

Initiation and sustenance of small portion size consumption behavior in rural Appalachia, USA: Application of multi-theory model (MTM)

Ram Lakhan¹, Sierra Turner², Sangyal Dorjee³, Manoj Sharma⁴

Affiliations:

¹ DrPH, Assistant Professor, Department of Health and Human Performance, Berea College, KY, USA.

² Senior, Health Studies Major, Berea College, Berea, KY, USA.

³ Sophomore, Biology Major, Berea College, Berea, KY, USA.

⁴ MBBS, Ph.D. Professor, Department of Behavioral and Environmental Health, School of Public Health, Jackson State University, MS; President, Health for All, NE; Faculty, Walden University, MN, USA.

Corresponding author:

Dr. Ram Lakhan, Assistant Professor, Department of Health and Human Performance, CPO 2187, Seabury Building, Berea College, Berea, KY, USA. Office phone: (859) 985-3573, Fax: (859) 985-3919, E-mail: ramlakhan15@gmail.com

Abstract

Introduction: About 81% counties of the central Appalachia in USA are experiencing the nation's highest obesity rates. It is generally accepted that the consumption of large food portion sizes is associated with obesity which in turn is related to the etiopathogenesis of several chronic diseases. Developing consumption of small portion size behavior can address obesity and related consequences. This study aimed to assess the likelihood of initiation and sustenance of small portion size consumption behavior based on application of multi-theory model (MTM) among residents from rural Appalachia.

Methods: The study utilized a cross-sectional research design ($n = 156$). A previously validated Multi-theory Model for Small Portion Size (MTM-SPS) questionnaire with acceptable reliability and validity for food portion size consumption behavior was adapted and used for data collection. Six counties of the rural Appalachian region of Kentucky defined as distressed, at risk, and transitional on socio-economic indicators by the Appalachians Research Commission (ARC) were selected for data collection. Stepwise multiple regression modeling was applied to predict the likelihood of initiation and sustenance of small portion size consumption behavior.

Results: Stepwise multiple regression demonstrated that initiation of small portion size consumption was explained by participatory dialogue (advantages outweighing disadvantages), behavioral confidence, and changes in physical environment ($R^2 = 47.9\%$, $P < 0.001$) and continuation of behavior by emotional transformation and practices for change ($R^2 = 40.2\%$, $P < 0.001$). Sociodemographic factors including age, gender, education, and ethnicity did not significantly contribute towards initiation and sustenance of small portion size consumption behavior in rural Appalachia ($P > 0.05$).

Conclusion: The MTM was found to be a useful theoretical framework that has the ability to predict initiation and sustenance of small portion size consumption. Findings of this study can be considered for designing an appropriate intervention in rural Appalachia.

KEY WORDS: Food; multi-theory model; portion size consumption; rural Appalachia; obesity; USA.

Riassunto

Introduzione: Circa l'81% delle contee della centrale Appalachia negli Stati Uniti d'America stanno evidenziando i tassi più alti di obesità della nazione. Viene generalmente accettato che il consumo di abbondanti porzioni di cibo sia associato all'obesità implicata nell'insorgenza di diverse malattie cronico-degenerative. Promuovere il consumo di piccole porzioni di cibo può combattere l'obesità e le sue conseguenze negative. Questo studio è stato mirato a valutare la probabilità di mettere in atto e di mantenere un comportamento basato sul consumo di piccole porzioni di cibo, secondo il modello multi-teorico, nei residenti della regione rurale dell'Appalachia.

Metodi: Lo studio ha utilizzato un disegno di ricerca trasversale ($n = 156$). Lo strumento MTM-SPS precedentemente validato con accettabile affidabilità e validità che studia il comportamento relativo alla dimensione del piatto consumato è stato adattato ed utilizzato per la raccolta dei dati. Sei contee nella regione della rurale Appalachia del Kentucky definite come "stressate", "a rischio" e "transizionali" per quanto riguarda gli indicatori socio-economici definiti dalla Commissione di Ricerca dell'Appalachia, sono state selezionate per la raccolta dei dati. Il modello di regressione multipla stepwise è stato applicato per predire la probabilità di iniziare e di mantenere un comportamento basato sul consumo di piccole porzioni di cibo.

Risultati: La regressione multipla stepwise ha dimostrato che la messa in atto del consumo di piccole porzioni di cibo viene predetta dal dialogo partecipativo (soppesando i vantaggi con gli svantaggi), dalla fiducia comportamentale e dai cambiamenti nell'ambiente fisico ($R^2 = 47.9\%$, $P < 0.001$), mentre la continuazione di tale comportamento viene predetta dalla trasformazione emotiva e da pratiche per il cambiamento ($R^2 = 40.2\%$, $P < 0.001$). Fattori socio-demografici inclusi l'età, il genere, l'educazione e l'etnia non hanno contribuito in modo significativo alla messa in atto ed al mantenimento del consumo di piccole porzioni nella rurale Appalachia ($P > 0.05$).

Conclusioni: È stato evidenziato che il modello MTM è un utile cornice teorica in quanto esso ha la capacità di predire la messa in atto ed il mantenimento del consumo di piccole porzioni. I risultati di questo studio possono essere considerati per la messa a punto di interventi appropriati nella rurale Appalachia.

TAKE-HOME MESSAGE

Recently developed fourth generation Multi-model Theory (MTM) found successful in predicting small portion size consumption behaviors in rural Appalachian population in the state of Kentucky in the USA. Participatory dialogue (advantages outweighing disadvantages) and behavioral confidence constructs were strong predictors for initiation models and emotional transformation and changes in the social environment for sustenance model.

Competing interests - none declared.

