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**The Effect of a Multi-tiered Model for Reducing Obesity Risk Factors:
Attitude and Behavior Change in a Rural Community**

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Abstract

While there is increasing interest in reducing obesity, relatively few of these efforts focus on rural communities. A multi-tiered model to reduce obesity risk factors was developed and implemented to change food behavior and health awareness in a rural West Texas community over a one year period. This paper evaluates the project outcomes based on mean comparison of self-reported health behavior and attitude response before and after the intervention. Findings show a significant increase in, a) obesity as cancer risk awareness and b) food nutrition awareness. Also, increased food nutrition awareness should lead to reduced obesity over time as suggested by A regression analysis of obesity risk factors on BMI.

Key Words: Body Mass Index, Cancer risk, Food Behavior, Health education, Multi-tier approach, Obesity, Rural community

Introduction

The prevalence of obesity in United States continues to be high. More than 35% of U.S. men and women were obese in 2009–2010 (Cynthia et al. 2012). Obesity is among the leading modifiable behavior risk for morbidity, mortality and disability in Americans (Mokdad et al. 2004). Attributing only to its effect on cancer; nearly 30 percent of cancer cases including colon cancer, breast cancer and cancers of the esophagus, stomach, pancreas, uterus and kidney are caused due to obesity. Obese individual have a 50 percent higher risk of dying from cancer than their healthy counterparts.

There is also a significant variation in obesity trend by race and ethnicity (Flegal et al. 2012). Researchers have also found that rural residents fare worse than their urban counterparts in regards to obesity (Blankenau, Bailey and Hudson 2009). Inevitably, individual's socioeconomic status (SES) affects timely access to health messages and health care services. In addition, the American Cancer Society has outlined that uninsured patients from ethnic minorities are substantially more likely to be diagnosed with cancer at a later stage when treatment is extensive and costly (Gosschalk and Carozza 2010).

There is less evidence available in the obesity research literature that suggests programs developed and tested to bring healthful obesity prevention services to local communities in urban areas, even at moderate success, would be effective in rural community context. Moreover, innovative public approaches including a variety of environmental initiatives designed to increase fruit and vegetable consumption have been recommended by obesity researchers (Flegal et al. 2012; Giang et al. 2008).

A multi-tiered community based obesity prevention project was launched in June of 2011 in West Texas. The objective of the project was to raise nutrition awareness and reduce obesity

induced health risks by changing food behavior. Multiple community-based and reinforced efforts were used to provide healthier food and activity choice information and improve health and nutrition awareness. In particular, the supermarket, given its relatively prominent role in the community and lack of choice in the community, provided a means to implement by using local supermarkets which are the primary food source for the rural population in the project area. This paper evaluates the success of this approach and analyzes its outcome by comparing food behavior and attitude before and after project as well as its effect on BMI.

The Project Concept and Model

Researchers have shown that the effect of exercise, smoking, occupation, and race vary by sizeable amounts from high to low BMI-quantiles (Belasco et al. 2012). Many researchers have also shown that in US higher BMI is ubiquitous in groups at lower SES and minority (Clarke et al. 2009; Grabner 2012). A multi-tiered behavior change model was developed to account for community heterogeneity and reinforce behavior change at multiple levels. Changing individual's decision making within a community context was central to this model. The model delivered educational interventions to rural populations using several means to encourage healthy eating and weight including articles in the local newspaper, television, posters at community sites, presentations to community groups and the supermarket.

Since, the local supermarket is the largest source of daily food needs; the supermarket can be an excellent source of information and reinforcement for healthy behavior. The supermarket was used 1) to conduct healthy food demos, 2) to put shelf talkers on the comparatively healthy food product, 3) to access food purchase data to run analysis on purchase behavior as affected by project intervention, and 4) as an active site of information flow, posters regarding healthy eating were placed in the store.

