A Pilot Food Store Intervention in the Republic of the Marshall Islands[1]

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ABSTRACT

To improve diet and reduce risk for obesity and chronic disease, we developed, implemented and evaluated a pilot intervention trial with 23 large and small food stores in the Republic of the Marshall Islands (12 intervention, 11 control). The intervention included both mass media (radio announcements, newspaper ads, video) and in-store (cooking demonstrations, taste tests, shelf labeling) components. Consumer exposure to the mass media components was high (65% had heard half or more of the radio announcements, 74% had seen at least one of the newspaper ads). Consumer exposure to the in-store components of the intervention was moderate (61% attended at least one cooking demonstrations, 59% received at least one recipe card). After adjustment for age, sex and education level, increased exposure to the intervention was associated with higher diabetes knowledge ($p<0.05$) and label reading knowledge ($p<0.05$), but not with increased self-efficacy for performing promoted healthy behaviors. The intervention was associated with increased purchasing of certain promoted foods ($p<0.005$), including oatmeal, turkey chili, fish, canned fruit and local vegetables. It was also associated with improvements in healthiness of cooking methods ($p<0.05$). Food store centered interventions have great potential for changing cognitive and behavioral factors relating to food choice and preparation, and may contribute to lessening the burden of diet-related chronic disease worldwide.

Introduction

Obesity is the most common nutrition-related disorder in Western countries, and its prevalence is increasing in both children and adults[1-3]. Obesity is associated with higher rates of diabetes, cardiovascular disease and other chronic conditions[4-9]. Recent studies have shown an increased prevalence of obesity in many Pacific island populations[10], associated with reduced levels of physical activity and dietary change[11-13]. As local economies move away from subsistence production and become more reliant on imported (mostly high fat) foods, obesity-related diseases, such as hypertension, hyperlipidemia and NIDDM, have become major causes of morbidity and mortality in Pacific populations[11;14-17].

Environmental factors linked to obesity include those that increase energy and fat intake, such as overall availability of very high fat foods, advertisements for and low price of high-energy density foods, marketing of larger portions, increased frequency of restaurant meals and the use of more fast-foods and convenience foods[9-10;18-19]. Prevention of obesity is frequently attempted through educational approaches aimed at improving knowledge, skills and attitudes, which are presumed to impact on individual behavior (20). Such approaches have been largely ineffective[21;22].

Environmental approaches attempt to modify the setting in which such choices are made[20;23;24]. Health educators have long viewed supermarkets as a promising environmental-level venue for providing health information and to encourage the purchase of healthful foods. Food store intervention strategies have the potential to reduce the incidence of obesity and related chronic disease by decreasing dietary fat intake (particularly saturated fat), decreasing simple carbohydrate intake, and increasing dietary fiber intake.

The majority of formally evaluated supermarket intervention programs have been conducted in large cities in the United States and Europe[21; 25-36]. They focused on high-income populations, while only a few studies have involved rural populations and low-income groups. We have found no published studies of food store interventions in developing countries. Most studies to date have focused on large grocery stores, with few working with small neighborhood stores or corner stores.

Unfortunately, most supermarket intervention trials to date have shown limited success. Most of the programs have been able to show improvements in knowledge or awareness, but not in terms of actual food purchasing or behavior[21; 25-26; 28; 32; 33-35]. Some have demonstrated increased sales or promoted foods[27; 37]. Only one showed improvements in diet[36].

Only one of the 15 supermarket interventions reviewed had significant formative research to assist with the design and implementation of the intervention[35]. Evaluation methods have been limited. Most of the studies reviewed used either knowledge[7/15] or purchasing[8/15] as the only assessed impacts. A few studies looked at food consumption[4/15] and preparation[2/15]. One study examined mediating variables

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such as self-efficacy[38]. Detailed assessments of food store interventions in terms of their impact on psychosocial factors and behaviors (purchasing, preparation and consumption) are needed to advance the field.

We developed, implemented and evaluated a pilot store-centered intervention, the Marshall Islands Healthy Stores program, based on substantive formative research, [39-41] and using a conceptual framework based on Social Cognitive Theory (SCT). SCT constructs employed included observational learning, reinforcement, self-efficacy and behavioral capability, with particular attention to impacting on the food environment.

This pilot had the following goals:

1. To attain a high level of exposure of consumers to intervention materials and messages.
2. To improve customer's knowledge, self-efficacy for making healthy food choices.
3. To improve customer's purchasing behaviors and cooking patterns.
4. To determine if a food store-centered healthy foods intervention would be acceptable and feasible from the perspective of local store owners and managers.

Study Setting

The Republic of the Marshall Islands is good setting in which to pilot store-centered intervention due to high rates of obesity and chronic disease, heavy reliance on imported foods and a large number and variety of stores. Located 2000 miles southwest of Hawaii, the Marshall Islands contain 33 small islands and atolls in two parallel chains. The 1999 census estimated the population at 50,840, with two-thirds living in two urban centers.

Our findings indicate that obesity is related to shifts to a high fat, high calorie diet and general decreases in physical activity.