Copyright © 2019 Ram Lakhan et al. Edizioni FS Publishers

This is an open access article distributed under the Creative Commons Attribution (CC BY 4.0) License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. See <http://www.creativecommons.org/licenses/by/4.0/>.

Cite this article as: Lakhan R, Turner S, Dorjee S, Sharma M. Initiation and sustenance of small portion size consumption behavior in rural Appalachia, USA: Application of multi-theory model (MTM). J Health Soc Sci. 2019;4(1):85-100

DOI 10.19204/2019/nttn9

Received: 03/10/2018

Accepted: 06/01/2019

Published Online: 18/01/2019

INTRODUCTION

Approximately one-third of the adult population in the United States is obese and therefore at a higher risk of developing chronic diseases directly related to obesity [1–2]. One of the significant determinants of obesity is the consumption of large portion sizes in meals [3]. Our brain is wired in such a complex manner that seeks immediate gratification and in order to receive such mental satisfaction, many people overeat which contributes to obesity [4]. Thus, eating a large portion size in meals takes the shape of addictive behavior [4]. However, eating large portion sizes in meals is a modifiable risk factor of obesity that can potentially be changed by applying suitable evidence-based interventions in the target population [5]. Small portion size consumption can reduce caloric intake that can contribute towards healthier body mass index and waist circumference [6]. The Appalachian region defined in Appalachian Regional Commission (ARC) [7] is a cultural region that spreads from southern New York to northern Mississippi. It covers a small, mainly mountainous terrain spread across 12 states (ARC, web) [7]. Kentucky has the 7th highest rate of obesity in the nation. The overall Appalachian region is suffering from a disproportionately higher rate of chronic diseases compared to the rest of the state. Further, within the Appalachian region, the rural population suffers even greater rate and risk of obesity and its sequelae [8]. According to the Kentucky State Obesity report [8], the rate of obesity is on an increasing trend in Kentucky. It was 27.1% in 2006, 31.5% in 2010 which translates to 7.1% increase since 2006 and 3.1% from 2010. Currently, 34.6% population is obese in the state. Obesity-related chronic diseases are also on a higher trend. Kentucky population suffers from higher rates of obesity-related hypertension 39% and diabetes 13.1%. The obesity rate is increasing with age in the population. Under the age of 25 years, the rate is 20.2% that increases to 37.1% for 26 to 44-year-old group and 38.4% for 45 to 64 years of age group. By 2030, over 1.2 million population is expected to suffer from obesity-related he-

art diseases, 1.1 million from hypertension, about 600,000 from diabetes, 176,000 from cancer, and about 750,000 from arthritis (the state of obesity web). Appalachian population in Kentucky suffers even with a higher rate of obesity 44% and serious disease and mortality compare to national average [8–9].

There is a scarcity of public health research for the rural Appalachians with regard to determinants of obesity-specific modifiable behaviors. To our knowledge, no study has been undertaken that examines the determinants of consuming small portion sizes in the rural Appalachians. This situation demands an urgent action to understand associated factors and intention and sustenance of small portion size consumption behavior in the rural population of Appalachia.

Appropriate interventions can be carried out to promote small portion size consumption in order to reduce the risk of chronic diseases in the populations if we are able to predict initiation and sustenance of this behavior. However, a very complex etiology behind this behavior creates a challenge to identify the most appropriate behavior theory that can predict the initiation and sustenance of this behavior.

Models and theories of health behavior changes

Previously, several behavioral theories and models have been developed and applied with varying levels of success in adopting several health behaviors. Among those, Transtheoretical model, Health Belief model, Precaution Adoption Process model, Theory of Planned Behavior, Social Cognitive Theory, Diffusion of Innovation, and Social Norms theory have gained popularity [10–11]. These theories can be applied at individual, interpersonal, and group levels. Most of these theories were developed before 2000, when the focus was to understand that how a new behavior can be acquired. Now, there is a need to predict the likelihood of behavior *change*. Previously, developed theories are lacking this ability. In order to address this gap, based on collective intelligence, Sharma (2015) has developed a

multi-theory model (MTM) [12]. This model argues that few constructs of different theories interact dynamically and when combined together they can gain the ability to predict a behavior *change*. Sharma (2015) has suggested that behavior change is a continuum process which moves through two important phases: 1) one-time initiation of the behavior and 2) continuation of the same behavior. Different sets of behavior constructs regulate the initiation and sustenance of the behavior [12].

This fourth-generation approach to behavior change, multi-theory model (MTM) suggests different sets of psychosocial and physical factors that contribute toward the initiation and continuation of any given health behavior. The model explains two sub-models (initiation and sustenance) interconnected with each other but supported with a different set of factors. Both sub-models are independent, both can be assessed, and practiced with and without overlap on each other. Initiation model emphasizes three factors or constructs: participatory dialogue (in which advantages outweigh disadvantages), behavioral confidence, and changes in the physical environment. The sustenance model revolves around changes in the social environment, practice for change, and emotional transformation. In initiation model, the '*participatory dialogue*' is an internal and mental ability of an individual in that the person is convinced that the advantages of behavior change are more than potential disadvantages. '*Behavioral confidence*' is a similar factor to self-efficacy of social cognitive [13] and perceived behavior control of theory of planned behavior [14]. However, in MTM, behavior confidence acts on behavior change in future time while in previous theories it is an internal ability of changing behavior in present time and sources of this behavioral confidence are not just confined to self but also includes external sources (such as faith in God, deities, etc.). '*Changes in the physical environment*' construct indicates conduciveness of physical settings that are inviting for behavior to take place. In sustenance model, construct '*emotional transformation*' is considered the organization of own emo-

tions and thoughts and directing that energy towards a health behavior change. '*Practice for change*' is a thought-based action driven construct that evaluates and reflects on own actions and makes needed modifications for a successful continuation of chosen behavior. '*Changes in the social environment*' construct is an interactive process in which individual collects intrinsic and extrinsic motivation from people who are in his close network (see Figure 1).

