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Scripted Messages Delivered by Nurses and Radio Changed Beliefs, Attitudes, Intentions, and Behaviors Regarding Infant and Young Child Feeding in Mexico[1–3]

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Abstract

Scalable interventions are needed to improve infant and young child feeding (IYCF). We evaluated whether an IYCF nutrition communication strategy using radio and nurses changed beliefs, attitudes, social norms, intentions, and behaviors related to breastfeeding (BF), dietary diversity, and food consistency. Women with children 6–24 mo were randomly selected from 6 semi-urban, low-income communities in the Mexican state of Morelos (intervention, $n = 266$) and from 3 comparable communities in Puebla (control, $n = 201$). Nurses delivered only once 5 scripted messages: BF, food consistency, flesh-food and vegetable consumption, and feed again if food was rejected; these same messages aired 7 times each day on 3 radio stations for 21 d. The control communities were not exposed to scripted messages via nurse and radio. We used a pre-/post-test design to evaluate changes in beliefs, attitudes, norms, and intentions as well as change in behavior with 7-d food frequency questions. Mixed models were used to examine intervention-control differences in pre-/post changes. Coverage was 87% for the nurse component and 34% for radio. Beliefs, attitudes, and intention, but not social norms, about IYCF significantly improved in the intervention communities compared with control. Significant pre-/post changes in the intervention communities compared with control were reported for BF frequency (3.7 ± 0.6 times/d), and consumption of vegetables (0.6 ± 0.2 d) and beef (0.2 ± 0.1 d) and thicker consistency of chicken (0.6 ± 0.2 d) and vegetable broths (0.8 ± 0.4 d). This study provides evidence that a targeted communication strategy using a scalable model significantly improves IYCF. J. Nutr. 143: 915–922, 2013.

Introduction

Infant and young child feeding (IYCF)[7] is important for preventing stunting and nutritional anemia. Large global health initiatives now support IYCF strategies from birth to 24 mo (1), with the promotion of complementary feeding viewed as an essential intervention (2). In Mexico, stunting and anemia are a public health concern, where 16% of children <5 y are stunted (3) and 21% have anemia (4). Furthermore, IYCF practices do not comply with international recommendations. By 9 mo, 50% of infants are not breastfed, animal-source foods are not regularly provided to the infant (5,6), and complementary foods are deficient in energy, iron, zinc, calcium, and vitamins A and C (7). The challenge is to promote appropriate complementary feeding practices at scale (2,8).

Primary health care is a pivotal delivery platform for public health. Bundling interventions is one approach for scaling up nutrition (9). Mexico bundles nutrition services (e.g., vitamin A, iron, multiple micronutrients, growth monitoring) for young children through National Health Campaigns (10), immunization visits, and primary care (11), and nurses deliver integrated care at these points of contact. A key consideration in this context is to work within the existing services of the health system (8,9) while strengthening health worker capacity. Low-burden strategies are essential for scaling-up complementary feeding given the high workload of health personnel.

To this end, we tested the effectiveness of a scalable nutrition communication strategy, premised on scripted messages delivered by nurses and radio, to improve complementary feeding in

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[3] This trial was registered at clinicaltrials.gov as NCT01405755.
[7] Abbreviations used: BF, breastfeeding; INSP, Instituto Nacional de Salud Pública; IYCF, infant and young child feeding.
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Morelos, Mexico. We hypothesized that this intervention would result in improved beliefs, attitudes, social norms, intentions, and behaviors regarding breastfeeding (BF), food consistency, and diet diversity. We also examined change in nutrient intakes. We report here the results of our impact evaluation for the combined nurse and radio intervention components. In a forthcoming publication, we examine the added impact of the radio component on behaviors among participants exposed to both the nurse and radio messages.

Methods

Intervention design.
A conceptual framework for explaining complementary feeding practices in Morelos derived from ethnographic research served as the foundation for this intervention (12). This previous research revealed that maternal feeding decisions were largely driven by mothers' highly organized knowledge and beliefs (7,13). Mothers showed a strong preference for liquid-based foods (i.e., broths and runny soups). Foods missing in the child's diet were present in sufficient quantities in the household but were not fed to the child due to specific reasons (13). For example, chicken or beef, when purchased for family consumption, were not given because of their tough consistency and could be a choking hazard, and vegetables were perceived by the mother not to be liked by the child, so vegetables were given infrequently. IYCF patterns show a striking similarity across regions in Mexico, with children's diets mostly consisting of fruits, broths, tortilla, and bread (14).

We used the Theory of Planned Behavior (15) and a social marketing approach (16) to guide the design of the intervention. We developed 5 scripted messages to target beliefs and attitudes underlying the key behaviors we wanted to improve. We conducted 3 focus-group discussions to develop messages and study materials to be provided to participating mothers (i.e., radio spots and a magnet). Scripted messages delivered by nurses (**Table 1**) were also aired on the radio but were not tailored for specific age groups.

Nurse component. By federal mandate, immunization services at health clinics must provide nutrition education (11). Implementation of nutrition education is variable and not standardized (17). From each of the 6 communities selected to participate in the intervention (see study evaluation section), we selected one nurse assigned to immunization services to participate in a 2-d training on complementary feeding and communication skills. There were also 2 additional days of practical training at a health center to homogenize message delivery. From June 13 to 17, 2011, these nurses delivered only once the 5 scripted messages to participants, either at the health center or at the participant's home, through an additional visit that was not part of routine care. Nurses were able to deliver 5 scripted messages in 8–10 min. Nurses used a picture card with vegetables, a cup to show the size of the child's stomach, and a jar of pap food and a spoon to demonstrate desired consistency. As a message reminder, nurses gave participants a magnet for their refrigerator that highlighted 4 messages: BF, vegetables, food consistency, and meat consumption.

Radio component. In Mexico, 79% of households have a radio. Social marketing campaigns in Mexico have found that radio allows for a greater reach than television (18). Mass media has been successfully used to promote immunization (19), oral rehydration (20), and food-based supplementation (21). We used radio to augment exposure to the messages and to strengthen the association between a behavior and its belief (22–24). We aired only one key message per day and developed 30-s spots for each key message; 7 spots were aired per day (n = 441). We also had live mentions by the radio host (n = 30) as well as live interviews (n = 5). All elements of our radio campaign aired for 21 d, June 6–26, 2011, from 0700 to 1800 h during programming aimed at housewives. Radio stations were monitored to ensure airplay of the spots and that no IYCF messages, other than ours, aired during the study period.

