Nutrition Counseling Training Changes Physician Behavior and Improves Caregiver Knowledge Acquisition

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ABSTRACT Physician behavior and caregiver retention of nutrition advice were examined as potential mediating factors in the success of a nutrition counseling efficacy trial in Pelotas, Brazil, which reduced growth faltering in children 12–24 mo old. After pair-matching on socioeconomic status and nutrition indicators, municipal health centers were randomly assigned to an intervention group, in which physicians were trained with an IMCI-derived (Integrated Management of Childhood Illness) nutrition counseling protocol, or to a control group, without continuing education in nutrition. In a substudy of the larger trial, direct observation of consultations, followed by home interviews with mothers, provided data on physician counseling behavior and mothers' retention of nutrition advice. Trained providers were more likely to engage in nutrition counseling (P < 0.013) and to deliver more extensive advice (P < 0.02). They also used communication skills designed to improve rapport and ensure that mothers understood the advice (P < 0.01). Mothers who received advice from trained providers had high rates of recalling the messages on specific foods (95 vs.27%; P < 0.01) and feeding practice and food preparation recommendations (90 vs. 20%; P < 0.01), whereas the proportions of the messages recalled on breast-feeding (60% vs. 30%) did not differ significantly (P < 0.20). The training course contained several elements that may explain why intervention group mothers were better able to recall nutrition advice. These include locally appropriate messages, tools for assessing individual problems, and counseling skills. J. Nutr. 134: 357–362, 2004.

KEY WORDS: • improving communication • Integrated Management of Childhood Illness • prevention of growth faltering

The nutrition component of the WHO/UNICEF strategy of “Integrated Management of Childhood Illness” (IMCI) (1) was shown to be efficacious in a randomized trial in Pelotas, Brazil (2). In this city of endemic mild-to-moderate malnutrition, physician counseling of caregivers bringing children to municipal health centers for clinical care significantly improved the anthropometric status in children aged 12–24 mo. The positive results raise a series of questions about the mediating factors that linked the provision of nutrition counseling education to physicians with better growth in children. In this paper, we present the results of a substudy whose design permits an examination of two steps in the process: how the nutrition training influenced physician behavior and how it influenced caregiver retention of nutrition advice. We argued elsewhere (3) that explicating the pathways by which nutrition interventions achieve (or fail to achieve) their effects (i.e., the mechanisms of effect) can provide important insights for intervention and policy planning, just as investigations of intermediary metabolism and the biochemical bases that mediate between nutritional interventions and health outcomes have yielded valuable knowledge about human biology.

This paper addresses the following questions concerning the counseling process: 1) Do physicians who were trained with the IMCI nutrition module give nutrition advice to caregivers in a clinical consultation? Do they do this more frequently than providers who were not trained? When they give nutrition advice in a clinical consultation, do trained providers provide more advice than physicians who had not received nutrition training? 2) Are there differences in the content of messages, type of advice, and communication style of trained vs. untrained physicians? 3) Do mothers who seek care for a sick child remember the nutrition advice they received in the consultation? Is advice from a nutritionally trained provider better remembered than advice received from an untrained provider?

In recent years, there has been growing interest in the role of health service providers and health clinics as resources for the promotion of good nutritional practices and dietary change not only to prevent malnutrition (as described in this paper) but also to prevent obesity (4–6). At the same time, the demonstration that mild-to-moderate malnutrition in young children increases the risk of mortality from disease (7) adds further impetus to the utilization of health services as a venue.
for improving nutritional status of infants and children in developing countries. During infancy and early childhood, contact with health services, particularly for curative care, is perhaps the single most common source of institutional contact between families and public sector services. Moreover, the credibility that health care providers are typically accorded in many social settings suggests that nutrition advice delivered by practitioners may be particularly persuasive.

On the other hand, there are substantial constraints that counterbalance the positive factors. The potentially negative features include the following: 1) health providers lack adequate knowledge to provide effective counseling on infant and young child feeding, including breast-feeding and complementary feeding (8,9); 2) a variety of characteristics of health service management (e.g., heavy demand relative to personnel, which limits the time providers have available for nutrition counseling, lack of incentives for health workers to engage in nutrition counseling); and 3) the organization of health care in a fashion that separates preventive and curative services, which is less conducive to sustained nutrition intervention. From the perspective of caregivers, a potential constraint for effective nutrition counseling within the context of a health center visit for a sick child is that worry about the illness precludes mother’s cognitive attention to other matters (i.e., the sick child consultation is not a “teachable moment”).