Theories in public health rooted in social and behavioral science have been found more effective [15–16]. All constructs of MTM have emerged from social and behavioral science thus MTM has greater promise in predicting a behavior change and guiding an intervention plan. However, this theory is relatively new but still in a short span of time it has been successfully applied or discussed in relation to multiple health issues in diverse populations including in predicting physical activities in college students [17], water consumption [18], fruits and vegetable consumption [19], sleep behavior [20], prevention of skin cancer [21, 22], binge drinking behavior [23, 24], smoking cessation [25], for promoting HPV vaccination [26], promotion of physical activities in elementary children [27], health behavior change in musculoskeletal conditions [28], oral health disparities in rural Appalachia [29], and in predicting small portion size consumption [5]. Through this study we wanted to explore the suitability of this model for developing an intervention targeting obesity in rural Appalachia. Therefore, this study aimed to apply multi-theory model (MTM) in predicting initiation and sustenance of small portion size consumption behavior in the rural Appalachians.

METHODS

The study utilized a cross-sectional research design. A quota sampling method was applied. The Appalachian Research Commission (ARC) classifies all counties on the basis of education, income, population, poverty, and unemployment in three major categories called distressed, at risk, and transitional. To

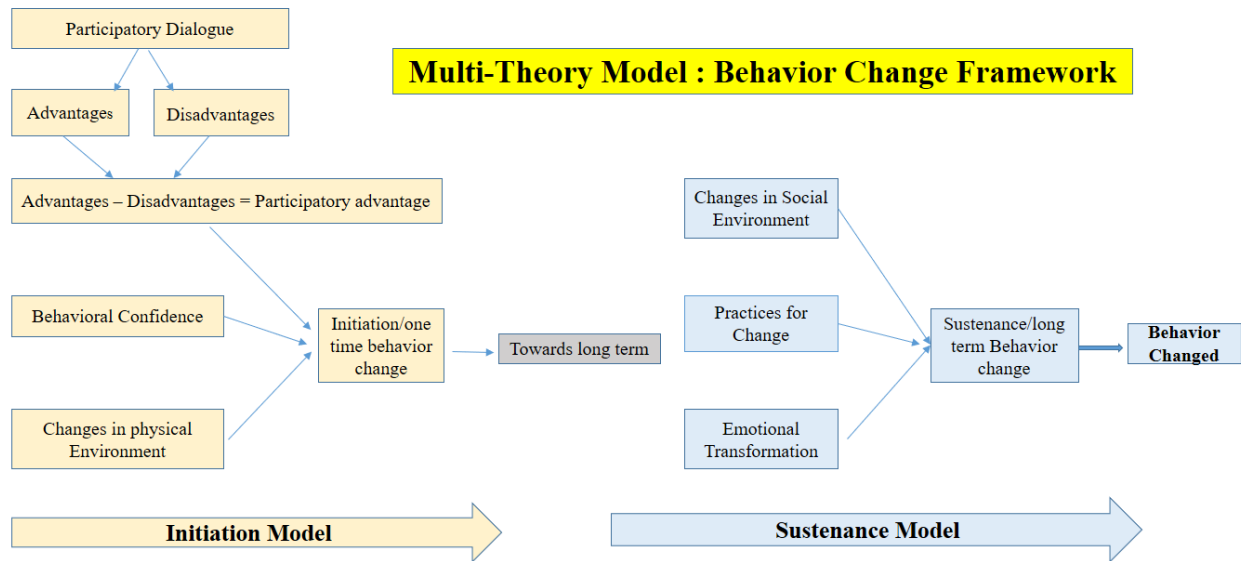


Figure 1. Constructs in initiation and sustenance of health behavior change in multi-theory model (MTM).

get a representative sample of an Appalachian population a total of six counties were selected for the study. Since the researching institute (BC) is located in Madison County so we kept this county as the base and selected five more neighboring counties for the reason of convenience. These counties geographically ranged between 15 miles to 70 miles of distance from the institute. In all three ARC categories, following counties were selected - distressed (Clark, Estill, Jackson, Rockcastle); at risk (Garrard), and transitional status (Madison). In selected counties, data collection was planned from the following towns: Berea from Madison; Winchester from Clark; Irvine from Estill; Lancaster from Garrard; Anville from Jackson, and Mount Vernon from Rockcastle. Estill town was replaced with Montgomery town which is another distressed county like Irvine. It was done because there was no turn out of participants in Estill town. An *a priori* sample size calculation for multiple regression using G*Power to achieve a statistical power of 0.80 at an alpha level of 0.05 with 0.10 (medium) effect size and three predictors in the equation was used and a sample size of 112 was needed [30]. We oversampled by 25% to reach 140 participants for statistical analysis in order to account for any potential missing values. Residents of those

counties, above 18 years of age, and who had consumed a large portion size in any of the meals in previous 24 hours were included. People who were not residents of selected counties, who were younger than 18 years of age and had already consumed small portion sizes were excluded. Data was collected between the third week of May 2018 and the first week of July 2018.

The study instruments

The Multi-theory Model for Small Portion Size (MTM-SPS) that was used in this research comprised of 36 items. Out of those, seven items were about the participants' sociodemographic information, 18 items were about the three constructs of initiation model, nine items were about the three constructs of sustenance model and two items were about the likelihood of one-time initiation and continuation of behavior change with regard to small portion size behavior consumption. A brief description of instrument's constructs (participatory dialogue, behavioral confidence, and changes in physical environment) of initiation and (changes in social environment, practices for change, and emotional transformation) sustenance sub models and their items is provided next and detailed instrument is provided in Appendix A.