Study evaluation. We used a quasi-experimental cluster design in which communities were the clusters. Morelos (intervention communities) and Puebla (control communities, usual care) were the 2 states involved that are adjacent and culturally similar; separation by state prevented contamination of the radio component.

TABLE 1 Scripted messages delivered by nurses at home visits or at clinic with study participants[1]

Key message	Scripted message
BF from 6 to 24 mo	Many think that breast milk after 6 mo does not feed the baby, but this is not the case. Breast milk always has vitamins and special proteins that nourish your baby. In addition to feeding healthy foods beginning at 6 mo, nourish your baby with your milk from birth to 2 y.
Food consistency	Your baby's stomach is small, like the size of this cup. If you feed your baby broth, you take up space in her stomach and you don't nourish her well. Every day, prepare your baby thick foods so that she grows strong and healthy. A thick food is one that does not fall easily from the spoon (show the spoon with the food from the jar) and that you can prepare as (pap, mashed, or chopped, specified according to the age of the child).
Green vegetable everyday	(Take out the vegetable card) To nourish your baby, cook one of these vegetables, like spinach, swiss chard, huauzontle pulp, or purslane every day. These vegetables have vitamins that strengthen their development. Prepare vegetables as (pap, mashed, or chopped, specified according to the age of the child).
Feed meats to prevent anemia	To prevent anemia, starting at 6 mo, it is important to feed your baby tastes of beef, chicken thigh or leg, and fish. A taste is like the size of your 2 thumbs together. As your baby grows older and eats more, you can give her a bigger portion. Many mothers are afraid that the baby may choke on the meat. So this does not happen, prepare these foods in pap until the baby is 1 y old and afterwards cut the foods into very small pieces. Every time you prepare beef, chicken thigh or leg, and fish for your family, save a small piece for your baby. If you give these foods very often you will prevent anemia.
Feed foods again if rejected	It is very common for baby to reject or dislike vegetables and meats. But for your baby to learn to eat them, you must insist and give them until she accepts them. Be patient and offer them with love, without forcing your baby to eat them or reprimanding her. This way you help your baby be well nourished.

[1] BF, breastfeeding.

Community selection. Using data from the National Statistics and Information Institute, we selected 6 communities in Morelos that were similar in size (9000–16,000 inhabitants), basic literacy (85–91%), ethnicity (percentage of households that spoke indigenous language, 0–3%), and basic services such as electricity (~98%), sewage (92–100%), running water (72–100%), and houses with cement floors (78–98%) (25). Three similar communities were selected from Puebla, with each Puebla community matched to 2 Morelos communities. The selection and matching process was verified with researchers at the Instituto Nacional de Salud Pública (INSP) who were familiar with the communities in both states.

Eligibility criteria and sampling of participants. Eligible mothers were those with healthy children between 6 and 24 mo. We did not include women who were: ≤17 y (3.5%); illiterate (1%), because they could not read the magnet; not the primary caregiver for the child (5.6%), as indicated by the mother; enrolled in the Early Stimulation Program, an outpatient program offered through private foundations (e.g., Teleton) that refers mothers with children who present high risk for malnutrition (anemia or growth faltering) for additional nutrition counseling (2.7%); had twins (0.7%); or had difficulty answering the yes/no screening questions (0.7%), because they would have difficulty completing the questionnaire. We did not include children who were born premature (3.5%), <37 wk, or low birth weight (3.5%), <2.5 kg, as indicated by the mother.

We sampled participant mothers from vaccination lists maintained by the health center in each community. The lists had been updated in April 2011 and contained the names of all mother-child pairs eligible for vaccination services in the community. Using simple random sampling, a sample of 150 women with children between the ages of 6 and 24 mo per community in Morelos and 180 mothers per community in Puebla were selected and screened for eligibility. Based on the eligibility criteria and anticipated refusal rates, it was estimated that 1 in 3 women in the drawn sample would participate. Our target sample size was 45 mothers per community for the intervention and 66 mothers per community for the control. This sample size was intended to provide sufficient power (90% power with α of 0.05 and one-tailed test) in a community-level analysis for double-differences in prevalence of ~10 percentage points for behaviors. Based on previous work in these communities, a 10% attrition rate from pre-test to post-test was anticipated. Of the women who were eligible to participate (n = 501), 6% in Morelos and 4% in Puebla declined to participate.

This study was approved by the Ethics Committee at INSP and the Institutional Review Board for Human Participants at the University of South Carolina. All women signed informed consent forms.

Data collection procedures. We used a pre- and post-test design to evaluate the effectiveness of the intervention. The evaluation was conducted by field staff who did not deliver the intervention. In the intervention communities, the post-test was completed 9 wk (July 19-Aug 3) after the pre-test and 4 wk after the completion of the intervention. Because of logistical constraints, the post-test was completed 5 wk (July 5–15) after the pre-test in the control communities. An interviewer-administered questionnaire was developed and subsequently tested during a focus-group discussion using cognitive interviewing techniques (26). Field staff received extensive training on asking questions, use of response cards, recording responses, and the multiple-pass 24-h dietary recall method.

Sociodemographic data. Participants reported their age, education, if they spoke an indigenous language, civil status, use of government programs, parity, and number of people in the home as well as housing characteristics, including construction type, sewage, electricity, running water, cooking fuel, major appliances (i.e., radio, television, telephone, blender, refrigerator, washer, and boiler), and car ownership.

Behaviors. Mothers who were BF reported the number of times they breastfed during the day and night and these numbers were summed to obtain the total BF frequency (27,28). For women who were not BF at pre-test, BF frequency responses were set to missing. We used 2 approaches to estimate BF frequency at post-test for women who were BF at pre-test but not BF at post-test: *1*) BF frequency responses were set to zero at post-test; and *2*) these women were excluded from the analysis.