The trial in Pelotas provides an opportunity to examine a number of issues concerning nutrition counseling in a health services context. As described below, physician training was structured to address several potential constraints, recommendations were tailored to local conditions, and subject selection procedures ensured that the types of problems for which care was sought were representative of typical case loads.

SUBJECTS AND METHODS

Design of the trial. All of the 28 municipal health centers in the city of Pelotas (Brazil) were pair-matched on census data for socioeconomic indicators and on nutritional status indicators available from surveillance surveys. One center from each pair was then randomly selected by a coin toss to be the intervention group. The other center was assigned to the control group. The staff in municipal clinics assigns one physician, either a pediatrician or a general practitioner, to the clinical management of young children. In 3 of the intervention clinics 2 physicians shared this responsibility; thus, a total of 17 doctors were allocated to the intervention group, whereas 14 physicians were in the control group. The physicians in the intervention group received 20 h of training in a program derived from the IMCI nutrition counseling module. The physicians in the control group received a clinical refresher course but no training in nutrition counseling.

A sample of 424 caregiver/child pairs was recruited for the trial. Caregivers bringing children <18 mo old to the municipal health centers were approached in the waiting room of the clinics. In two thirds of the cases, these were “sick child” visits, whereas the rest were scheduled preventive care or follow-up visits. They were invited to participate in a study that would involve home visits 1 wk, 6 wk, and 6 mo after their present visit. To avoid bias in the results, the explanation to the caregiver emphasized child health and did not include a specific statement about nutrition. (Hereafter the caregiver is referred to as the mother because all of the children in the sample were brought to the clinic by their mothers.) Recruitment was initiated in the pair-matched centers at the same time, and continued at each facility until a sample of 13 children was obtained for each physician. There were no refusals among the women who remained in the waiting room long enough before they were called into the consultation to complete the recruitment interview. Allowing for staffing needs for the follow-up home visits, recruitment was conducted over a 3-mo period, between March and May, 1998 until the full sample of 424 caregiver/child pairs was obtained.

Home visits were utilized to collect data from mothers, which included questions on their recall of the advice they had received at the clinic, sociodemographic characteristics, and current feeding practices. Dietary intake of the child and anthropometry data were also collected.

Substudy design. For each physician in the study, the first 3 consultations of the 13 children who were recruited into their individual sample were observed by a trained observer. Before the observations, informed consent to observe the consultation was obtained from both mothers and physicians, in addition to the consent to participate in the larger study. A total of 48 consultations (by 16 physicians) were observed in the intervention group and 42 (by 14 physicians) in the control group. (Although 17 physicians received nutrition counseling training, one did not see enough children to remain in the study.)

To avoid a potential for bias, the observers were rotated between intervention and control group clinics and were unaware of the clinics’ status in the study. Data were collected with the aid of a structured observation instrument, and information on both physician and mother behavior was recorded. The observers recorded all of the nutrition advice that was given to the mother, as well as a detailed description of the clinical examination procedures and verbal and nonverbal interactions between physicians and mothers.

Although an effort was made to conduct the first home visit 1 wk after the clinic visit, there was some variability in the time period between the two data collection points. Because recall of nutrition advice would be expected to change as a function of time, we restricted this analysis to a narrow time window of not <7 or ≥9 d elapsed time from the consultation to the home visit. This resulted in the elimination of 23% of mothers from the intervention group and 24% from the control group. Thus, the sample for these analyses comprises 69 physician/mother pairs (out of the total of 90 in the substudy) in which both observations of three consultations and time-controlled first home visit data are available.

The study protocol and oral informed consent procedures were approved by the ethical committees of the Federal University of Pelotas and the WHO.

Coding and definition of variables. A message is defined as a statement (or set of statements) that refers to a specific action or food. Examples from the physician consultations include: “use a cup and spoon instead of a bottle,” “give mashed chicken liver,” or “give different foods at different meals.” Each statement was coded as a separate message. For example, a physician who advised a mother to do all three of these actions would be classified as having given three messages.