Our study's instrument was adapted from the MTM-SPS instrument that was previously used by Sharma et al (2016) in their research for predicting small portion size consumption in college students [5]. This study aimed to collect data from the community where many participants may not have the reading ability like college students, so it was an important need to see that adopted instrument met the criteria. Instrument was found suitable to use in a rural Appalachian population with the Flesch-Kincaid Reading Ease level 80.5 and Flesch-Kincaid Grade level 3.7 which was acceptable for this target audience [31]. Construct validity of both sub-models was calculated by Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's test. For all constructs of initiation model including participatory dialogue disadvantage, $KMO = 0.856$, $X^2 = 1483.29$, $df = 153$, $P < 0.001$ and for all constructs of sustenance model $KMO = 0.809$, $X^2 = 645.66$, $df = 36$, $P < 0.001$ demonstrated high level of construct validity of the instrument. Discriminant validity was computed through the correlational matrix in factor analysis by counting the number of times the item correlates higher with the items of other constructs than items of own construct. If such counts are less than the potential counts than instrument considered to have a higher degree of discriminant validity [32]. Zero occurrence of such an event in our analysis demonstrated that the MTM instrument also had a higher degree of discriminant validity.

To determine the internal consistency of items in each construct, Cronbach's alpha was calculated. The instrument was found highly reliable (see Table 1).

In Table 1, Cronbach's alpha was over 0.80 for four constructs including participatory dialogue advantages, participatory dialogue disadvantages, behavioral confidence, and emotional transformation indicative of high internal consistency reliability. For the remaining three constructs, changes in physical environment, practice for change, and changes in social environment, alpha over 0.75 was also a demonstration of a good internal consistency.

Cronbach's alpha 0.67 for entire scale was also considered acceptable as reported in research [33–34]. Mean score of 12.41 ± 4.4 units of advantages construct was indicative of slight propensity in participants toward eating small portion sizes while the mean score of 7.30 ± 4.06 units for disadvantages indicated that there was room for improvement. The lower mean score of behavioral confidence of 8.95 ± 4.9 units was indicative that participants were moderately sure about eating small portion sizes. Changes in the physical environment mean score 5.96 ± 3.2 units was indicative that participants were moderately sure that changes in the physical environment could lead to small portion size consumption behavior. Mean score of 5.95 ± 3.0 units for emotional transformation construct was indicative that participants had a moderate ability to transform their emotions towards the continuation of small portion size behavior. Practice for change mean score 4.5 ± 3.0 units was indicative that participants were slightly sure about maintaining a record of their small portion size consumption behavior. Changes in social environment mean score of 6.49 ± 3.35 units was indicative that participants were more than moderately sure about taking help from the people in their close network.

Initiation model

Participatory dialogue advantages were measured by asking five questions. Each item was scored on a five-point Likert type scale (0 was 'being never', 1 was 'almost never', 2 was 'sometimes', 3 was 'fairly often', and 4 was 'very often'). Participatory dialogue disadvantages construct similarly had 5 items which were rated the same way. Total scores ranged from 0 to 20 units for both constructs. Participatory dialogue score was computed by subtracting scores of participatory dialogue disadvantages score from participatory dialogue advantages score, which yielded a range of -18 to + 20 units. Remaining two constructs in the initiation model, behavioral confidence had five items and changes in physical environment had three items, which were similarly rated on 0 to 4 point scale (0 was 'not at all sure', 1 was

Table 1. Descriptive statistics and Cronbach's alpha of study variables ($n = 156$).

Constructs	Possible Range	Observed Range	Mean (SD)	Cronbach's alpha
Initiation	0-4	0-4	1.65 (1.26)	
<i>Participatory dialogue: advantages</i>	0-20	0-20	12.41 (4.4)	0.88
<i>Participatory dialogue: disadvantages</i>	0-20	0-20	7.30 (4.06)	0.81
<i>Participatory dialogue: advantages - disadvantages</i>	0-20	-18 - + 20	5.09 (7.2)	
<i>Behavioral confidence</i>	0-20	0-20	8.95 (4.9)	0.88
<i>Changes in physical environment</i>	0-12	0-12	5.96 (3.2)	0.76
Sustenance	0-4	0-4	1.44 (1.24)	
<i>Emotional transformation</i>	0-12	0-12	5.95 (3.0)	0.88
<i>Practice for change</i>	0-12	0-12	4.5 (3.0)	0.75
<i>Changes in social environment</i>	0-12	0-12	6.49 (3.35)	0.78
Entire scale	-	-	-	0.672

'slightly sure', 2 was 'moderately sure', 3 was 'very sure', and 4 was 'completely sure') and they could receive 0 to 20 units score and 0 to 12 units score, respectively (see Appendix A).

Sustenance model

All three constructs of sustenance model, emotional transformation, practice for change, and changes in social environment had three items corresponding to each construct, which were rated on a 0 to 4 point scale (0 was 'not at all sure', 1 was 'slightly sure', 2 was 'moderately sure', 3 was 'very sure', and 4 was 'completely sure') and their score ranged between 0 to 12 units. Remaining two items measured initiation and continuation of behavior by asking 'how likely is that you will eat small portion sizes at every meal in the upcoming week?' for initiation of one-time behavior and 'how likely is that you will eat small portion sizes at every meal from now on?' for sustenance behavior. Similar to other items these items are also rated on a 0 to 4-point scale (0 was 'not at all likely', 1 was 'somewhat likely', 2 was 'moderately likely', 3 was 'very likely', 4 was 'completely likely') and the range was between 0 to 4 units (see Appendix A).