Identification of local community leaders was another important component of this model following (Corda et al. 2010); (Hystad and Carpiano 2012; Macaulay et al. 1998). Persons in leadership positions in the local school district, churches, city and county government, United States Department of Agriculture Cooperative Extension Service office, media (local newspaper and television station), and community organizations, such as 4-H clubs, the Boy and Girl Scouts, and the local senior center, along with the manager of the local supermarket were identified as local community leaders during the implementation of this project.

In regards to the primary goal of individual behavior change this research model can also be related to the Trans-theoretical Model (TM) of behavior change. Stages of change are central in TM where views and behavior changes through a process over time, as individuals move from pre-contemplation stage to maintenance stage (Cancer Prevention Research Center, n.d.; Taylor, et al., 2004; Zimmerman, et al., 2000). Like TM; the research objective is attained when individuals believe that benefits of performing a behavior outweigh its costs. Table 1 show the stages of the Trans theoretical model, stage wise objective and research action in the project with respect to each stage.

Data

Two rural West Texas communities: Muleshoe and Dalhart were selected, as project implementation and control site respectively, based on their similar demographics. The average poverty rate in these communities is around 16% and more than one third of the populations are Hispanic. The multi-tiered behavior reinforcing model was executed in Muleshoe from June of 2011 to June of 2013. The data for this paper were drawn from the data collected in two independent surveys, baseline (June of 2011) and post implementation survey (June of 2012) conducted at both sites. Survey respondents completed a self-report survey questionnaire based

upon questions from the Behavioral Risk Factor Surveillance system (BRFSS). Both BRFSS and the new questions were pretested in a similar community in Lubbock, TX. The same sets of activities were conducted during the 2011 and 2012 survey. A post project survey following the same set of activities was conducted during January of 2013 in Muleshoe the findings from this survey have not been included in the quantitative analysis of this paper due to time limitations.

The questionnaire had multiple choice, Likert scale and open ended question under the following sub headings:

1. Beliefs regarding cancer - eight cancer causing factors were identified, beliefs regarding overweight and obesity as a cancer causing factor was a proxy to changed attitude.
2. Health Practices – eight questions regarding current health practices with regards to smoking, snuffing and tanning habits were asked.
3. Socio-demographics – marital status, number of people in household, education level and income range were included in the main survey. Respondents' age, gender, ethnicity language was collected in a different worksheet along with anthropometric measurements. Some food behavior change proxy variables like number of meals eaten in fast food restaurant, number of home prepared meals, and self-identification of awareness about different food's nutritional value, self-weight perception and interest in finding ways to reduce cancer risk was also collected as part of socio demographics.
4. Activity level – several indicator questions like TV hours, yard work hours etc were collected.
5. Food behavior – included several proxies to food behavior change like consumption of high fat food, number of sugary drink and desserts per day etc.

6. Emotional health – questions were designed to understand if poor mental and physical health and stress or depression obstructed usual activity; and if participation in some form of spiritual or cultural activity provided emotional strength to the respondent.

Besides, respondents had an option to select their current attitude and their degree of openness to change from a close ended multiple choice question on activity level, food behavior and emotional health. Height, weight and waist circumference were collected in a separate anthropometric worksheet.

In two years, there were a grand total of 932 respondents. They were invited to participate by mail sent out to a random sample of local population drawn from the local telephone book; the average show up rate was 22.25%, the random sample was supplemented by participants invited through flyers and pamphlets distributed in public areas and printed in local newspapers. During 2011 survey, there were a total of 382 respondents: 225 from Muleshoe, and 157 from Dalhart. The total participant number increased to 550 during 2012 survey: 335 from Muleshoe and 215 from Dalhart. Of the total in Muleshoe and Dalhart; 69 and 39 of them were two year participants, respectively. All the study protocols were approved by the Texas Tech University Institutional Review Board.

Missing data was dealt by imputation or dropping the observation with missing values as suggested by (Malhotra 2007). Imputation was done for demographic variables like marital status, income education, number of people in household, number of home prepared meals, number of meals in a fast food restaurant. There were 87 questionnaires with missing data during 2011 survey. During 2012 all questionnaire were checked before collection and respondent were asked to fill if any response were missing, there were only two questionnaires with missing data in 2012. The two questionnaires in 2012 and one questionnaire from 2011 set were completely

blank. This Blank questionnaire was deleted before imputation. Other missing data were arbitrary. Missing data imputation was done using SAS (2008), V 9.2, SAS Institute Inc.