From the observation, two features of physician communication style were coded: 1) praising the mother, and 2) asking checking questions to ascertain that the mother understood the advice. These features were also used to construct a communication score (CS): the physician received 1 point for each of these two features when he or she utilized them in a consultation. The points were summed across the three observed consultations, yielding a total score that ranged from 0 to 6.

Differences in proportions were tested by χ² statistics as were associations in 2 × 2 tables. Differences in the means of continuous variables were tested by t tests. Differences were considered significant when P < 0.05.

RESULTS

The first set of questions we posed in the introduction are concerned with whether trained physicians used their newly acquired knowledge in their practice. The number of different messages physicians gave in an individual consultation (Table 1) addresses the matter of whether the trained physicians

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3 The full database, as reported in the initial publication (2), contains a total of 104 physician-mother observations. However, of these, 3 involved an intervention group physician who did not see enough other children to qualify for the larger study, and 11 consisted of additional observations of some physicians that were made outside of the sampling design for the substudy.
made use of the clinical consultation to give mothers nutrition advice and whether they gave more advice. In the majority of their consultations, the physicians in the intervention group gave some nutrition advice. Only 9 (24.4%) consultations of the trained physicians did not include advice; thus 28 of the 37 observed consultations (75.6%) included 1 or more nutrition messages. In contrast, only 14 of 32 consultations (43.7%) of the observed consultations with untrained physicians involved a nutrition-related communication. Thus, the two groups differed in giving nutrition advice in a clinical consultation ($P < 0.013$).

The trained physicians gave 81 messages in contrast to the 20 messages given by physicians in the control group. If any message was given, physicians in the intervention group gave more messages than did the practitioners in the control group ($P < 0.02$). At the upper extreme was a consultation in which the mother received 8 advice messages. In two thirds of the consultations in which a trained physician engaged in some nutrition counseling, he or she gave $>1$ message.

To address the second set of questions, we classified the specific messages given by physicians into the following 3 categories: 1) advice concerning breast-feeding; 2) advice concerning the value of specific complementary foods; and 3) advice concerning feeding practices and food preparation. Trained physicians gave significantly more messages about specific foods and food preparation and practices, but there was no difference in breast-feeding messages (Table 2).

Trained physicians used two communication skills more frequently than did their counterparts in the control group ($P < 0.01$) (Table 3). In only three consultations by doctors in the intervention group were neither of these skills observed. In the control group, only 43.8% involved any of these communication techniques ($P < 0.01$); 56.2% did not use either praise or checking questions. The mean CS for physicians in the trained group was 3.94 ± 1.68, whereas it was 1.38 ± 1.02 in the control group ($P < 0.01$).

The third set of questions about the counseling process pertained to the mothers. How well or poorly mothers recalled the nutrition messages they had received 1 wk before the home interview is documented in Table 4. Of the 81 messages, 90% were remembered by the mothers in the intervention group compared with 30% in the control group. For two categories of messages, specific foods and food practices/food preparation, mothers who were seen by the trained physicians recalled more advice than did mothers in the control group. Striking differences existed between the two groups in recall of messages on specific foods and on food practice/preparation, with 95% of messages on specific foods and 90% of messages on food practice or food preparation advice remembered by the intervention group. In contrast 27% of messages on specific foods and 20% of messages on food practices/food preparation were recalled by mothers in the control group. There was no difference between the two groups of mothers in recalling messages on breast-feeding.

**DISCUSSION**

In Pelotas, as in most other communities with endemic undernutrition, the pattern of growth faltering is one of progressive deviation from international growth reference standards, beginning in the first semester of life and continuing into y $2$ (10). As previously reported, the nutrition counseling intervention did not completely eliminate this pattern of growth faltering, but children in the intervention group grew significantly better than children in the control group (2). The effect of the trial on growth implied that there were behavioral changes on the part of both physicians and caregivers. The questions we set forward in the introduction concern two essential steps in the process, i.e., physician utilization of the clinical encounter for nutrition counseling and caregiver retention of the information they receive.