Data analysis

The IBM, Statistical Package for the Social Sciences (SPSS), Version 24 was used for data analyses. Descriptive statistics for demographic and study variables were obtained

by computing frequencies and percentages for categorical variables and means and standard deviations for metric variables. Stepwise multiple regression modeling was employed for inferential statistics. Analysis for initiation and sustenance models were conducted separately. Initiation of small portion and sustenance of small portion size were used as dependent variables for initiation and sustenance model, respectively. The *a priori* criteria of the probability of F to enter the predictor in the model was chosen as less than or equal to 0.05 and for removing the predictor as greater than or equal to 0.10. Female gender and white race were considered reference categories in the analysis.

Ethical approval

The research study was approved by the Berea College Institutional Review Board (IRB). Ethical approval was obtained from the Institutional Review Board (IRB) of the parent institution. All research participants were provided informed consent before taking the survey. In order to maintain anonymity, all identifiable information of the participants was systematically secured and individual responses were pooled together for analysis and reporting.

RESULTS

A total of 286 participants had filled the survey form. Among those only 156 participants met the requisite criteria of age and eating a

Table 2. Demographic characteristics of participants in the study ($n = 156$).

Category		n (%) / Mean ± SD
Age (in years)		39.22 ± 19.02
Gender	Male	63 (40.4%)
	Female	92 (59.0%)
Education	Below high school	4 (2.6%)
	High school	81(51.9%)
	Associate degree	19(12.2%)
	Undergraduate degree	31(19.9%)
	Master degree	13(8.3%)
	Doctorate degree	4(2.6%)
Ethnicity	White	133(85.3%)
	African American	14(9.0%)
	Asian American	1(.6%)
	Hispanic American	2(1.3%)
	others	5(3.2%)
Employed	Yes	96 (61.5%)
	No	60 (38.5%)

Table 3. Initiation of small portion size consumption behavior change based on stepwise multiple regression modeling ($n = 156$).

MTM components	B	SE _B	β	95% CI	P value
Participatory dialogue (advantages outweighing disadvantages)	.028	.013	.158	.002 .054	.033
Behavioral confidence	.096	.022	.374	.053 .138	.000
Changes in physical environment	.119	.032	.291	.056 .181	.000

$F(3, 139) = 44.46, p < 0.001, R^2$ (adj. R^2) = 0.490 (0.479), Durbin Watson = 1.87

DV= initiation of small portion size consumption; B= unstandardized coefficient; β = standardized coefficient; SE_B = standard error of the coefficient; P = significance level; CI = confidence interval

Table 4. Sustenance of small portion size consumption behavior change based on stepwise multiple regression modeling ($n = 156$).

MTM components	B	SE _B	β	95% CI	P value
Emotional transformation	.147	.032	.365	.084 .210	.000
Practice for change	.143	.033	.350	.079 .208	.000

$F(2, 140) = 46.97, p < 0.001, R^2$ (adj. R^2) = 0.402 (0.393), Durbin Watson = 1.77

DV= sustenance of small portion size consumption; B= unstandardized coefficient; β = standardized coefficient; SE_B = standard error of the coefficient; P = significance level; CI = confidence interval

large portion size in the past 24-hour period for inclusion in the analysis. Participants ranged from 18 to 91 years of age. Majority of the respondents were women (59%), white (85.3%), had high school education (51.9%), and were employed (61.5%) (see Table 2).

Table 3 presents the results of stepwise multiple regression for initiation model. Adjusted R^2 indicates that 47.9% of the variance in the initiation of small portion size consumption is explained by the participatory advantage (advantages outweighing disadvantages), behavioral confidence and changes in the physical environment. The Durbin Watson = 1.87 (less than 2) indicates that each construct fits best and contribute towards the initiation of small portion size consumption behavior change. Table 4 presents the results of stepwise multiple regression for sustenance model. Adjusted R^2 indicates that 39.3% of the variance in the sustenance of small portion size consumption is explained by the emotional transformation and practice for change. The Durbin Watson = 1.77 (less than 2) indicates that both constructs fit best and contribute towards the continuation of small portion size consumption behavior. Changes in the social environment did not contribute to the model and neither did the socio-demographic factors age, gender, education, and ethnicity in both the models.

DISCUSSION

The purpose of this study was to use the multi-theory model (MTM) of health behavior change to predict consumption of small portion size behavior among a sample of the rural Appalachians in Kentucky. The findings of this study lend credence to the multi-theory model (MTM) of health behavior change in explaining small portion size consumption behavior in the rural Appalachian sample. It was found that the initiation and continuation of small portion size consumption behavior can be strongly predicted with both sub-models of MTM. For the initiation model, all three proposed constructs, participatory dialogue ($P = 0.033$), behavioral confidence ($P < 0.001$), and changes in physical (P