To assess changes in diversity and food consistency, mothers reported how often (days per week) they fed beef, chicken, or fish, green vegetables, and soup and broth (thick and thin consistency) consumption in the previous 7 d. Participants also reported how often they fed fruit, other vegetables, milk, yogurt, cheese, eggs, commercially prepared complementary food, and fortified foods.

A multiple-pass, 24-h dietary recall (29) was used to assess change in food amounts for meats and green vegetables and nutrient intakes for iron, zinc, folate, vitamins B-6 and B-12, and β-carotene (retinol equivalents). These were the key nutrients that are lacking in the diets (7) and would be improved if the key behaviors were systematically adopted. Household measures were used to estimate food amounts when it was not possible for field staff to weigh food items. Recall data represent weekday intakes.

Beliefs. Beliefs about the benefits of particular feeding behaviors were assessed using a statement that linked the behavior to an expected outcome (30) and scored on a 3-point Likert scale: disagree, neither agree nor disagree, or agree.

Attitudes. Judgments about specific feeding behaviors (30) were assessed using statements reflecting valence of the evaluation (e.g., very good, good, not that good). For example, attitude toward BF was assessed by asking if breast milk after 6 mo nourished a lot, somewhat, or does not nourish the baby.

Norms. For social norms, we asked how often the mother-in-law, mother, husband, or health professional offered advice on key feeding behaviors. Response options were: never says anything, rarely says anything, sometimes, often, and very often.

Behavioral intention. Participants were asked if they intended to engage in each of the target behaviors in the next 3 d. The 4 response categories were: definitely yes, very likely, somewhat likely, and not likely.

Exposure to intervention. At post-test, we used unaided recall to measure exposure to the radio and nurse component; i.e., participants were asked to recall the messages they heard on the radio without any prompts or cues from the interviewer and responses that clearly reflected campaign content indicated correct unaided recall.

Data analysis and statistical methods.

A measure of household wealth was created by considering household construction (i.e., floor, roof, walls, water, sewage, electricity, and bedrooms) and possessions (i.e., car, TV, washer, refrigerator) and smaller household items (i.e., radio, blender) as well as type of cooking fuel (gas or wood) and location of kitchen (indoor or outdoor) (31). We conducted a factor analysis and retained the first factor as it explained 90% of the common variance. The wealth score had a Cronbach's α reliability of 0.7.

Responses to questions on beliefs, attitudes, norms, and intentions were treated as ordinal values. For beliefs, "don't know" responses were set to missing. Food frequency questions were used to analyze differences in frequency (days/week) of feeding green vegetables, beef, chicken, fish, and thin and thick broths and soups. The 24-h recall data were examined for differences in total amounts of green vegetables, beef, chicken, and fish consumed and changes in nutrient intakes. For amounts estimated using household measures (e.g., serving spoons or small, medium, or large pieces), the average weight of the food item for that household measure was used as estimated in the INSP food-weight database. We excluded amounts that could have been attributed to recording errors such as amounts >500 g/item on the 24-h recall (1%).

We used a double-difference approach to assess the difference in change in outcomes between the presence (intervention) and absence of treatment (control) (32). The double difference is calculated by first

subtracting the pre-test from the post-test values for the intervention (Δ I) and control (Δ C). The second difference is the subtraction of the pre-/post-test difference in control from that of the intervention (double difference = Δ I − Δ C); the double difference estimates the change in outcome that can be attributed to the intervention. The double difference also adjusts for time-invariant observed (e.g., wealth and education) and unobserved variables (e.g., motivation to comply) (32). We examined pre- and post-test differences between the intervention and control with a linear mixed-model analysis. We generated a response variable by subtracting the pre-test value from the post-test and modeled this response as a function of the intervention (yes/no). This is equivalent to the double-difference approach described above to measure the magnitude of the impact of the intervention. Community was added as a random intercept, which allows the intercept for each community to vary and accounts for the cluster design. Mixed models were adjusted for child age at post-test, because outcomes were likely to differ over time and follow-up times differed between the intervention and control. From the perspective of pre- to post-test differences in individual women, for intentions to feed green vegetables, 50% of the total variance was attributed to the community and for frequency of feeding green vegetables, 30% of the total variance was attributed to the community cluster; variance at the community level was small for beliefs and attitudes and was inconsistent across the behaviors.

Given the quasi-experimental design of this study, we examined baseline differences between the intervention and control communities in sociodemographic variables, behaviors, and cognitive outcomes adjusted for community clustering (i.e., mixed model).

The double-difference analysis was conducted on complete cases as intent-to-treat, i.e., regardless of exposure to intervention. We report double differences and their SEs unless otherwise noted. The a priori hypothesis was that our intervention would result in improved outcomes. We considered double differences significant at $P < 0.05$ using a 1-sided test.

Results

Participant flow

We observed a 10% attrition rate from pre-test to post-test in the intervention and control communities (**Fig. 1**). The primary reasons for loss to follow-up were not wanting to continue (2% intervention, 4% control), unable to locate mother at time of post-test (5% intervention, 4% control), and relocation (2% intervention, 1% control). The baseline characteristics did not differ between women who continued in the study and those lost to follow-up.

Demographic data

A significant difference of 0.4 between the intervention and control was observed at baseline for the number of people in the home (**Table 2**). Otherwise, baseline characteristics did not differ between treatment groups. At post-test, children in intervention communities were older (means ± SDs), (15.8 ± 4.6 mo) than children in control communities (14.5 ± 4.5 mo) ($P = 0.03$).

Baseline data

Regarding behaviors at baseline, children in the intervention received beef, chicken, and fish more frequently than children in the control communities (**Table 3**). From the 24-h recall, there were no baseline differences between intervention and control in the total amount consumed for green vegetables, beef, chicken, or fish in the previous day. Children in the intervention communities more frequently consumed tortillas (5.3 ± 0.3 d/wk) than did children in the control communities (4.7 ± 0.2 d/wk) ($P = 0.01$). Also, Liconsa milk (micronutrient-fortified milk distributed through the *Liconsa* program and available to non-*Oportunidades* recipients) consumption was reported more frequently for children in intervention communities (2.3 ± 1.0 d/wk) than for those in control communities (0.3 ± 0.8 d/wk) ($P = 0.03$).