Body Mass Index (BMI), defined as the individual's body mass divided by the square of his or her height, was computed based on recorded height and weight and is used to classify individuals into four main weight categories: underweight (<19), ideal (19-25), overweight (25-30), and obese (>30). As in (Dunn 2010), individuals with BMI below 12 or above 90 was omitted. Eight observations on BMI were outliers, three of them had weight beyond weighing scale capacity, two were 36 months pregnant and three had very low BMI observation. Mean BMI was 30.43 and it ranged from 18.16 to 54.52.

The variable 'activityscore' was calculated by summing up participation in project activities and variable 'projectcoresp' was calculated by summing up the correct response of a set of five questions about health awareness. A project target was to increase the awareness on obesity as a cause of cancer. Description of other variables and summary statistics for the explanatory variables are presented in Table 2 and 3 respectively. According to the census of 2011, 49% of the population was Hispanic, and the sample Hispanic population is very close to the population proportion. As is often the case with randomized mail surveys, the majority of respondents are female. For comparison, 62.1% of respondents to the 2009 BRFSS were female. The age of respondents ranged from 18 to 92 years.

Methods

The objective of analysis is to find the change in health attitude, and food behavior before and after project implementation. To that end, two methods were used. A mean comparison tests was accomplished as per the methods outlined in (McClave, Benson and Sincich 2005). Paired t-test was used to compare BMI for a sub set of respondent pool that participated in the survey in

both before and after project scenario. The assumption for normality for paired t-test was checked by using Q-Q plot for conducting paired t-test. The outcomes of mean comparison were augmented by a linear regression analysis; BMI was estimated with the set of explanatory variables defined in Table 2. Variable Muleshoe is a control dummy for Muleshoe (1=Muleshoe, 0=Dalhart) and m2012 is a control dummy for response from Muleshoe in year 2012 (1=Muleshoe response of 2012, 0=otherwise). All statistical analysis were done using Microsoft excel and SAS (2008), V 9.2, SAS Institute Inc.

Results

This paper analyzes the effect of the project intervention on food behavior and health and nutrition awareness. To begin with, Table 4 below summarizes the participation in project activities and their perception on participation. Overall, 85% reported to have seen healthy living messages in posters, local television channel, newspaper, church bulletins and supermarket and the majority of them reported project activities to be helpful.

Change in nutrition awareness through these nutrition education classes is observed to be among the most effective project activities. Table 5 shows the change in awareness from 2011 to 2012. Food nutrition awareness significantly increased, by 10%. There was also a significant change in beliefs regarding use of tanning bed and obese condition as causes of cancer; an increase of six and 12% was observed respectively.

The results of a linear regression model of BMI and program effect are shown in Table 6. Age, frequency of meals eaten at a fast food restaurant, satisfaction, participation in sports more than once a week were found to have a significant effect on BMI. BMI increases as age increases but at a decreasing rate similar to what Belasco et al. 2012 has found. The direction of change for activity score and project correct response was both negative; that is to say increase in nutritional

awareness and participation in the project leads to lower BMI. Despite the fact that BMI was not significant at a high level; it is suggestive that having increased access to healthy living messages and exposure to a supermarket environment that promote healthy living can have a negative relation with respondents' BMI. This last result might suggest the potential effect if the intervention went beyond one year.

Conclusion

This paper uses survey data to analyze the effect of a multi-tiered behavior re-enforcement model on food behavior and health awareness and the effect of the project on BMI. Unlike most other research, the project model focuses more on changing behavior by changing the community environment with a substantial component of project activities being delivered by the local supermarket. The results show that the project has been successful in changing major attitudes in relation to obesity as cause of cancer and nutrition awareness. The effect of change in nutrition awareness on BMI was significant. Overtime it would be expected that increased nutritional and cancer risk awareness would lead to reduced BMI.