< 0.001) were found statistically significant. Two constructs, emotional transformation ($P < 0.001$) and practice for change ($P < 0.001$) in sustenance model were found strong predictors of continuation of small portion size consumption behavior in the rural Appalachian sample population. The findings of this study are slightly consistent with a previous study in college students [5]. In the referred study, participatory dialogue (advantages outweighing disadvantages) and behavioral confidence constructs were strong predictors for initiation models and emotional transformation and changes in the social environment for sustenance model [5]. Changes in the physical environment and practice for change were found significant in the current study but are inconsistent with the previous study in college students [5]. Age and gender (male) for initiation and white race for sustenance model were found inconsistent with the findings of the previous study in college students [5]. Compared to college students, residents in rural Appalachia have shown a stronger likelihood for change in physical environment and practice for change. This demonstrates an additional strength in rural Appalachian residents compared to young college population, which can be reinforced to increase the likelihood of healthy behavior change of small portion size consumption behavior. It also indicates that rural Appalachian people may be aware of negative health outcomes of obesity and therefore they are more willing to take control of their physical environment and also practice for change. The analysis indicates that dwellers in rural Appalachian do not seek changes in the social environment. It could be because most of this population is employed and have more responsibilities than the college population. Also, college students are easily affected in their food choices by their peers, while adults are more set in their eating patterns and if the change has to take place it is not that much affected by support from others. Reinforcing change in social environment may not add toward behavior change in this population. Social reinforcement has been found very

powerful in shaping an individual's behavior. However, social reinforcement operates with a unique neural system [35]. It gets weaker as an individual grows in age. Study population being close to middle age (39.22 ± 19.02 years) may not be neurologically as receptive like college population for social reinforcement. It is possible due to fact that our nervous system starts responding slower with age [36–37]. Lower mean scores for initiation (1.65 ± 1.26 units) and sustenance (1.44 ± 1.24 units) models indicate that people in sample population were only somewhat likely to initiate and continue behavior change for small portion size consumption and there was a need for interventional support. Relatively, low scores for sustenance indicate that even if the behavior was to be initiated it had a much lower chance of being continued. These findings accentuate the need for developing an intervention for rural Appalachian residents based on MTM.

The study limitations

Being a cross-sectional research design, it is not possible to establish a causative relationship between putative constructs and the target behavior. A convenience quota sample also poses its own limitation. The findings of this study are limited to the ARC counties of Kentucky. Southern Appalachian regions have a larger population of African Americans where a very small representation of the African American population (9%) in this

research limits its generalizability. Self-reported data in this research have a higher chance of being affected with the participant's recall, under, and over reporting biases.

Implications for practice

The research findings of this study strongly demonstrate the applicability of MTM in developing small portion size consumption behavior change in rural Appalachian population. Strategies such as one-on-one counseling and group counseling for participatory dialogue and behavioral confidence can be used. For intervening in areas of behavioral confidence, incremental steps can be suggested, and reward system can be applied. Emotional transformation is highly crucial in shaping and maintaining a behavior change. For that two-way communication, the approach should be applied where moderator provides enabling guidance that helps individuals in channelizing negative emotional energy towards the goal. Overall intervention designed on MTM framework can successfully promote small portion size consumption behavior and address the risk of obesity in the population.

Acknowledgments

We sincerely thank to Berea College for funding this research and to all participants for their participation and experts for providing their inputs for validating the instrument.

Appendix A. Multi-theory Model for Small Portion Size (MTM-SPS).

MEASURING CHANGE IN PORTION SIZE QUESTIONNAIRE
IRB # _____

Multi-Theory Model for Small Portion Size (MTM-SPS)

Directions: This survey is voluntary, which means you may choose not to complete it or not to answer individual questions. There is no direct benefit of this survey to you. All data from this survey will be anonymous and kept secret. Your responses will help in developing effective nutrition education programs. Please put an X mark by the response or fill the response that correctly describes your position. Thank you for your help!

1	During the past 24 hours what was the size of the meals that you consumed in your self- assessment?						
Meal	Did not consume	Small portion (1/4 dinner plate)	Average portion size (1/2 dinner plate)	Large portion size (full dinner plate)			
Breakfast							
Lunch							
Dinner							
Snacks (Combined for whole day)							
Any additional meals							
If you did not mark any LARGE portion size for any of the meals above, then you can STOP taking this questionnaire. Thank you for your time.							
2	How to you identify yourself?	Male	Female	Other			
3	How old are you today?						
4	What is your race/ethnicity?	White or Caucasian American	Black or African American	Asian American	American Indian	Hispanic American	Other
5	Where do you live (name of the town)?						
6	Do you work?	No	Yes _____ hours/week (put a single number not a range)				
7	Which is your highest education?	Below high school	High school	Associate degree	Under-graduate degree	Master degree	Doctorates / professional degree
<i>Participatory dialogue: Advantages</i>							
	If you consume a small portion size at every meal you will...	Never	Almost never	Sometimes	Fairly often	Very often	
8be healthy						
9be relaxed						
10manage your weight						
11have more energy						
12enjoy more life						
<i>Participatory Dialogue: Disadvantages</i>							
	If you consume a small portion size at every meal you will.....	Never	Almost never	Sometimes	Fairly often	Very often	
13	..feel hungry						
14	..be hungry most of the time						
15	...have less energy						
16	...get sick						
17have less enjoyment						
<i>Behavioral confidence</i>							
	How sure are you that you will consume a small portion size in every meal....	Not at all sure	Slightly sure	Moderately sure	Very sure	Completely sure	
18 this week?						