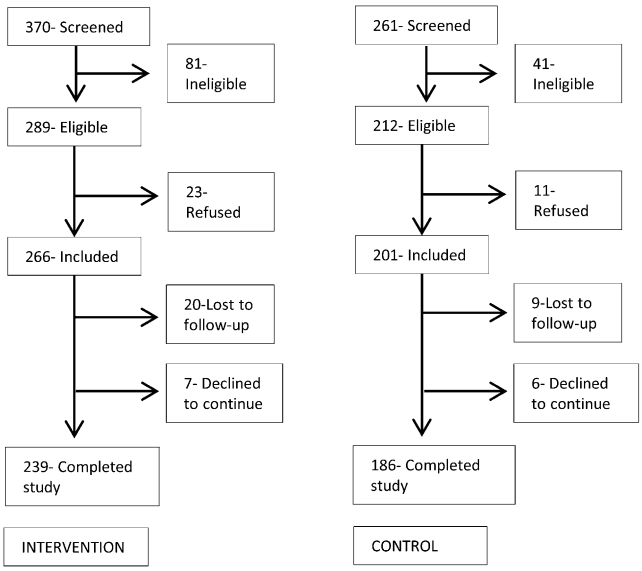

FIGURE 1 Participant flow through screening, recruitment, and study completion for intervention and control.

We observed significant differences at baseline between intervention and control communities in beliefs attitudes about and intentions for broths, fish, and vegetables (**Table 4**).

Changes in beliefs, attitudes, norms, and intentions by behavior category

Dietary diversity: green vegetables and meat. The intervention resulted in significant improvement in beliefs about green vegetables, beef, chicken, and fish (Table 4). Beliefs were measured on a 3-point scale, and a double difference of 0.6 for beef, e.g., represented a 20% improvement as a result of the intervention. The intervention significantly improved attitudes for the intake of beef and fish. Intentions to feed were significantly improved for beef and green vegetables. Compared with the control communities, women in the intervention communities reported that both their mothers (0.2 ± 0.1; $P = 0.003$) and mothers-in-law (0.1 ± 0.1; $P = 0.03$) were more likely to suggest that beef be given to the child.

TABLE 2 Selected baseline socioeconomic status characteristics for intervention and control communities[1]

Characteristic	Intervention	Control
n	266	201
Child's age, *mo*	13.6 ± 4.7	13.3 ± 4.7
Sex, girl	130 (49)	101 (50)
Maternal age, *y*	26.8 ± 5.7	26.2 ± 6.2
Education, *y*	9.9 ± 3.5	8.9 ± 3.9
Wealth score	0.06 ± 0.9	−0.08 ± 0.9
At least one young sibling ≤5 y	107 (40)	88 (44)
People in the home, *n*	5.1 ± 2*	5.5 ± 2.3
Married	235 (88)	170 (84)
Housewife	208 (79)	151 (75)
Oportunidades beneficiary	31 (12)	36 (18)

[1] Values are means ± SDs or *n* (%). Statistical tests using mixed-model regression that accounts for clustering by community. *Different from control, $P < 0.05$.

TABLE 3 Pre- and post-test differences by treatment group and the effect of the intervention on frequency of consumption of target foods and BF[1]

	Pre-test		Post-test		Double	
Feeding behavior	Intervention	Control	Intervention	Control	difference[2]	*P* value
Green vegetables	2.3 ± 0.3 (266)	2.2 ± 0.2 (201)	2.9 ± 1.8 (239)	2.4 ± 1.7 (186)	0.6 ± 0.2 (425)	0.01
Beef	0.5 ± 0.09 (266)*	0.3 ± 0.08 (201)	0.8 ± 0.2 (239)	0.4 ± 0.1 (186)	0.2 ± 0.1 (425)	0.02
Chicken	2.0 ± 0.2 (266)*	1.2 ± 0.2 (201)	2.3 ± 0.2 (239)	1.6 ± 0.1 (186)	0.1 ± 0.2 (425)	0.30
Fish	0.4 ± 0.9 (266)*	0.1 ± 0.08 (201)	0.3 ± 0.5 (239)	0.2 ± 0.4 (186)	−0.06 ± 0.1 (425)	0.30
Thin chicken broth	1.9 ± 0.2 (158)	2.0 ± 0.2 (103)	0.6 ± 0.2 (168)	1.4 ± 0.1 (118)	−0.4 ± 0.3 (175)	0.09
Thicker chicken broth	1.2 ± 0.2 (217)	0.9 ± 0.1 (173)	1.7 ± 0.2 (209)	1.0 ± 0.2 (159)	0.6 ± 0.2 (308)	0.01
Thicker vegetable broth	1.1 ± 0.3 (188)	0.9 ± 0.2 (165)	1.7 ± 0.2 (197)	0.9 ± 0.2 (155)	0.8 ± 0.4 (273)	0.02
Thick rice soup	2.2 ± 0.1 (266)	2.1 ± 0.1 (201)	2.0 ± 0.2 (239)	2.2 ± 0.2 (186)	−0.3 ± 0.3 (425)	0.20
Vegetable soup	0.9 ± 0.2 (265)	0.8 ± 0.09 (201)	1.0 ± 0.1 (239)	0.7 ± 0.09 (186)	0.2 ± 0.2 (424)	0.20
BF frequency[3]	11.0 ± 0.5 (133)	11.0 ± 0.4 (97)	9.4 ± 0.8 (124)	5.6 ± 0.7 (90)	3.7 ± 0.6 (208)	<0.001
BF frequency[4]	11.0 ± 0.5 (133)	11.0 ± 0.4 (97)	10.6 ± 0.5 (110)	6.9 ± 0.4 (73)	3.8 ± 0.5 (179)	<0.001
BF, yes	133 (50)	97 (48)	110 (46)	73 (39)	4 ± 2% (425)	0.07

[1] Values are means ± SEs (*n*) or *n* (%); means are number of days per week, unless otherwise noted. BF, breastfeeding. *Different from control, $P < 0.05$.
[2] Mixed-model regression analysis for double differences accounts for clustering and child age at post-test.
[3] Frequency in the previous day reported for women who were BF at pre-test and participated in post-test.
[4] Frequency in the previous day reported for women who were BF at pre-test and post-test only.