In our pilot study (1995-97) of diet, physical activity and body composition in Marshallese households (n=225), we found that 31% of men and 29% of women were overweight (25<BMI<30), while 20% of men and 33% of women were obese (BMI>30). [40] In 1998, we initiated a two-year study of the behavioral, economic and environmental determinants of obesity in Marshallese households (n=160 hhs).

Our findings indicate that obesity is related to shifts to a high fat, high calorie diet and general decreases in physical activity. These problems are most acute in the two urban settings (Majuro atoll and Ebeye Island), where the diets are almost exclusively based on imported foods [39-40].

Store situation in Majuro atoll, Republic of the Marshall Islands. The pilot trial was conducted entirely on Majuro atoll, home to the majority of the population. Majuro atoll is comprised of a series of road-linked islets strung along a coral reef. There are seven large stores on Majuro atoll, and 136 small stores. Large stores have import and wholesale as well as retail components to their businesses. Small stores, which are often owner-operated, purchase their goods from larger import/wholesale stores. Convenience, non-perishability and preference of consumers determine what the store owners stock and sell.

Access to imported fresh vegetables and fruits is limited even in the large stores, where such goods have to be brought in via air-freight. Such vegetables are often damaged before they are placed on the shelves, and their cost is prohibitive for most Marshallese families. Small stores seldom carry imported fresh fruit; canned goods, sugared or fatty snacks, prepared ramen and coffee are the backbone of the small store's inventory.

Prices vary little between small stores due to competition and shared wholesalers. These operations are economically precarious, and must rely on their most commonly sold items (such as corned beef, sugared or fatty snacks, etc) to draw what little profit they can. Such stores tend to offer credit to their customers, a practice that affects their profit schedule.

Materials and Methods

Development of store intervention strategy and materials. A detailed description of the development format of the Marshall Islands Healthy Stores Program has been published[41]. The store intervention was a collaborative effort between the RMI Ministry of Health and Environment and the Johns Hopkins Center for Human Nutrition. Five principles drove the intervention strategy: 1) changing specific behaviors; 2) promoting healthy alternatives to specific 'high risk' (high fat, high sugar, and/or low fiber) foods; 3) teaching how to make unhealthy foods more nutritious and economical; 4) producing effects that have the potential to change food policy in the Marshall Islands; and 5) using themes salient to local people and identified in our formative research[39; 41]. The intervention included small stores as well as large in an effort to reach as wide a target population as possible.

Three main motivational themes underlay all the specific behavioral messages, including: how to avoid diabetes, being healthy for life, and being there for your children and grandchildren. We identified key foods/food categories that are commonly purchased at local stores (in descending frequency of mention): rice, Ramen noodles, canned meats, poultry parts (turkey tails, chicken quarters), canned tuna in oil, candy and cookies. We also included soft drinks, pancakes, and donuts – all commonly purchased in this setting. Our intervention strategy focused on introducing customers to lower fat, lower calorie, higher fiber alternatives to these foods, or alternative manners of preparation that lower the fat.

The intervention trial took place over a 10 week period, from August 1, 2001 to October 15, 2001. Every 2-3 weeks a different food-related theme was highlighted (eg. "mix canned vegetables in your canned meat; it will feed more people, is less expensive and has less fat"). Store owners were encouraged to stock highlighted foods if they did not already do so. Customers were encouraged to sample these foods through in-store taste tests and cooking demonstrations (n=45). Healthy alternative foods were labeled on store shelves in order to increase access by consumers. Local

media was used to announce demonstrations and reinforce study messages. A key educational approach taught label reading (using newspaper ads, flyers and posters) as a means of identifying healthier alternative foods.

Of the 136 small stores on Majuro, twelve stores were randomly selected to be part of the intervention. Due to changes in ownership, store closures and a store fire, three of the intervention stores dropped out by the end of the study. In addition, we worked with three out of six large stores, who expressed interest in participating in the program. The intervention differed slightly from store to store based on store size.

Evaluation of the program. Evaluation of the Marshall Islands Healthy Store program had four components: 1) process evaluation; 2) exposure to intervention components; 3) impact of the intervention on consumer mediating variables (knowledge and self-efficacy) and behavior; 4) impact of the intervention on store owner/manager knowledge, psychosocial variables and behavior. This paper focuses on exposure to the intervention, and on the impact of the program on consumer mediating variables and behavior.

All evaluation instruments were developed and tested prior to data collection. The consumer instruments were validated by use of cognitive interviewing techniques (n=3), where the interviewer went over each of the questions and responses to see how the respondent understood the question. Four Marshallese nationals and a Johns Hopkins graduate assistant were data collectors. All data collectors were trained and standardized on the evaluation instruments.

This paper focuses on exposure to the intervention, and on the impact of the program on consumer mediating variables and behavior.

Customer respondents were a convenience sample of adults shopping at the intervention stores, plus at 11 other comparison stores. Interviewers rotated between stores and approached the first adult customer who entered a store. After an interview was completed, the interviewer would take the next person who approached.