19	... this week while finding time to complete all academic/work-related tasks?						
20	...this week while finding time for leisure?						
21	...this week without feeling tired?						
22 this week without feeling hungry?						
Changes in physical environment							
How sure are you that you will....							
23	...this week?						
24	...this week while finding time to complete all academic/work-related tasks?						
25	..this week while finding time for leisure?						
Emotional transformation							
..... How sure are you that you can							
26	...direct your emotions/feelings to the goal of eating small portion sizes at every meal?						
27motivate yourself to eat small portion sizes at every meal?						
28	...overcome self-doubt in accomplishing the goal of eating small portion sizes at every meal?						
Practice for change							
..... How sure are you that you can...		Not at all sure	Slightly sure	Moderately sure	Very sure	Completely sure	
29	...keep a self-diary to monitor eating small portion sizes at every meal?						
30	...be able to eat small portion sizes at every meal if you encounter barriers?						
31	..change your plan for eating small portion sizes at every meal if you face difficulties?						
Changes in social environment							
How sure are you that you can get the help of a..							
	..family member to support you with eating small portion sizes at every meal?						
	..friend to support you with eating small portion sizes at every meal?						
	...health professional to support you with eating small portion sizes at every meal?						
Behavior change: Initiation							
How likely is it that you will...		Not at all likely	Slightly likely	Moderately likely	Very likely	Completely likely	
35	..eat small portion sizes at every meal in the upcoming week.						
Behavior change: Sustainance							
How likely is it that you will...							
36	..eat small portion sizes at every meal from now on.						

Thank you for your time!

SCORING

Construct of advantages: Scale: Never (0), Almost never (1), Sometimes (2), Fairly often (3), Very often (4). Summative score of Items 9-13. Possible range: 0- 20. High score associated with likelihood of initiation of behavior change.

Construct of disadvantages: Scale: Never (0), Almost never (1), Sometimes (2), Fairly often (3), Very often (4). Summative score of Items 14-18. Possible range: 0- 20. Low score associated with likelihood of initiation of behavior change.

Subtract disadvantages score from advantages score to calculate participatory dialogue construct score. Positive score will be indicative of behavior change.

Construct of behavioral confidence: Scale: Not at all sure (0), slightly sure (1), moderately sure (2), very sure (3), completely sure (4). Summative score of Items 19-23. Possible range 0-20. High score associated with likelihood of initiation of behavior change.

Construct of changes in physical environment: Scale: Not at all sure (0), slightly sure (1), moderately sure (2), very sure (3), completely sure (4). Summative score of Items 24-26. Possible range 0-12. High score associated with likelihood of initiation of behavior change.

Construct of emotional transformation: Scale: Not at all sure (0), slightly sure (1), moderately sure (2), very sure (3), completely sure (4). Summative score of Items 27-29. Possible range 0-12. High score associated with likelihood of sustenance of behavior change.

Construct of practice for change: Scale: Not at all sure (0), slightly sure (1), moderately sure (2), very sure (3), completely sure (4). Summative score of Items 30-32. Possible range 0-12. High score associated with likelihood of sustenance of behavior change.

Construct of changes in social environment: Scale: Not at all sure (0), slightly sure (1), moderately sure (2), very sure (3), completely sure (4). Summative score of Items 33-35. Possible range 0-12. High score associated with likelihood of sustenance of behavior change.

For modeling initiation dependent variable can be Item 36: not at all likely (0), somewhat likely (1), moderately likely (2), very likely (3), and completely likely (4) and multiple regression can be used. For modeling sustenance dependent variable can be Item 37: not at all likely (0), somewhat likely (1), moderately likely (2), very likely (3), and completely likely (4) and multiple regression can be used.

Flesch Reading Ease 80.5 Flesch-Kincaid Grade Level 3.7

References

1. Hakkak R, Bell A. Obesity and the link to chronic disease development. *J Obes Chronic Dis.* 2016;1(1):1–3. doi: 10.17756/jocd.2016-001.
2. Hall ME, do Carmo JM, da Silva AA, Juncos LA, Wang Z, Hall JE. Obesity, hypertension, and chronic kidney disease. *Int J Nephrol Renovasc Dis.* 2014;7:75–88.
3. Livingstone MBE, Pourshahidi LK. Portion size and obesity. *Adv Nutr.* 2014;5(6):829–834. <https://doi.org/10.3945/an.114.007104>.
4. Volkow ND, Wang GJ, Tomasi D, Baler RD. The addictive dimensionality of obesity. *Biol Psychiatry.* 2013;73(9):811–818. <https://doi.org/10.1016/j.biopsych.2012.12.020>.
5. Sharma M, Catalano HP, Nahar VK, Lingam V, Johnson P, Ford MA. Using multi-theory model to predict initiation and sustenance of small portion size consumption among college students. *Health Promot Perspect.* 2016;6(3):137–144. doi: 10.15171/hpp.2016.22.
6. Vernarelli JA, Mitchell DC, Rolls BJ, Hartman TJ. Dietary energy density and obesity: how consumption patterns differ by body weight status. *Eur J Nutr.* 2018;57(1):351–361. doi: 10.1007/s00394-016-1324-8.
7. The Appalachian Region (ARC) [cited 2018 Dec 15]. Available from: https://www.arc.gov/appalachian_region/TheAppalachianRegion.asp
8. The state of obesity web, <https://stateofobesity.org/states/ky/>.
9. Herath J, Brown C. An analysis of adult obesity and hypertension in appalachia. *Glob J Health Sci.* 2013;5(3):127–138. doi: 10.5539/gjhs.v5n3p127.
10. Wewers ME, Katz M, Paskett ED, Fickle D. Peer Reviewed: Risky Behaviors Among Ohio Appalachian Adults. *Prev Chronic Dis.* 2006;3(4):A127.
11. Glanz K, Bishop DB. The role of behavioral science theory in development and implementation of public health interventions. *Annu Rev Public Health.* 2010;31:399–418.
12. Sharma M, Romas JA. Theoretical foundations of health education and health promotion. Burlington, MA: Jones & Bartlett Publishers; 2011.
13. Sharma M. Multi-theory model (MTM) for health behavior change. *Webmed Central Behaviour.* 2015;6:WMC004982.
14. Bandura A. Human agency in social cognitive theory. *Am Psychol.* 1989;44(9):1175–1789.
15. Ajzen I. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior. *J Appl Soc Psychol.* 2002;32(4):665–683. <https://doi.org/10.1111/j.1559-1816.2002.tb00236.x>.
16. Glass TA, McAtee MJ. Behavioral science at the crossroads in public health: extending horizons, envisioning the future. *Soc Sci Med.* 2006;62(7):1650–1671.
17. Ammerman AS, Lindquist CH, Lohr KN, Hersey J. The efficacy of behavioral interventions to modify dietary fat and fruit and vegetable intake: a review of the evidence. *Prev Med.* 2002;35(1):25–41.
18. Nahar VK, Sharma M, Catalano HP, Ickes MJ, Johnson P, Ford MA. Testing multi-theory model (MTM) in predicting initiation and sustenance of physical activity behavior among college students. *Health Promot Perspect.* 2016;6(2):58–65. doi: 10.15171/hpp.2016.11.
19. Sharma M, Stephens PM, Nahar VK, Catalano HP, Lingam VC, Ford MA. Using a Multitheory Model to Predict Initiation and Sustenance of Fruit and Vegetable Consumption Among College Students. *J Am Osteopath Assoc.* 2018;118(3):507–517. doi: 10.15171/hpp.2016.22.
20. Sharma M, Catalano HP, Nahar VK, Lingam VC, Johnson P, Ford MA. Applying multi-theory model (MTM) of health behavior change to predict water consumption instead of sugar-sweetened beverages. *J Res Health Sci.* 2017;17(1):e00370.
21. Knowlden AP, Sharma M, Nahar VK. Using multitheory model of health behavior change to predict adequate sleep behavior. *Fam Community Health.* 2017;40(1):56–61.