Significant improvements after the intervention were observed in beliefs, attitudes, and intentions toward feeding the child a vegetable she had disliked before (Table 4). The questions about beliefs and intentions toward offering meat to the child were included in only the post-test for the intervention, with 86% of participants believing that children should be offered meat on multiple occasions, even if they have previously rejected them, and 40% of participants were willing, in the coming days, to feed a meat that the child had rejected before. Norms were not improved around feeding a meat or vegetable that the child disliked (data not shown).

BF. Beliefs and attitudes that after 6 mo breast milk nourishes the child were significantly improved in the intervention compared with the control (Table 4). Norms for BF did not significantly improve (data not shown).

Food consistency. Beliefs, attitudes, and intentions concerning the consistency of broths significantly improved as a result of the intervention, but we did not observe the same improvement for solid foods (Table 4). Norms for food consistency did not significantly improve (data not shown).

Changes in behaviors by behavior category

Dietary diversity: green vegetables and meat. Women in the intervention communities reported feeding green vegetables and beef more often than women in the control communities, but the frequency of chicken or fish consumption did not significantly differ between the 2 groups (Table 3).

BF. At baseline, one-half of the women in our study were BF. At post-test, BF frequency was significantly higher in the intervention communities (Table 3).

Food consistency. Compared with control, women in the intervention communities reported feeding more often chicken and vegetable broths of thicker consistency (added chicken or vegetable with rice or pasta to broths) (Table 3).

Dietary intake. From pre- to post-test, we did not observe a significant change in the amount of beef, chicken, and fish consumed by children in the intervention compared with children in control communities. In the intervention communities, the changes in amounts consumed of beef, chicken, and fish were 3.3 ± 3.5, 1.8 ± 6.4, and −2.5 ± 3.4 g, respectively. In the control communities, the changes in amount consumed of beef, chicken, and fish were −0.3 ± 2.8, 2.3 ± 4.9, and 0 ± 2.7 g, respectively. There was, however, an increase in the amount of green vegetable consumed in the intervention group (10.6 ± 5.2 g) compared with the control group (−0.5 ± 4.0 g) ($P = 0.02$)

The mean double differences for intervention compared with control were positive for energy (71 ± 32 kcal; $P = 0.01$), zinc (0.7 ± 0.3 mg; $P = 0.003$), and vitamin B-6 (0.1 ± 0.04 mg; $P = 0.02$) but not for vitamin B-12 (0.1 ± 0.1 μg; $P = 0.2$), iron (0.4 ± 0.4 mg; $P = 0.1$), folate (2.0 ± 8.0 μg; $P = 0.4$), and β-carotene (retinol equivalents, 15.0 ± 83.2; $P = 0.5$). As a sensitivity test on the data, we removed *Liconsa* milk, a fortified milk beverage, and "Nutrisano," a fortified pap distributed by *Oportunidades*, from the analysis, but differences in energy (61 ± 31 kcal; $P = 0.02$), zinc (0.3 ± 0.2 mg; $P = 0.04$), and vitamin B-6 (0.08 ± 0.04 mg; $P = 0.02$) remained between the intervention and control communities. Post-hoc analyses revealed that dairy products accounted for 60% (46 ± 21 kcal; $P = 0.01$) of the total observed double difference in energy intakes between treatment groups, whereas flesh foods and eggs combined accounted for 26% (20 ± 12 kcal; $P = 0.05$). A similar pattern was observed for zinc but not for vitamin B-6 (data not shown).

Exposure to radio and nurse components. In the intervention communities, 34% ($n = 93$) of participants reported to have heard on the radio at least one of the scripted messages. Of these women, 35% recalled 1 message, 32% recalled 2 messages, and 22% recalled ≥3 messages. In the intervention communities, 56% ($n = 134$) of participants reported receiving the messages directly from the trained nurse at home, 31% ($n = 73$) at health center, and 13% ($n = 32$) did not receive the messages directly from the nurse; 93% ($n = 201$) reported that the magnet helped them remember what the nurse had said.

TABLE 4 Pre- and post-test differences by treatment group and the effect of the intervention on beliefs, attitudes, and intentions on key behaviors[1]

Characteristic	Pre-test		Post-test		Double difference[2]	*P* value
	Intervention	Control	Intervention	Control		
n	266	201	239	186		
Beliefs,[3] agree						
Vegetables keep my baby well nourished	224 (85)**	185 (93)	213 (89)	169 (91)	0.1 ± 0.1 (240)	0.01
Beef prevents anemia	66 (24)	62 (31)	155 (65)	56 (30)	0.7 ± 0.1 (319)	<0.001
Chicken prevents anemia	118 (44)	89 (44)	184 (77)	88 (48)	0.4 ± 0.1 (326)	<0.001
Broths nourish my baby	228 (86)	163 (81)	85 (35)	157 (85)	−1.0 ± 0.1 (420)	<0.001
Fish prevents anemia	120 (54)	91 (58)	189 (85)	85 (60)	0.5 ± 0.1 (315)	<0.001
After 6 mo, BM nourishes my baby	78 (29)	64 (32)	154 (65)	58 (31)	0.8 ± 0.1 (414)	<0.001
If child rejects vegetables, do not feed them again	38 (14)	26 (13)	15 (6)	29 (15)	−0.2 ± 0.1 (425)	0.01
Attitude[4]						
Give a green vegetable every day, very good	116 (44)	85 (43)	107 (44)	921 (49)	0.07 ± 0.6 (425)	0.13
Feed beef at 6 mo, very good	17 (6)	20 (9)	50 (21)	12 (6)	−0.5 ± 0.07 (425)	<0.001
Feed chicken at 6 mo, very good	63 (24)	53 (26)	62 (26)	38 (20)	−0.09 ± 0.08 (425)	0.20
Feed fish at 6 mo, very good	37 (14)*	25 (12)	42 (18)	11 (6)	−0.3 ± 0.08 (425)	0.001
Broths have vitamins, a lot	191 (72)*	117 (58)	70 (29)	111 (60)	0.7 ± 0.07 (425)	<0.001
Broths at least once per day[5]	108 (41)	91 (45)	55 (23)	81 (43)	0.6 ± 0.2 (425)	<0.001
Give solid foods, very good	35 (13)	31 (15)	56 (24)	32 (17)	−0.1 ± 0.07 (425)	0.07
BM does not nourish after 6 mo	60 (23)	47 (23)	16 (6)	49 (26)	0.5 ± 0.08 (425)	<0.001
Feed vegetables often until accepted	184 (69)	146 (72)	208 (86)	128 (68)	0.2 ± 0.6 (425)	<0.001
Intentions,[6] definitely yes						
Feed my baby a vegetable	90 (34)*	94 (47)	126 (53)	89 (48)	0.4 ± 0.1 (425)	<0.001
Feed my baby beef	12 (5)	15 (8)	55 (23)	16 (9)	0.6 ± 0.1 (425)	<0.001
Feed my baby chicken	63 (24)**	43 (21)	101 (42)	51 (28)	0.2 ± 0.2 (425)	0.12
Feed my baby broths	108 (41)	95 (47)	43 (17)	95 (51)	−1.0 ± 0.2 (425)	<0.001
Continue BF[7]	99 (73)	71 (73)	87 (82)	55 (76)	0.1 ± 0.1 (425)	0.20
Offer my child a vegetable she may dislike	82 (31)	64 (31)	128 (53)	62 (34)	0.4 ± 0.1 (425)	<0.001
Feed my baby food that is mashed or cut up	61 (22)	44 (23)	108 (45)	70 (38)	0.1 ± 0.1 (425)	0.18