Consumer Exposure: We assessed exposure to the intervention through a detailed questionnaire conducted post-intervention (n=185). For each component of the intervention the respondent was asked if they had seen or heard of it specifically. To cope with the potential bias of respondent's trying to please the interviewer, a test question was embedded in the instrument. Respondents were asked if they had attended the "lowfat donut" cooking demonstration; something that had never occurred. Ten of the 185 respondents replied in the affirmative. We have removed these respondents from analyses on the impact of exposure.

Consumer Impact Questionnaire: This instrument was conducted on two separate samples of respondents at baseline (n=102) and immediately following the intervention (n=185). The questionnaire included the following sections:

Sociodemographic characteristics: age, sex, household size, education level, occupation, and location of the respondent.

Knowledge: knowledge regarding information emphasized in the intervention, including: label reading, causes of diabetes, and so on.

Self-efficacy: the confidence that the respondent felt to perform the healthy behaviors promoted as part of the intervention. The self efficacy questions were in a "how sure are you" format (eg. How sure are you that you know how to use cooking spray?). Respondents were given four possible responses, from "100% Sure" to "Not Sure at All".

Food purchasing: reported frequency of purchasing of approximately 60 key foods (healthy, promoted foods and their high fat/high sugar/low fiber alternatives) over the past month by respondent, and where these foods have been purchased.

Food preparation: first, second and third most common forms of preparation (boiling, roasting, baking, deep frying, frying, cooking spray, etc.) of 9 commonly consumed foods

Data Analysis

Data collected from the questionnaires were entered into Excel files, and then analyzed in SAS® (Cary, NC).

Scale and score development: Additive scales were developed for knowledge (diabetes, label reading), self-efficacy, preparation methods used, and exposure to the intervention.

Diabetes knowledge score: Respondents were asked to state what diabetes is, describe its causes, and how it can be prevented. Each subsection was scored from 0 to 3 based on correctness of response, where a 0 indicates a "don't know"/inaccurate response and a 3 indicates an accurate and specific response. The total diabetes knowledge scale was calculated by adding together the three subscales, and ranges from 0 to 8 with a mean of 3.9. As the scale is not normally distributed, the analyses presented here are based on a converting the scale to a low (0-3) and a high (4-8) value.

Label reading score: Respondents were shown the label of a high fat food and asked to report on the number of servings in the package, grams of fat per serving, grams of fat in the whole package, milligrams of sodium, grams of sugar, whether it is a healthy food, and whether it is a high fat food. Respondents were given a point for each correct response. Scores ranged from 0 to 7, with a mean of 4.4.

Self-efficacy scale: Respondents were given a series of 19 "How sure are you" questions, which were linked to specific behaviors promoted by the program. For example; "How sure are you that you can mix a can of corned beef with a can of beans or mixed vegetables instead of serving two cans of corned beef the next time you eat corned beef?"

Responses were coded as 100% sure (3 points), pretty sure (2 points), just a little sure (1 point) and not sure at all (0 points). The overall scale ranged from 3 to 63 with a mean of 41 and a Cronbach's alpha of 0.95.

Frequency of food purchasing: Frequency of purchasing of each food was divided into high and low levels for the analyses. These cutoffs differ from food to food as some foods were purchased very frequently and others much less frequently.

Cooking method score: Respondents were asked to describe their first and second most common method of preparing 9 commonly consumed foods. From a starting point of 0, methods of cooking that add fat (pan frying, deep frying, stewing) led to the subtraction of 1 point from the score for each food cooked in that manner. Methods of cooking that reduced the amount of fat or added no extra fat (cooking spray, baked, eating raw, grilling, boiling, and steaming) led to the addition of 1 point to the score. Scores ranged from –9 to 10, with a mean of –0.19.

Additive scales were developed to assess exposure to the components of the intervention. Two different exposure scales were calculated.

In-Store Exposure Score: The first scale examines exposure to the in-store components of the intervention (presence and participation in each of the 8 cooking demonstrations, receipt of the 8 recipe cards, having seen shelf labels). One point was given for each component seen or heard. Scores ranged from 0 to 25 with a mean of 9.6.

Mass Media Exposure Score: The second exposure score examines exposure to the mass media components of the intervention (number of the 7 radio shows heard, number of the 8 newspaper ads seen, number of times saw television video(out of three times possible)). Scores ranged from 0 to 18 with a mean of 8.7.

Analyses sought to examine the impact of the intervention on cognitive (knowledge and self-efficacy) and behavioral (purchasing of healthy foods, healthy cooking methods) factors.

Pre-intervention and post-intervention variable scores were compared using the T-tests for normally distributed variables, and chi-square tests for non-normally distributed variables. Changes in purchasing of key foods were examined by food, divided into low and high frequency of purchase of the food. We looked at both frequency of purchasing of healthy promoted foods and of unhealthy foods. As the pre and post intervention sample differed significantly in terms of education, we looked at these differences both overall and stratified by education.

We conducted a series of multiple regressions on the post-intervention sample only, using level of exposure to assess intervention impacts. Logistic regression was used when the dependent variables were not normally distributed, and linear regression was used for normally distributed variables. Dependent variables were the cognitive and behavioral variables described above. Independent variables in the models to predict consumer behavior included: in-store exposure, mass media exposure, and sociodemographic characteristics of the respondent (age, sex and education level). As the two exposure scales were correlated (Spearmans rho=0.6376), we ran separate regressions for each scale.