The analyses above that pertain to physicians are aimed at identifying the types of changes they made in their clinical consultations with mothers. The comparisons of trained with untrained physicians provide unequivocal evidence that the knowledge and skills they gained from the training were utilized in their routine clinical practice. They gave advice more often, gave more of it, and did so with better communication skills than physicians who did not participate in the training course. Thus, the answers to the first two sets of questions we set out in the introduction are affirmative.

The nutrition counseling training has several characteristics that may explain its positive effect on physician behavior change. The IMCI nutrition counseling material is built on two basic features: 1) providing technical nutrition knowledge, which is organized around appropriate foods and feeding practices (including breast-feeding) in relation to child age, and 2) skill-building tools to promote rapport and effective communication. Characteristics of the training with respect to the first feature include the following: 1) The nutrition module contains guidelines on the types of problems health workers might expect to encounter and provides suggestions about how to question caregivers to efficiently elicit their current practices. 2) A central feature of the approach to nutrition counseling in IMCI is that advice is adapted for local conditions.

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**TABLE 2**

<table>
<thead>
<tr>
<th>Message topic</th>
<th>Intervention group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast-feeding</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Specific foods</td>
<td>38</td>
<td>8</td>
</tr>
<tr>
<td>Feeding practices/food prep.</td>
<td>38</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>81</td>
<td>20</td>
</tr>
</tbody>
</table>

$\chi^2 = 13.2; P < 0.01.$

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**TABLE 1**

<table>
<thead>
<tr>
<th>Messages delivered, n</th>
<th>Intervention consultations</th>
<th>Control consultations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0*</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>3+</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Total**</td>
<td>81</td>
<td>20</td>
</tr>
</tbody>
</table>

1 $n = 37$ intervention and 32 control consultations. * $\chi^2$ (none vs. 1 or more) = 6.06; $P < 0.014$. ** Intervention vs. control (excluding none); $P < 0.02$. 

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To achieve this, the IMCI program contains a protocol for an adaptation study, which includes guidelines for analyzing local food availability, collection of information on cultural beliefs and practices, and household trials to test the feasibility of putting recommendations into practice (11,12). A local adaptation study permits health workers to engage in specific rather than generic discussion with caregivers and to recommend particular foods and advise parents about avoiding any negative practices that are known to be common in an area. For example, in the Pelotas trial, mothers were advised to give “mashed chicken liver” or “egg yolk,” both of which were found, through household trials in the adaptation study, to be economically and culturally acceptable.

The IMCI protocol concerning the second basic feature discussed above focuses on two features of health worker communication behavior that are not typically included in discussions above focuses on two features of health worker communication behavior that are not typically included in the nutrition counseling component in the Pelotas nutrition counseling trial. In short, the training course gave the physicians basic, up-to-date information about nutrition, including the scientific rationale for the recommended practices. It also provided them with practical, locally relevant suggestions that they could use in counseling caregivers. Finally, it integrated the learning of communication skills in counseling practice sessions rather than teaching these in a separate communication module.

The characteristics of the nutrition training package in this study addressed many of the concerns that have arisen in previous studies and discussions about the difficulties of including nutrition as part of clinical practice. It included a quick, accurate assessment tool, which has been flagged as an essential requirement for conducting counseling in a primary care setting (13). It also met the need for a method that permits practical nutritional guidance, which has been noted by several observers as an impediment to nutrition counseling (5,14,15). It directly addressed the need for increasing physician knowledge, which was identified as a serious barrier to effective support of infant and young feeding in clinical settings (8,16). Finally, it used an approach that has been characterized as an “interaction model” of nutrition counseling, which was advocated by van Woerkum (17) and others as an orientation that is likely to be more successful than more didactic or authoritarian approaches.

Counseling on breast-feeding was little affected by training relative to counseling on foods and feeding. Although the training included breast-feeding, this was not new information for physicians because breast-feeding promotion has been a high priority in Pelotas for several decades and is well established in the preclinical curriculum, as well as in continuing education activities (18).