This paper is first among a series of publication to come forward that will analyze the effect of the project from different aspects. The findings in this paper suggest that change has occurred. Other models will be developed to quantify the change and understand the challenges and potential of this model in regards to changing food behavior and health awareness to community health. The results of this paper are suggestive that a community approach to obesity prevention that includes a substantial supermarket component can be effective.

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Table 1: Stage specific objective and research action according to Trans-theoretical Model

Stages	Objectives at each stage	Research action
Pre-contemplation	Identify risk associated with current behavior	Health assessment survey
Contemplation	Increase risk knowledge and build confidence	Access to information
Preparation	Provide suitable environment, avoid relapse	Market environment change
Action	Reinforce positive behavior, build self esteem	Second stage assessment
Maintenance	Prevent change that may encourage relapse	Post project survey

Table 2: Description of Explanatory Variables

hispanic	Self-identified race (1=hispanic, 0=non-Hispanic)
female	Gender (1=female, 0=male)
age	Age of respondent
age_2	Square of variable age
modaware	Self-reported food's nutritional value awareness (1=at least moderately aware, 0=not at all or somewhat aware)
fastfood	Number of meals at fast food restaurant last week
whlgrain	Servings of whole wheat products in a day (≤ 1 , 2, 3 or more)
satisfied	Describe themselves as "happy and satisfied" (1=happy or satisfied, 0=otherwise)
sportMT1	Participate in sports or exercise program (1=more than once a week, 0=otherwise)
muleshoe	Control for muleshoe (1=muleshoe, 0=Dalhart)
activityscore	Project involvement proxy (0 to 11, 11 being participated in all project activities)
projcoresp	Attitude change proxy (0 to 5, five being all correct answer)
m2012	Control for 2012 (1=respondent in 2012 survey, 0=otherwise)

Table 3: Descriptive Statistics for Explanatory Variables^a

Hispanic (%)	42.92±00.03
Female (%)	65.98±00.03
Age (years)	50.25±18.15
Modaware (%)	38.28±00.05
Fast food (frequency)	01.47±01.97
Whlgrain	02.17±00.75
Satisfied (%)	59.82±00.04
SportMT1 (%)	36.13±00.04
Activity score	02.08±02.48
Projcoresp	04.18±00.90

^a Means ± standard deviation

Table 4: Project participation and perception on participation

Activities	Participation Percentage	Perception on participation		
		Helpful	Neutral	Not helpful
Information through 4-H	27	92	8	0
Nutrition Education Classes	8	100	0	0
Shelf Talkers	41	84	16	0
Healthy living messages	85	NA	NA	NA

Table 5: Increased Awareness after Project Implementation at Muleshoe (Percentages)

Indicators	2011	2012	Difference	P value
Believe the use of tanning beds can cause cancer	80	86	6	0.081
Believe getting sun burned can cause cancer	92	93	1	0.724
Believe being overweight can cause cancer	38	50	12	0.005
Believe chewing tobacco/using snuff can cause cancer	96	97	1	0.393
Always get sun burn when outside for >60	10	7	3	0.200
Very aware about food nutrition	11	21	10	0.003

Table 6: Statistical Relationship on BMI

Intercept	26.956 ^{***}	(2.112)
Hispanic	0.311	(0.481)
Female	0.118	(0.468)
Age	0.321 ^{***}	(0.068)
Age^2	-0.003 ^{***}	(0.001)
Modaware	-1.034 ^{**}	(0.462)
Fastfood	0.371 ^{***}	(0.115)
Whlgrain	-0.354	(0.297)
Satisfied	-1.524 ^{***}	(0.461)
SportMT1	-1.893 ^{***}	(0.469)
Muleshoe	1.267 ^{**}	(0.614)
Activityscore	-0.163	(0.110)
Projcoresp	-0.403	(0.260)
m2012	0.069	(0.713)
n=888		
RMSE=6.42		
R ² = 0.0995		
Adj. R ² =0.0861		

***, **, * denote statistically significant at $p < 0.01$, $p < 0.05$ $p < 0.10$ respectively.