[1] Values are *n* (%) or means ± SEs; proportions are for the premier response item indicated. BF, breastfeeding; BM, breast milk. Different from control: $*P < 0.05$; $**P < 0.01$.
[2] Mixed-model regression analysis for double differences: averages on the scales and accounts for clustering by community and child age at post-test.
[3] Beliefs were measure using a 3-point Likert scale (1, disagree; 2, neither agree/disagree; 3, agree).
[4] Attitudes were measured using a 3-point semantic differential scale (e.g., 1, very good; 2, good; 3, not that good).
[5] 4-point semantic differential scale.
[6] Intentions (''In the next 3 d, I will...'') were measured using a 4-point scale (1, don't think so; 2, somewhat possible; 3, very possible; 4, definitely yes).
[7] Among women who were BF at both time points.

Discussion

This study aimed to change 5 IYCF behaviors, BF, food consistency, feeding meats and green vegetables, and offering these foods again if the child had rejected them before, that had been previously identified as important for improving IYCF in Mexico (5,13,33). This intervention resulted in significant improvements in how often mothers fed green vegetables, beef, and broths of thicker consistency (i.e., semi-solids), with concomitant changes in beliefs, attitudes, and intentions as a result of one-time contact with vaccination nurses and exposure to radio messages.

We observed large pre- and post-test differences between groups for BF frequency and this variable captures the relative intensity of the behavior (high vs. low intensity) (28). In both groups at baseline, children were 13 mo, an age when children are weaned from the breast (5). Weaning is not abrupt and a nonsignificant difference in BF prevalence between treatment groups supports this assertion. Even as mothers curtail BF frequency for nourishment, BF is used to soothe and calm or put the baby to sleep (13). In the control communities, BF frequency at post-test was almost one-half of the frequency reported at pre-test, which is likely due to weaning as mothers BF less intensively; in contrast, the small decline in BF frequency in the intervention communities suggests that a high BF frequency from pre-test to post-test was sustained. Also, the intervention significantly improved attitudes and beliefs about BF after 6 mo. More frequent BF during complementary feeding is important given that breast milk may provide ~40% of the total energy needs of young children 12–23 mo and is a good source of vitamin A and calcium (34).

Our messages discouraged the use of broths and promoted a thicker consistency of foods. Women in the intervention group gave broths with a thicker consistency more frequently than women in the control group. This behavior was mirrored by changes in attitudes and beliefs about thin broths. Broths and soups are a core food for infants and young children in Morelos (13,33) and elsewhere in Mexico (14) that also serve as a vehicle for other food like meats, vegetables, beans, rice, wheat noodles, and egg (13). Thus, improving the consistency of soups and broths (semi-solids) will lead to improved diet quality (35).

We observed improvements in nutrient intakes, even though the 24-h recall data did not show significantly higher amounts consumed of key foods (chicken, beef) and only a small increase in green vegetables, equivalent to a tablespoon of cooked spinach, between treatment groups. It is likely that mothers exposed to the intervention were more aware of healthy foods and chose these more often. Fruits, vegetables, and milk all have healthy attributes for women in Morelos and are considered to be more age appropriate for young children than meats (12). Mothers in the intervention fed significantly more fruits and other vegetables more frequently in the week (data not shown). Post-hoc analyses of 24-h recall also show that animal-source foods (dairy, eggs, flesh foods) were given more frequently or in greater quantity in the intervention communities.

With the exception of participants' mothers and mothers-in-law advising to feed more beef, we did not see significant improvements in social norms with the intervention. We do not know to what extent social referents were exposed to the radio messages, because we did not collect these data. If grandmothers heard the word anemia, a "disease" word, in the message, it may have prompted them to insist on feeding beef to prevent anemia in the young child.

We used a quasi-experimental design at the community level and matched intervention communities to control communities for size, nonindigenous ethnicity, and marginalization index. We did not find significant differences at baseline between treatment groups in education, wealth, or use of the *Oportunidades* program, a government program with an IYCF education component, cash transfer, and nutrition supplement. An effectiveness evaluation of the *Oportunidades* program showed no significant improvement in complementary feeding practices among program participants (36), so it is unlikely that participation in *Oportunidades* influenced our study outcomes. We mitigated threats to internal validity by including a control group. We did not observe responses to the food frequency questions in the post-test that were unreasonable or similar to the frequency suggested in the messages, signifying that social desirability bias was minimal in the self-reported data. Follow-up times were shorter for the control group, but we adjusted for child age at post-test to account for this. Our analysis did not take into account the amount of exposure of participants, so our results are a conservative estimate of behavior change that could be expected among a population fully exposed to the nurse and radio component. Also, the double-difference approach estimates the magnitude of intervention and control differences assuming that the pre- and post-test differences do not depend on the pre-test values. From this design, it is not possible to estimate how long behavior change will persist.