22. Martin B, Nahar VK, Boyas JF, Jacks SK, Brodell RT, Sharma M. Future Application of Multitheory Model of Health Behavior Change for Skin Cancer Prevention Behaviors. *J Dermatol Nurses Assoc.* 2017;9(5):243–247. doi: 10.1097/JDN.0000000000000332.
23. Nahar VK, Hosain A, Sharma M, Jacks SK, Brodell RT. Need for primary prevention for skin cancers in Iran. *J Res Health Sci.* 2016;16(3):170–171.
24. Sharma M, Chizoba A, Kim RW, OMS I, Nahar VK, Ford MA. Predictors of Responsible Drinking or Abstinence Among College Students Who Binge Drink: A Multitheory Model Approach. *J Am Osteopath Assoc.* 2018;118(8):519–530. doi:10.7556/jaoa.2018.120.
25. Sharma M, Knowlden AP, Nahar VK. Applying a new theory to alter binge drinking behavior in college students. *Fam Community Health.* 2017;40(1):52–55. Doi: 10.1097/FCH.0000000000000136.
26. Patel F, Kim RW, Ghafari G, Dietz B, Nahar VK, Sharma M. Predicting initiation and sustenance to smoking cessation among smokers using multi-theory model (MTM) approach. *Cancer Res.* 2018;78(13):5280. doi: 10.1158/1538-7445.AM2018-5280.
27. Sharma M, Nahar VK. New approach for promoting HPV vaccination in college men based on multi-theory model (MTM) of health behavior change. *J Prev Med Hyg.* 2017;58(3):E203–E210.
28. Sharma M, Nahar VK. Promoting physical activity in upper elementary children using multi-theory model (MTM) of health behavior change. *J Prev Med Hyg.* 2018;59(4):267–276. doi: <http://dx.doi.org/10.15167/2421-4248/jpmh2018.59.4.847>.
29. Kim RW, Stephens PM, Nahar VK, Sharma M. Influencing Health Behavior Change Related to Musculoskeletal Conditions: The Need to Expand the Evidence Base and the Case for Multitheory Model. *Am J Phys Med Rehabil.* 2018;97(12):933–934. doi: 10.1097/PHM.0000000000000968.
30. Martin B, Wilkerson AH, Patterson G, Nahar VK, Sharma M. Need for addressing oral health disparities in rural Appalachia. *Health Promot Perspect.* 2017;7(4):178–180. doi: 10.15171/hpp.2017.32.
31. Faul F, Erdfelder E, Lang AG, Buchner A. G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods.* 2007;39(2):175–191.
32. Sharma M, Petosa RL. *Measurement and Evaluation for Health Educators.* Burlington, MA: Jones & Bartlett Learning; 2014.
33. Campbell DT, Fiske DW. Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychol Bull.* 1959;56(2):81–105. <http://dx.doi.org/10.1037/h0046016>.
34. Tavakol M, Dennick R. Making sense of Cronbach's alpha. *Int J Med Educ.* 2011;2:53–55. doi: 10.5116/ijme.4dfb.8dfd.
35. Spiliotopoulou G. Reliability reconsidered: Cronbach's alpha and paediatric assessment in occupational therapy. *Aust Occup Ther J.* 2011;56(3):150–155. doi: 10.1111/j.1440-1630.2009.00785.x.
36. Jones RM, Somerville LH, Li J, Ruberry EJ, Libby V, Glover G, et al. Behavioral and neural properties of social reinforcement learning. *J Neurosci.* 2011;31(37):13039–13045. doi: <https://doi.org/10.1523/JNEUROSCI.2972-11.2011>.
37. Glisky EL. Changes in cognitive function in human aging. In: Riddle DR (eds) *Brain aging: Models, Methods, and Mechanisms.* Boca Raton, FL. Taylor & Francis; 2007. p. 1-20.
38. Ingall TJ, McLeod JG, O'Brien PC. The effect of ageing on autonomic nervous system function. *Aust N Z J Med.* 1990;20(4):570–577.