Human Subjects Protection

The research study was approved by the Johns Hopkins Bloomberg School of Public Health Committee on Human Research and the Marshall Islands Ministry of Health and Environment. Informed consent was obtained in English or Marshallese from each respondent.

Results

Description of the study population. Table 1 presents basic demographic data on the pre-intervention and post-intervention store customer samples. The two samples differ significantly in terms of education level and occupation status, with the pre-intervention sample being significantly more educated.

TABLE 1. Demographic information on the consumer study sample

Demographic Variables	Pre-intervention sample (n=102)	Post-intervention sample (n=185)	Significance
Age, yrs, x	36.1	35.9	NS
Female, %	50	44.9	NS
Household size, x	10.2	9	NS
Education level, %			
<8th grade	3.2	11.1	
8-12th grade	26.6	14	X^2, p=0.008
High School grad	30.9	43.6	
Some college	26.6	22.7	
College grad or more	12.8	8.7	
Occupation Level[a], %			
Not employed	26.3	28	X^2, p=0.033
Low	35.4	47.8	
High	38.4	24.2	

[a] Occupations were ranked according to social status rather than by income

Exposure to components of the intervention program. Exposure to components of the intervention varied, with generally higher levels of exposure to mass media components and lower levels of exposure to in-store components of the intervention. Exposure to the intervention was associated with age and education level of the respondent, but not to their household size or gender. Older respondents were more likely to be exposed to the in-store components of the intervention, while more educated respondents were more likely to be exposed to mass media components of the intervention.

Diabetes knowledge. Tables 2 and 3 present results on the impact of the intervention on cognitive variables. Pre-post results indicated no significant impact of the intervention on diabetes knowledge, either overall, or within education level (Table 2). On the other hand, logistic regression results indicate a significant relationship between exposure to the

intervention and increased diabetes knowledge, adjusted by age, sex and education level (Table 3). A one point increase in exposure from the in-store and mass media exposure scales was associated with a 7.6% and 7.7% increased likelihood of having a higher diabetes knowledge score.

Label-Reading Knowledge/Skill. Pre-post results indicate a significant positive impact of the intervention on label-reading scores, both overall (X^2=13.897, p=0.001), and by education level (Table 2). The effect was weakest in the highest level of education (X^2=3.008, p=0.083), and stronger in those persons who were High school graduates (X^2=6.206, p=0.013) or who had less than a high school education (X^2=5.767, p=0.016). Logistic regression confirmed these results and indicated a significant positive relationship between exposure to the intervention and increased label reading knowledge (Table 3). A one point increase in exposure from the in-store and mass media exposure scales was associated with 11.3% and 14.7% increased likelihood of having a higher label reading score.

Self-efficacy. Pre-post results indicate that respondents had a higher score for self-efficacy prior to the intervention than post, although the difference was not significant (p<0.10), possibly linked to the higher educational status of respondents pre-intervention. The reverse relationship is seen among respondents in the lowest educational group, who significantly improved their scores pre to post intervention. The medium education and high education group all decreased scores pre to post intervention (Table 2). There was no relationship between both exposure score and self-efficacy in regression models.

TABLE 2. Pre-post effects on label reading, diabetes knowledge and self-efficacy

Cognitive Variable	Overall (Not Stratified)		Stratified by Education Level					
	Pre-intervention (n=102)	Post-intervention (n=185)	Low		Medium		High	
			Pre (n=28)	Post (n=43)	Pre (n=29)	Post (n=75)	Pre (n=37)	Post (n=54)
Diabetes Knowledge, % who scored high	67.7	64.3	60.7	51.2	72.4	70.7	73	68.5
Label Reading	34.3[b]	57.3[b]	10.7[a]	16.9[a]	41.4[b]	68.0[b]	43.2[b]	68.5[b]
Knowledge, % who scored high								
Self-Efficacy,	44.0[a]	38.5[a]	34.4[b]	40.2[b]	45.2[b]	33.7[b]	47.9[a]	43.5[a]
Mean score								

[a] – p<0.10

[b] – p<0.05

TABLE 3. Effect of exposure to the intervention on label reading and diabetes knowledge1

Cognitive Variable	In-Store Exposure OR	95% CI	Mass Media Exposure OR	95% CI
Diabetes Related Knowledge	1.076	1.027-1.128	1.077	1.006-1.153
Label Reading Knowledge	1.113	1.059-1.169	1.147	1.066-1.234

[1] Adjusted for age, sex, and education level

Healthy food purchasing. Table 4 presents pre-post results for healthy food purchasing. Purchasing of oatmeal, turkey chili, fish, canned fruit, and local vegetables significantly increased pre to post intervention. Purchasing of low-fat milk, carnation low-fat evaporated milk, diet soda, low-fat cereal, low-fat ramen, cooking spray and canned vegetables, all significantly decreased prior to post intervention. When stratified by education level, significant increases in purchases of healthier foods were most commonly found in the lower education group. Surprisingly, we found decreased purchases of some healthier foods pre to post in the higher education group.