To reduce selection bias, we randomly chose women to be screened for inclusion into this study. Because the proportion of women who refused participation was small, our results are generalizable to literate, low-income women with healthy children in Morelos and Puebla from semi-urban communities. Most women in this study were housewives, so it is not known how this intervention might affect other primary caregivers or women employed outside the home.

Scripted messages were the central element of the intervention and were delivered by nurses and on radio. Penny et al. (37) also used scripted messages for improving IYCF and child growth in Peru. Our communication strategy differs from the general approach to IYCF promotion, one that relies primarily on nutrition counseling and multiple points of contact at health services (e.g., antenatal care, immunization, growth monitoring) (37–40), home visits by peer educators (38,39,41), and mothers groups for recipe trials (37,38). Furthermore, our results and those of Penny et al. (37) suggest that scripted messages may be a feasible alternative to counseling for improving IYCF. Among caregivers with healthy young children, one-on-one counseling may result in more effort and time per case than is needed or feasible, especially when caregivers engage in similar behaviors and share similar attitudes and beliefs about feeding children, as happens in Morelos (12). Scripted messages, such as those used in our study, must be concordant with maternal knowledge, include culturally appropriate advice, and focus on foods already purchased for family consumption. Future research should examine if scripted messages are more cost-effective than nutrition counseling for IYCF and if behavior change is sustained.

Our intervention has several implications for scaling up IYCF within health services. Nurses deliver vaccines at health clinics, through routine door-to-door visits, or during National Health Campaigns. In 2009, 80% of districts in Mexico reported 90% coverage in diphtheria, pertussis, and tetanus vaccine (42). Thus, scripted messages delivered through immunization services would result in a high, equitable coverage for IYCF promotion. Moreover, they are a low-burden approach (delivered in $\leq$10 min) for practitioners with a high work load. The Vaccination Week in the Americas, a model similar to the Mexican Vaccination Campaigns, has been widely adopted by Spanish-speaking countries in Latin America (10), and this nutrition communication strategy provides an opportunity to bundle IYCF with immunization in Mexico and the region. Bundling with health campaigns could allow for more regular message exposure that would likely be necessary to enhance sustainability.

In conclusion, we provide evidence that a theory-based, nutrition communication strategy using scripted messages results in significant improvements in beliefs, attitudes, and behaviors regarding IYCF and thus "nudges" mothers in the appropriate direction. This simple strategy is inherently feasible and scalable and could be integrated into existing immunization services to support good complementary feeding practices. Future work for scaling up should consider extending the duration of the radio component, airing more spots per day, and airing these during programming for a broad audience to reach other family members.

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Literature Cited

1. Feed the Future. U.S. investment in global nutrition. Fact sheet: September 2011. 2011 [cited 2012 Jun 6]. Available from: http://feedthefuture.gov/sites/default/files/resource/files/FeedtheFutureNutritionFactSheetSept2011.pdf.
2. Bhutta ZA, Ahmed T, Black RE, Cousens S, Dewey K, Giugliani E, Haider BA, Kirkwood B, Morris SS, et al. What works? Interventions for maternal and child undernutrition and survival. Lancet. 2008;371:417–40.
3. González-de Cossío T, Rivera J, González-Castell D, Unar-Munguía M, Monterrubio E. Child malnutrition in Mexico in the last two decades:

