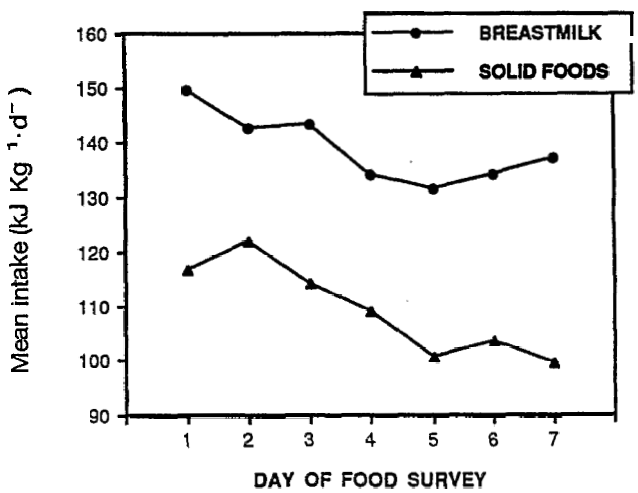


FIG 1. Mean energy intake from daytime breast milk and solid foods by day of the food survey.

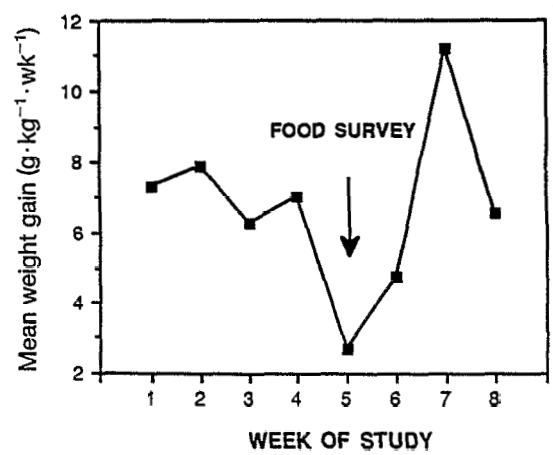
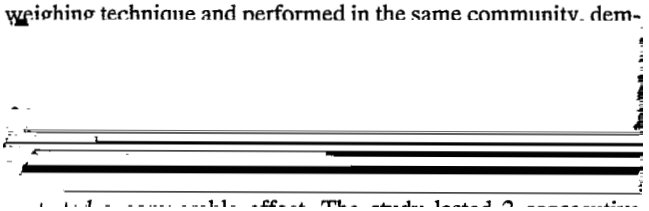


FIG 2. Mean weight gain by week of study. The food survey took place on week 5 (ANOVA: week-of-study effect, $P = 0.02$).

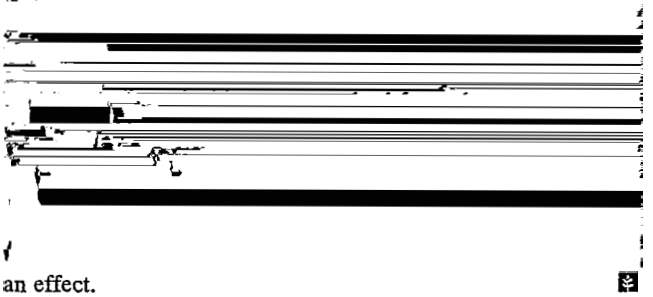
intakes. This finding clearly demonstrates that the decrease in intakes was due to an instrument effect. It is difficult to say what the magnitude of the decrease was, compared with the children's usual intake, but it was important enough to cause a 70% reduction in weight-gain compared with the presurvey weeks. This "Hawthorne effect" did not depend on the field workers. It was caused by the food survey methodology itself.

Why the 7-d weighed record decreased the children's intake is difficult to analyze. Daytime breast milk intake declined because of a reduction in the number of daytime feeds. Senegalese mothers breast-feed on demand and often use breast-feeding for its soothing effect when the child is not hungry. It is possible that to reduce the number of weighings, the mothers tended to feed the children only when they felt that they were obviously hungry. The observation that, after the first 5 d of the food survey, the breast milk intake increased slightly, although the number of feeds remained low, suggests that children adapted to the new pattern of feeding. Solid food intakes were more sensitive to the instrument effect than breast milk intake. How they were affected by the implementation of the food survey is less clear. The absence of a significant instrument effect for duplicated foods is difficult to interpret because intake from the family common pot was highly variable within subjects. Finally, whether the instrument effect changed intakes of solid food only quantitatively or also qualitatively cannot be inferred from these data.

The overly demanding design of the food survey could explain by itself why an instrument effect occurred. But data from another simplified survey of shorter duration, also using the precise weighing technique and performed in the same community, dem-



record might not reflect African children's true dietary intake.



an effect.

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