The positive impacts of the intervention on healthy food purchasing are largely confirmed when we look at the effect of exposure on purchasing of healthy foods in the post-intervention sample (Table 5). Higher exposure to the in-store components of the intervention was associated with increased likelihood of purchasing diet soda, 100% juice, pretzels, turkey chili, canned fruit, imported vegetables, and local vegetables – all foods promoted as part of the intervention. Purchase of all other healthy foods showed no significant association with exposure, except imported fruit and low-fat evaporated milk, which show significant decreases in purchase associated with exposure. Most significant associations occurred with greater exposure to the in-store components of the intervention.

TABLE 4. Pre-post effects on purchasing of promoted healthy foods, % purchasing at 1-3 times/month or more[1]

Food	Overall		Low Education		Medium Education		High Education	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Low-fat milk	33.3[d]	17.3[d]	17.9	32.6	31.0[c]	9.3[c]	40.5[c]	14.8[c]
Low-fat evap milk	15.7[b]	7.6[b]	7.1	18.6	10.3	4.0	24.3[d]	3.7[d]
Low-fat Powdered milk	5.9	3.8	0	4.7	6.9	1.3	10.8	5.6
Diet soda	48.0[b]	34.6[b]	28.6	44.2	51.7	36.0	54.1[c]	25.9[c]
100% juice	55.9	55.1	21.4[b]	51.2[b]	65.5	65.3	67.6[a]	50.0[a]
Equal	33.3	29.7	17.9[c]	48.9[c]	37.9	24.0	35.1	24.1
Oatmeal	12.8[d]	28.1[d]	17.9	34.9	6.9[a]	22.7[a]	13.5[b]	33.3[b]
Low-fat cereal	32.4[d]	11.4[d]	17.9	9.3	17.2[b]	4.0[b]	51.4[d]	22.2[d]
Pretzels	9.8	11.4	7.1	9.3	6.9	14.7	13.5	11.1
Canned beans	12.8	15.7	21.4	30.2	6.9	8.0	13.5	9.3
Turkey chili	1.0[d]	13.5[d]	3.6	4.7	0.0[b]	14.7[b]	0.0[c]	18.5[c]
Fish	78.4[d]	92.4[d]	57.1[d]	93.0[d]	82.8	89.3	86.5[a]	96.3[a]
Noodles	39.2	33.0	10.7	23.3	44.8[a]	26.7[a]	54.1	48.2
Lowfat ramen	17.7[d]	6.0[d]	3.4	9.3	24.1[b]	6.7[b]	24.3[d]	1.9[d]
Cooking spray	16.7[b]	7.0[b]	3.6	0	13.8	5.3	27.0	14.8
Imported fruit (1-2x/wk or more)	75.5	71.9	50.0	46.5	86.2	76.0	83.8	88.9
Local fruit	66.7	71.4	46.4[d]	90.7[d]	75.9	69.3	70.3	59.3
Canned fruit	20.6[d]	48.1[d]	17.9	30.2	20.7[d]	54.7[d]	24.3[b]	50.0[b]
Frozen fruit	5.9	9.7	0	2.3	6.9	9.3	8.1	16.7
Imported vegetables	80.4	77.3	64.3	74.4	86.2	70.7	83.8	88.9
Local vegetables	23.5[d]	61.6[d]	25.0[d]	67.4[d]	10.3[d]	64.0[d]	35.1	50.0
Canned vegetables (1-2x/wk or more)	60.8[b]	45.4[b]	28.6	27.9	62.1b	38.7[b]	78.4	68.5
Frozen vegetables	14.7	11.9	7.1	11.6	27.6[b]	10.7[b]	13.5	16.7

[1] Cut-offs set at 1-3 times/month or more unless otherwise indicated

[a] – $p<0.10$ [c] – $p<0.01$

[b] – $p<0.05$ [d] – $p<0.005$

TABLE 5. Effect of exposure to the intervention on purchasing of healthy foods[1,2]

Food	In-store exposure			Mass media exposure		
	OR		CI	OR		CI
Low-Fat Milk	0.993	0.939	1.051	0.942	0.863	1.027
Low-Fat Evap Milk	1.024	0.942	1.113	0.865	0.753	0.993
Low-Fat Powdered Milk	0.982	0.882	1.094	1.000	0.849	1.179
Diet Soda	1.064	1.016	1.115	1.011	0.941	1.087
100% Juice	1.095	1.046	1.147	1.069	0.998	1.144
Equal	1.029	0.982	1.079	0.932	0.865	1.005
Oatmeal	1.039	0.994	1.087	0.977	0.911	1.048

(cont. on next page)