prevalence using the new WHO 2006 growth standards. Salud Publica Mex. 2009;51:S494–506.
4. De la Cruz-Góngora V, Villalpando S, Rebollar R, Shamah-Levy T, Humaran IMG. Nutritional causes of anemia in Mexican children under 5 years. Results from the 2006 National Health and Nutrition Survey. Salud Publica Mex. 2012;54:108–15.
5. Gonzalez-Cossío T, Rivera-Dommarco J, Moreno-Macias H, Monterrubio E, Sepulveda J. Poor compliance with appropriate feeding practices in children under 2 y in Mexico. J Nutr. 2006;136:2928–33.
6. Gonzalez-Cossío T, Moreno-Macias H, Rivera JA, Villalpando S, Shamah-Levy T, Monterrubio EA, Hernandez-Garduno A. Breast-feeding practices in Mexico: results from the Second National Nutrition Survey 1999. Salud Publica Mex. 2003;45 Suppl 4:S477–89.
7. Instituto Nacional de Salud Publica. Desarrollo de una Estrategia para Prevenir la Desnutricion Infantil Temprana Mediante la mejora de las Practicas de Alimentacion Complementaria y el Acceso a Alimento Fortificados. Reporte Final, Mexico. Washington, DC: Pan American Health Organization; 2003.
8. Bryce J, Coitinho D, Darnton-Hill I, Pelletier D, Pinstrup-Andersen P. Maternal and child undernutrition: effective action at national level. Lancet. 2008;371:510–26.
9. Knippenberg R, Lawn JE, Darmstadt GL, Begkoyian G, Fogstad H, Walelign N, Paul VK. Systematic scaling up of neonatal care in countries. Lancet. 2005;365:1087–98.
10. Ropero-Álvarez AM, Kurtis HJ, Danovaro-Holliday MC, Ruiz-Matus C, Tambini G. Vaccination Week in the Americas: an opportunity to integrate other health services with immunization. J Infect Dis. 2012;205:S120–5.
11. Secretaría de Salud. Guía técnica para la cartilla nacional de salud. Mexico DF (Mexico): Secretaría de Salud; 2008.
12. Monterrosa EC, Pelto G, Frongillo E, Rasmussen KM. Constructing maternal knowledge frameworks: how mothers conceptualize complementary feeding. Appetite. 2012;59:377–84.
13. Monterrosa EC. The influence of maternal fatness, knowledge, and diet on infant and young child feeding in Mexico. Ithaca (NY): Cornell University; 2010.
14. Martinez Andrade G, Gonzalez Unzaga M, Klunder Klunder M, Flores Huerta S, Martinez Salgado H. Prácticas de alimentación complementaria. In: Flores Huerta S, Martinez Salgado H, editors. Prácticas de alimentación, estado de nutrición y cuidados a la salud en niños menores de 2 años en México. Mexico DF (Mexico): Instituto Mexicano de Seguro Social; 2004. p. 119–52.
15. Mascareñas A, Salinas J, Tasset-Tisseau A, Mascareñas C, Khan MM. Polio immunization policy in Mexico: economic assessment of current practice and future alternatives. Public Health. 2005;119:542–9.
16. Lefebvre RC, Flora J. Social marketing and public health intervention. Health Educ Q. 1988;15:299–315.
17. Gutierrez J, Bautista S, Gertler P, Hernandez-Avila M, Bertozzi S. Impacto de Oportunidades en la morbilidad y el estado de salud de la población beneficiaria y en la utilización de los servicios de salud. Resultados de corto plazo en zonas urbanas y de mediano plazo en zonas rurales. Cuernavaca (Mexico): Instituto Nacional de Salud Pública; 2005.
18. Thrasher JF, Huang LL, Perez-Hernandez R, Niederdeppe J, Arillo-Santillan E, Alday J. Evaluation of a social marketing campaign to support Mexico City's comprehensive smoke-free law. Am J Public Health. 2011;101:328–35.
19. Fernández Castro J. Mass vaccination against poliomyelitis in Mexico. Rev Infect Dis. 1984;6:S397–9.
20. WHO. Health: a key to prosperity [cited 2009 Oct 30]. Available from: http://www.who.int/inf-new/child1.htm.
21. Bonvecchio A, Pelto GH, Escalante E, Monterrubio E, Habicht JP, Nava F, Villanueva M-A, Safdie M, Rivera JA. Maternal knowledge and use of a micronutrient supplement was improved with a programmatically feasible intervention in Mexico. J Nutr. 2007;137:440–6.
22. Singhal A, Rogers E, Brown W. Harnessing the potential of entertainment-education telenovelas. Int Commun Gaz. 1993;51:1–18.
23. Bandura A. Health promotion by social cognitive means. Health Educ Behav. 2004;31:143–64.
24. Fishbein M, Yzer M. Using theory to design effective health behavior interventions. Commun Theor. 2003;13:164–83.
25. INEGI. Indice de marginalizacion 2005 [cited 2010 Oct]. Available from: http://www.inegi.org.mx/sistemas/iter2005/selentcampo.aspx?c=10395&s=est.
26. Willis GB. Cognitive interviewing: a tool for improving questionnaire design. Thousand Oaks (CA): Sage Publications; 2004.
27. WHO Multicentre Growth Reference Study Group. Breastfeeding in the WHO Multicentre Growth Reference Study. Acta Paediatr Suppl. 2006;450:16–26.
28. Monterrosa EC, Frongillo EA, Vasquez-Garibay EM, Romero-Velarde E, Casey LM, Willows ND. Predominant breast-feeding from birth to six months is associated with fewer gastrointestinal infections and increased risk for iron deficiency among infants. J Nutr. 2008;138:1499–504.
29. Johnson RK, Driscoll P, Goran ML. Comparison of multiple-pass 24-hour recall estimates of energy intake with total energy expenditure determined by the doubly labeled water method in young children. J Am Diet Assoc. 1996;96:1140–4.
30. Contento I. Foundation in theory and research: increasing awareness and enhancing motivation. Nutrition Education: linking research, theory, and practice. Boston: Jones and Bartlett Publishers; 2007. p. 78–113.
31. Ramakrishnan U, Gonzalez-Cossio T, Neufeld L, Rivera J, Martorell R. Multiple micronutrient supplementation during pregnancy does not lead to greater infant birth size than does iron-only supplementation: a randomized controlled trial in a semirural community in Mexico. Am J Clin Nutr. 2003;77:720–5.
32. Gertler PJ, Martinez S, Premand P, Rawlings LB, Vermeersch CMJ. Impact evaluation in practice. Washington, DC: World Bank; 2011.
33. Instituto Nacional de Salud Pública. Desarrollo de una estrategia para prevenir la desnutricion infantil temprana mediante la mejora de las practicas de alimentacion complementaria y el acceso a alimento fortificados. Reporte final, Mexico. Washington, DC: Pan American Health Organization; 2003.
34. Pan American Health Organization. Guiding principles for complementary feeding of the breastfed child. Washington, DC: Pan American Health Organization; 2002.
35. Dewey KG, Adu-Afarwuah S. Systematic review of the efficacy and effectiveness of complementary feeding interventions in developing countries. Matern Child Nutr. 2008;4:24–85.
36. Neufeld LM, Steta C, Rivera J, Martinez Valle A, Grados R, Uriega S, López VH. Evaluation for program decision making: a case study of the Oportunidades Program in Mexico. J Nutr. 2011;141:2076–83.
37. Penny ME, Creed-Kanashiro HM, Robert RC, Narro MR, Caulfield LE, Black RE. Effectiveness of an educational intervention delivered through the health services to improve nutrition in young children: a cluster-randomised controlled trial. Lancet. 2005;365:1863–72.
38. Bhandari N, Mazumder S, Bahl R, Martines J, Black RE, Bhan MK. An educational intervention to promote appropriate complementary feeding practices and physical growth in infants and young children in rural Haryana, India. J Nutr. 2004;134:2342–8.
39. Guyon AB, Quinn VJ, Hainsworth M, Ravonimanantsoa P, Ravelojoana V, Rambeloson Z, Martin L. Implementing an integrated nutrition package at large scale in Madagascar: The Essential Nutrition Actions Framework. Food Nutr Bull. 2009;30:233–44.
40. Shi L, Zhang J, Wang Y, Caulfield LE, Guyer B. Effectiveness of an educational intervention on complementary feeding practices and growth in rural China: a cluster randomised controlled trial. Public Health Nutr. 2010;13:556–65.
41. Guldan GS, Fan H-C, Ma X, Ni Z-Z, Xiang X, Tang M-Z. Culturally appropriate nutrition education improves infant feeding and growth in rural Sichuan, China. J Nutr. 2000;130:1204–11.
42. WHO. Immunization profile: Mexico; 2012 [cited 2012 Jun 6]. Available from: http://apps.who.int/immunization_monitoring/en/globalsummary/countryprofileresult.cfm?C=mex.