Apart from the direct effects on physician behavior, the results indicate that structural conditions in the public health system in Pelotas provided an environment in which physicians could utilize their knowledge. Ockene and colleagues (6) noted, with respect to adult nutrition counseling in clinical settings, that health worker behavior change requires a facilitative structure in the clinic, as well as training. In assessing the generalizability of the results of the trial in Pelotas to other settings, it is important to note that, compared with many other communities, the organization, operation, and staffing of public clinics in Pelotas is excellent. Consequently, the physicians in these clinics may be more highly motivated to make use of their training, and they may have better conditions for implementing it than is often the case. Thus, the influence of the training on behavior change of health workers may be greater than could be anticipated in some other settings.

It is also important to note that although the nutrition training that was provided to the physicians in this study followed the guidelines and utilized the counseling tools of the nutrition component of IMCI, it differed from the standard training in the following ways: 1) the physicians in Pelotas were given the nutrition training as a “stand alone” course, independently of the other modules in the protocol. (Typically health workers receive this training as part of more extensive

### Table 3
**Communication skills of intervention and control doctors observed in consultations in Pelotas, Brazil IMCI nutrition counseling trial**

<table>
<thead>
<tr>
<th>Communication skills</th>
<th>Intervention group</th>
<th>Control group</th>
<th>P-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Praise and check understanding</td>
<td>17</td>
<td>45.9</td>
<td>2</td>
</tr>
<tr>
<td>Praise only</td>
<td>6</td>
<td>16.2</td>
<td>9</td>
</tr>
<tr>
<td>Check understanding only</td>
<td>11</td>
<td>28.7</td>
<td>3</td>
</tr>
<tr>
<td>Neither communication skill</td>
<td>3</td>
<td>8.1</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td></td>
<td>32</td>
</tr>
</tbody>
</table>

* Difference between intervention and control group physicians in use of these skills.

### Table 4
**Number and proportion of messages recalled by mothers by topic of message in intervention and control groups in Pelotas, Brazil**

<table>
<thead>
<tr>
<th>Message topic</th>
<th>Intervention messages recalled by mothers</th>
<th>Control messages recalled by mothers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Breast-feeding</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>Specific Foods</td>
<td>36</td>
<td>95a</td>
</tr>
<tr>
<td>Feeding practices/Food preparation</td>
<td>34</td>
<td>90b</td>
</tr>
<tr>
<td>Total</td>
<td>73</td>
<td>90c</td>
</tr>
</tbody>
</table>

1 Letters indicate significant differences between intervention and control groups, a P < 0.01; b P < 0.01; c P < 0.01.
course on the management of illness.) 2) The number of hours devoted to nutrition training was greater than would be the case in a standard course. However, part of the additional time was for counseling skill development, which is taught and reinforced in every module of the larger integrated course, so that the greater amount of time devoted to this aspect was intended to compensate for the other opportunities for skill development in the full course. Because the principal features of IMCI nutrition counseling were maintained in this study, we expect that the findings can be generalized to other areas.

From the caregiver point of view, the questions we posed in the introduction relate to the first step in a behavior change process, which begins, for them, with receiving nutrition counseling. These questions for which we have data, relate to why the behavior change was triggered through the nutrition counseling. Specifically, we sought to determine whether mothers who bring children for clinical services recall nutrition advice they receive in the consultation and whether the advice received was influenced by being more sensitive to the messages retained by mothers in the control group 1 wk after the clinic visit. From the observations in the clinics, we saw that physicians in the control group also gave nutrition messages. These questions for which we have data, relate to why the behavior change was triggered through the nutrition counseling. Specifically, we sought to determine whether mothers who bring children for clinical services recall nutrition advice they receive in the consultation and whether the advice received was influenced by being more sensitive to the messages retained by mothers in the control group 1 wk after the clinic visit. From the observations in the clinics, we saw that physicians in the control group also gave nutrition advice, albeit not as often and not as amplified as those in the intervention group. But the majority of the messages they gave were not remembered. This suggests that a clinic visit can be a “teachable moment” for nutrition, but is not automatically so. The importance of examining the linkage between physician and caregiver is the revelation that mothers who were seen by trained providers retained the knowledge that was conveyed.

The differences between the intervention and control group mothers in their recall performance were striking. The majority of the messages that were delivered by the trained physicians were recalled. In contrast, less than a third of the nutrition messages were retained by mothers in the control group 1 wk after the clinic visit. From the observations in the clinics, we saw that physicians in the control group also gave nutrition advice, albeit not as often and not as amplified as those in the intervention group. But the majority of the messages they gave were not remembered. This suggests that a clinic visit can be a “teachable moment” for nutrition, but is not automatically so. The importance of examining the linkage between physician and caregiver is the revelation that mothers who were seen by trained providers retained the messages at significantly higher levels.