Food	In-store exposure			Mass media exposure		
	OR		CI	OR		CI
Low-Fat Cereal	0.959	0.893	1.030	0.904	0.813	1.006
Pretzels	1.091	1.019	1.168	1.052	0.946	1.169
Beans	1.000	0.939	1.064	0.937	0.851	1.032
Turkey Chili	1.187	1.081	1.302	1.078	0.957	1.215
Fish	0.991	0.918	1.070	0.952	0.842	1.078
Noodles	1.043	0.998	1.090	1.066	0.991	1.146
Low-Fat Ramen	1.083	0.994	1.180	0.991	0.872	1.126
Cooking Spray	0.952	0.866	1.046	1.034	0.895	1.196
Imported Fruit	0.838	0.725	0.968	0.804	0.698	0.926
Local Fruit	1.002	0.955	1.051	0.943	0.871	1.020
Canned Fruit	1.077	1.031	1.124	1.073	1.004	1.146
Frozen Fruit	1.053	0.972	1.140	0.966	0.853	1.094
Imported Vegetables	1.058	1.005	1.114	1.023	0.951	1.101
Local Vegetables		1.046	1.002	1.093	1.024	0.958
Canned Vegetables	0.936	0.827	1.060	0.842	0.705	1.004
Frozen Vegetables	1.044	0.981	1.110	0.978	0.888	1.078

[1]Adjusted for age, sex, education level of customer respondent

2High=cut-off at 1-3 times/month or more, except for imported fruits and canned vegetables where cut-off set for 1-2 times/week

Unhealthy food purchasing. Table 6 presents pre-post results for purchasing of unhealthy foods, which might be expected to decrease in a successful intervention promoting healthy alternatives. The majority of unhealthy foods purchased by respondents significantly decreased in frequency pre to post intervention, including regular milk, regular evaporated milk, regular soda, sugary cereals, potato chips, corned beef, ramen noodles, butter, chocolate, candy, ice cream, barbequed chicken and doughnuts. Stronger effects appear to be observed among the higher educated group. Whole fat powdered milk, popcorn, and fried chicken showed a significant increase in purchase pre to post intervention.

Our exposure data are discordant with the pre-post assessments of purchasing of unhealthy foods (data not shown). Purchasing of most of the unhealthy foods considered was not significantly associated with exposure to in-store or mass media components of the intervention. Decreased purchase of two unhealthy foods only, whole fat powdered milk and shortening, were associated with exposure to the in-store components of the intervention. Exposure to the intervention was associated with several negative results, including increased likelihood of purchase of potato chips, ramen noodles, chocolate, hard candy, ice cream and donuts.

Food preparation. Some positive effects of the intervention on cooking method were found. From pre to post intervention, cooking method score showed a trend towards improvement (from –0.55 to –0.19), but this overall change was not statistically significant. When broken down by education level, lower education subgroups improved pre to post (low education: -1.07 to –0.65; medium education: -1.48 to 0.00; high education: 0.54 to 0.02), with medium education showing statistical significance (t-test=-2.495, p=0.0142). Exposure to in-store components of the intervention was not a significant predictor of a higher cooking score, but exposure to mass media components did positively predict higher cooking scores (p=0.036, Beta=0.170).

Discussion

The Marshall Islands Healthy Store pilot intervention was associated with positive changes in customer knowledge and food purchasing and preparation behaviors. The intervention, while brief, was intensive, and involved a variety of media and approaches that apparently contributed to success.

This food store-centered intervention trial is ground-breaking in several areas.

To our knowledge, this is the first carefully evaluated store-centered intervention program to take place in a developing country setting.

Also, to our knowledge, this is the first food store-centered intervention trial that has worked in both large supermarkets and smaller local stores.

These findings have relevance to the many rural communities and inner city neighborhoods throughout the United States where large supermarkets are scarce or inaccessible, and where consumers rely on small convenience or corner stores. The intervention itself was unique in that it employed a wide variety of approaches which reinforced each other, both within stores (shelf labels, cooking demonstrations, posters) and at the mass media level (radio, newspaper, television).

TABLE 6. Pre-post effects on purchasing of unhealthy foods, %

Food	Overall		Low Education		Medium Education		High Education	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Regular Fresh Milk[1]	68.6[d]	30.8[d]	42.9[b]	18.6[b]	72.4[d]	29.3[d]	81.1[d]	44.4[d]
Regular Evap. Milk[1]	68.6[a]	57.8[a]	46.4	39.5	69.0	61.3	78.4	68.5
Regular Powd. Milk[2]	7.8[b]	17.3	7.1[b]	30.2[b]	10.3	10.7	8.1	16.7
Creamer (Regular)[1]	28.4	28.6	14.3	20.9	27.6	28.0	32.4	35.2
Regular Soda[1]	85.3[b]	74.1[b]	75.0[b]	48.8[b]	86.2	81.3	89.2	85.2
Sugared Cereal[1]	37.3[d]	17.3[d]	21.4[a]	7.0[a]	41.4[b]	21.3[b]	40.5[b]	18.5[b]
Potato Chips[1]	66.7[d]	37.8[d]	39.3[b]	14.0[b]	72.4[b]	50.7[b]	78.4[d]	40.7[d]
Popcorn[2]	24.5[a]	35.7[a]	21.4	14.0	27.6[a]	45.3[a]	27.0	38.9
Regular Chili[2]	3.9	5.4	3.6	7.0	3.5	5.3	5.4	1.9
Corned Beef[3]	53.9[d]	20.0[d]	46.4	30.2	55.2[d]	10.7[d]	51.4[d]	22.2[d]
Ramen (Regular)[1]	79.4[b]	66.0[b]	64.3	51.2	79.3	74.7	86.5[b]	66.7[b]
Shortening[1]	3.9[d]	16.2[d]	3.6[a]	16.3[a]	3.5	2.7	2.7[d]	31.5[d]
Cooking Oil[1]	32.4	27.6	25.0	18.6	27.6	25.3	29.7	35.2
Butter[1]	64.7[d]	35.7[d]	32.1[a]	14.0[a]	65.5[b]	40.0[b]	81.1[d]	51.9[d]
Chocolate Candy[1]	63.7[d]	43.2[d]	32.1[b]	11.6[b]	62.1	62.7	81.1[d]	46.3[d]
Hard Candy[1]	55.9[d]	31.4[d]	21.4[b]	4.7[b]	55.2	49.3	73.0[d]	31.5[d]
Ice Cream[1]	69.6[d]	51.9[d]	53.6[d]	16.3[d]	62.1	66.7	81.1[a]	63.0[a]
Fried Chicken[1]	41.2[d]	62.2[d]	21.4[b]	51.2[b]	34.5[b]	61.3[b]	51.4[a]	70.4[a]
BBQ Chicken[1]	44.1[d]	24.3[d]	21.4	30.2	34.5[d]	9.3[d]	59.5[b]	35.2[b]
Donuts[3]	73.5[d]	49.2[d]	60.7[b]	34.9[b]	75.[a]	57.3[a]	75.7[b]	55.6[b]

[1]Cut-off set at 1-2 times/week or more frequently purchased
[2]Cut-off set at 1-3 times/month or more frequently purchased
[3]Cut-off set at 3-6 times/week or more

[a] – $p<0.10$
[b] – $p<0.05$
[c] – $p<0.01$, [d] – $p<0.005$

Our intervention strategy was based on extensive formative research in the community, and focused on themes that were important to the Marshallese people.

The program showed some positive effects on cognitive variables, with better scores on the diabetes knowledge scale associated with increased exposure to the intervention. Diabetes was mentioned with some frequency in program materials as a motivating factor for behavioral change, however not a great deal of attention was paid to understanding what it was, how it is caused or could be prevented. This explains to some degree the lack of significant results pre to post intervention. Label reading was significantly improved by the intervention, particularly in those persons of higher education levels, perhaps reflecting literacy. These effects reflect the heavy attention paid to label reading in the intervention materials.

The program was associated with increased frequency of purchasing of many of the healthy foods promoted. On the other hand, some of the foods promoted showed a significant decease in purchasing pre to post intervention.

Decreased purchasing in one type of food may have been balanced by increased purchasing of another food. So for example, while canned vegetable purchases decreased pre to post intervention, local vegetable purchases increased. Purchases of healthy and unhealthy milk products decreased across the board. This may be related to our intervention, which emphasized decreased tea and coffee consumption, and use of less added sweeteners and lighteners.

Study results for purchasing of unhealthy foods are less easy to explain. While we did see most of these foods decrease in frequency of purchase pre to post intervention, there appeared to be no or even opposite effects in the analyses associated with exposure to the intervention and food purchases. It should be reiterated that our intervention was aimed at promoting the consumption of new healthy foods as alternatives to unhealthy foods. We specifically avoided negative marketing of unhealthy foods, out of concern with alienating store owners and managers whose primary concern it was to stay in business. We would argue that our study was successful in increasing trial purchases of many healthy foods, but did not impact significantly on purchasing of their less healthy counterparts.

It is also quite possible that overall decreases in food purchasing may reflect secular or seasonal trends. Our later interviews with large store managers lend some credibility to this theory; they observed that sales had overall decreased from August to October. This speaks to the need to conduct controlled intervention food store intervention trials of longer duration so that seasonal effects can be assessed.

We conducted separate analyses of the impact of exposure to in-store components of the intervention, and impact of mass media components of the intervention. In general, exposure to mass media components was higher than exposure to in-store components, but stronger effects were observed of the in-store components than the mass media components. About 20% of the samples were exposed to the mass media intervention only. Many of the materials and messages were reinforcing (e.g. some of the same graphics on the recipe cards appeared in the newspaper ads). We argue for the need for multiple, reinforcing intervention approaches, at both the in-store and mass media levels.

Future assessments of the impact of food-store centered interventions should examine impacts on diet and food consumption at the household level, and make linkages with health outcomes.

There are several limitations of the intervention trial that should be noted. First, the study design suffered due to a lack of a control group of consumers. Unfortunately, there is no other comparable atoll or island in the Marshall Islands that would have permitted an appropriate comparison.

Second, there was potential for seasonal changes (particularly in the availability of local fruits and vegetables) which impact on pre to post changes. It should be noted however, that on Majuro atoll, population density is so high, that during the season of local produce, availability of these foods is limited and these foods do not comprise a major part of the diet.

Third, the intervention itself was lacking in several areas. In the brief period of the intervention we had difficulty in convincing smaller stores to stock many of the foods we were promoting. Future programs of this type will require more time and effort to make these changes which bear an obvious risk for owners of small stores. The majority of interventions conducted to date have been of short duration, with only a few covering periods of a year or more. Interventions occurring over longer periods may contribute to the success of the program[21].