To generalize these results to other communities in which undernutrition produces growth faltering in early childhood, the economic, social, and cultural characteristics of the population must be considered. The results of the study cannot be generalized to conditions in which absolute economic constraints prohibit behavior change. Moreover, compared with some populations in which nutrition counseling interventions are undertaken, the educational level of the mothers in Pelotas is relatively high, with 50% of mothers in the study reporting between 4 and 7 y of schooling, and only 42% with 0–3 y of education. It is possible that the educational background of the mothers predisposed them to be more sensitive to the differences in the nutrition counseling content and style of the intervention compared with control physicians than would be the case in another population. However, maternal recall was unrelated to education; thus the “education factor” at the population level may not be an important issue in generalizing the results to other places.

Because of the truncating of the substudy sample, which resulted in a parallel loss of subjects from the intervention and control groups, there is a potential for bias that reduces the strength of the randomized design. On the other hand, recall performance in general was associated with elapsed time and we judged this to be a greater potential source of bias than the bias that might have been introduced by truncating the sample. Because exactly the same proportion of mothers was eliminated by applying the time criterion, and because staff scheduling as well as maternal availability at the time of the unannounced home visit affected the date of the visit, the likelihood of significant bias between the intervention and control group mothers with respect to recall performance is reduced.

The purpose of these analyses was to examine both physician behavior and caregiver response as mediating factors in the pathway through which nutrition counseling led to improvements in child growth in Pelotas. Although it is possible that physicians who received the IMCI nutrition training changed their total approach to ill management, we think this is unlikely to be the explanation for better child growth. There is little evidence to suggest that medical management of moderate, acute illness in early childhood has large effects on growth, whereas sustained improvements in dietary intake (as a result of good nutrition counseling) is the more likely explanation. Moreover, the control group physicians received updated illness management training (instead of nutrition training), and because most of the clinic staff are relatively young, they all received modern ideas of medical management in their preclinical education.

Given the physicians’ responses to training, we then examined the mothers’ ability to remember the advice they received from the physician. Why do mothers who receive advice from a nutritionally trained physician remember that advice better? Is it in the characteristics of the advice itself, the content of the messages? If so, what features of these messages make them more noteworthy from the perspective of mothers? Is it the way in which the advice is given, the communication style? Or is it both?

As described above, the training the physicians received and their use of that training fully integrates the two different components of content and communication. The IMCI nutrition training module is based on current best practice recommendations, which are learned as specific and locally feasible translations from general principles, a feature that is made possible by the application of a local adaptation protocol. At the same time, the training on content is fully integrated with training on communication skills so that practitioners acquire these counseling skills in the context of their training. The analysis of the clinical observations demonstrates that the training in Pelotas accomplished both objectives, i.e., improving communication skills and giving them actionable recommendations to discuss with caregivers.

Identifying the relative importance of content and communication style, or determining whether these have synergistic effects, has implications for future nutrition planning. The organization and content of in-service training will be affected by such knowledge because the different elements of the intervention carry different investment costs that become substantial in large-scale programming decisions. For example, to derive locally appropriate recommendations necessitates investments in local adaptation studies, which, however streamlined, still require the allocation of some resources.

Apart from the substantive knowledge gained about the effectiveness of health provider training to influence maternal nutritional knowledge, this study adds plausibility (19) to the assumed pathway between health provider training and the improved nutrition seen in the larger study. Well-conducted randomized trials give unambiguous statistical probability statements about the causality of the intervention, not just a statement about a significant difference. However, such a causal statement does not give any information about the path of causality, and another path might not have been mediated through the physician counseling to maternal knowledge acquisition. This study lends plausibility to the statistically dem-
onstrated probability of causality. The findings from these analyses illustrate the utility of exploring the intermediate pathways through which behavioral interventions affect nutrition outcomes. They also raise new questions whose answers have important implications for how advances in basic nutrition science are translated into actions to improve the health of populations.

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LITERATURE CITED