Fourth, several areas in our choice of evaluation methods could have been improved. It appears that our pre and post samples were significantly different in some areas, such as education. It is likely, but was not assessed, that there were economic differences as well, which might have impacted on ability to purchase different foods we were promoting. We dealt with this by stratification of the pre-post sample by education, and by including education level in the logistic regressions.

Future assessments of the impact of food-store centered interventions should examine impacts on diet and food consumption at the household level, and make linkages with health outcomes. A final limitation of this study lies in the lack of assessment of size of store on food purchasing by consumers.

As stated earlier, this issue is confounded in this setting by the fact that consumers use multiple stores for their purchases, often several small and one or more large stores. Recent work has shown that presence of stores and store size can impact on consumption of healthy food alternatives in the United States[42]. Future store-centered intervention trials should carefully examine the relative impact of large and small stores on food purchasing and consumption.

In conclusion, the Marshall Islands Healthy Stores program was successful in impacting on many of the cognitive and behavioral outcomes measured. Future plans for the Marshall Islands Healthy Stores program include expansion to other stores on Majuro atoll, and expansion to other atolls in the country. With modification, we feel the current program is applicable to other countries in Micronesia and the Pacific.

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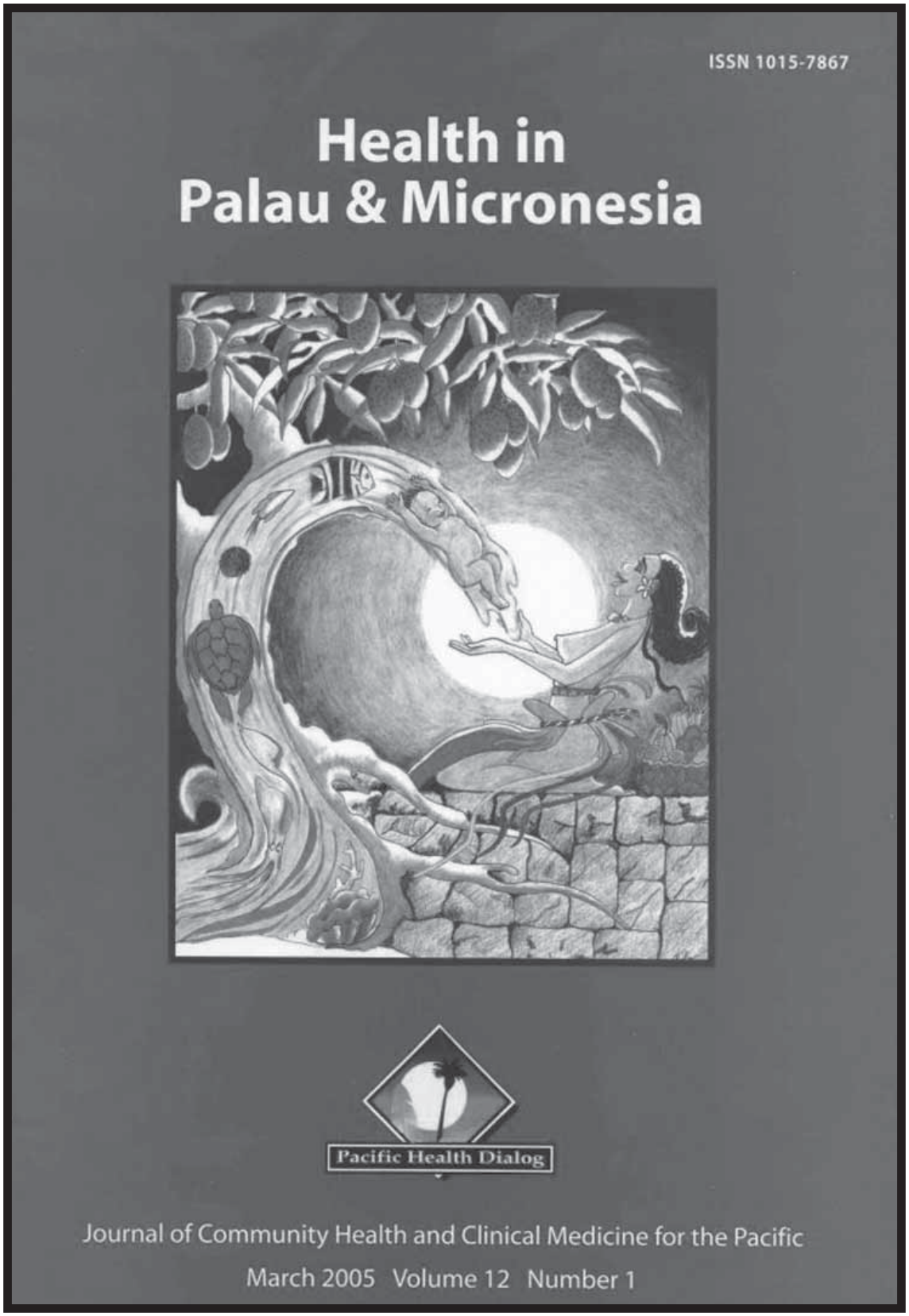
"Not everything that can be counted counts, and not everything that counts can be counted."

- Albert Einstein (1879-1955)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