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Application of the Transtheoretical Model to Fruit and Vegetable Consumption Among Economically Disadvantaged African-American Adolescents: Preliminary Findings

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Abstract

Purpose—To examine the application of the transtheoretical model (TTM) to fruit and vegetable consumption among economically disadvantaged African-American adolescents.

Methods—Scales for measuring decisional balance, situational self-efficacy, and processes of change for fruit and vegetable consumption were developed and pretested with 57 economically disadvantaged African-American adolescents. The scales and measures for assessing stages of change, demographic variables, and fruit and vegetable consumption were administered to a separate sample of 262 participants. T-tests for independent samples and analysis of variance were used to examine differences in TTM variables and fruit and vegetable consumption across stages of change.

Results—Two-factor solutions for decisional balance and processes of change and a three-factor solution for situational self-efficacy provided the best fit to the data. Alpha coefficients of reliability for the scales ranged from .77 (experiential change processes) to .91 (pros). Participants in action-maintenance stages evidenced higher pros, self-efficacy, and fruit and vegetable consumption and significantly lower cons than did participants in precontemplation and contemplation-preparation stages. Also, participants in action-maintenance stages used processes of change more frequently than did those in precontemplation-contemplation-preparation stages. The use of experiential and behavioral processes within these stages did not differ significantly, as posited.

Discussion—Observed differences in TTM variables and fruit and vegetable consumption by stage of change in this sample of economically disadvantaged African-American adolescents were consistent with theory and previous applications of the model to fruit and vegetable consumption in adults. With replication studies, the TTM may be appropriate for designing interventions to increase fruit and vegetable consumption among this population.

Keywords

Cancer Prevention; Fruit and Vegetable Consumption; Transtheoretical Model; African-Americans; Adolescents; Prevention Research. Manuscript format: research; Research purpose: instrument development; modeling/relationship testing; descriptive; Study design: nonexperimental; Outcome measure: cognitive; behavioral; Setting: local community; Health focus: nutrition; Target population: youth; Target population circumstances: education/income level, race/ethnicity

INTRODUCTION

There is substantial epidemiological evidence of a protective role for fruit and vegetable consumption in the prevention of cancer.¹ Studies show that African-Americans have lower fruit and vegetable intake than do non-Hispanic whites, Hispanics, and individuals of other ethnic-racial origins, and, like other U.S. ethnic-racial groups, their average intake decreases with income.² As might be expected, African-Americans have a higher incidence rate for all cancer sites combined than do persons of any other racial or ethnic group.³ Given their higher cancer incidence and lower intake of fruits and vegetables, economically disadvantaged African-Americans may benefit from intervention to increase their fruit and vegetable consumption. Programs for adolescents hold the promise of establishing healthy eating habits that may persist into adulthood.⁴

Developing such programs requires the identification of theories that inform understanding of the process of health-behavior change. The transtheoretical model (TTM) provides an integrative framework for understanding this process.⁵ The model is composed of four constructs: (1) *stages of change*, the temporal readiness to modify health behavior; (2) *decisional balance*, the relative importance of the perceived pros and cons of change; (3) *situational, self-efficacy*, confidence in one's ability to modify behavior across positive social, negative affect, and difficult situations; and (4) *processes of change*, the experiential and behavioral strategies individuals use to progress through the stages of change.

According to the TTM, health behavior change involves progression through five stages: (1) *precontemplation*, no intention of changing behavior in the foreseeable future (defined as the next 6 months); (2) *contemplation*, intending to change within the next 6 months; (3) *preparation*, intending to change within the immediate future (defined as the next month); (4) *action*, behavior change has been made within the past 6 months; and (5) *maintenance*, changes have been made and sustained for 6 months or longer.⁵ Longitudinal studies from the Cancer Prevention Research Center at the University of Rhode Island have determined that the cons outweigh the pros in precontemplation; the reverse is true in action and maintenance, with the crossover occurring in contemplation or preparation, depending on the behavior studied.⁶ Dietary applications of the TTM have found individuals in action and maintenance stages to have higher self-efficacy than those in preaction stages of change.^{6,7} A meta-analysis of cross-sectional studies assessing relationships among stages and processes of change revealed that experiential and behavioral processes increase together across the stages of dietary behavior change.⁸ An examination of the use of change processes across nine problem areas found that experiential processes were used more in the earlier stages (precontemplation through preparation), whereas behavioral processes were used more in later stages of change (action and maintenance).⁹

The TTM has been effective in predicting and promoting fruit and vegetable consumption in diverse adult populations.¹⁰⁻¹⁷ Applications of the model to adult fruit and vegetable consumption have shown stage of change to be a significant predictor of intake.¹⁰⁻¹⁴

Moreover, stage-tailored interventions have been effective in increasing fruit and vegetable consumption and promoting forward movement through successive stages of change.^{15–17} Although the TTM has advanced research and practice for adult fruit and vegetable consumption, applications of the model to fruit and vegetable consumption among African-Americans¹⁸ and adolescents^{19,20} are few. The present study was designed to examine the application of the TTM to fruit and vegetable consumption among economically disadvantaged African-American adolescents. The aim was to determine if relationships between TTM variables and fruit and vegetable consumption reported in previous studies with adults would be observed in this sample.

For accomplishing this aim, scales for measuring the decisional balance, situational self-efficacy, and processes of change TTM constructs among economically disadvantaged African-American adolescents were developed. The scales and measures for assessing stages of change, demographic variables, and fruit and vegetable consumption were administered to a sample of 262 economically disadvantaged African-American adolescents. Data provided by participants were used to determine the measurement structure and internal consistency reliabilities of the scales and to assess the relationships between TTM variables and fruit and vegetable consumption.

METHODS

Design

Focus groups and pilot-testing procedures with a convenience sample of 57 economically disadvantaged African-American adolescents were used to develop and pretest scales for measuring decisional balance, situational self-efficacy, and processes of change for fruit and vegetable consumption. A separate sample of 262 youths completed a cross-sectional survey composed of the scales and measures for assessing demographic variables, stages of change, and fruit and vegetable consumption. Data provided by the sample of 262 participants were used to determine the measurement structure and internal consistency reliabilities of the scales and to assess the relationships between TTM variables and fruit and vegetable consumption.

Sample

Selection criteria for study participation included African-American adolescents aged 11 to 14 years enrolled in youth services agencies serving low-income communities in greater New York City. To be eligible, adolescents were required to provide assent and obtain written permission from one of their parents or legal guardians to participate in the study, which was approved by the Internal Review Board of Intersystems Incorporated. Of the 319 adolescents who were eligible, 57 participated in focus groups and pilot-testing procedures. The remaining 262 completed the cross-sectional survey (65% girls; mean age = 12.21 years, SD = 1.33).

Measures

Decisional Balance, Situational Self-efficacy, and Processes of Change—

Scales for measuring decisional balance, situational self-efficacy, and processes of change for fruit and vegetable consumption were constructed using the sequential steps outlined by Spector.²¹ Each construct was defined, and initial item pools were written. Focus groups were conducted with 48-youths to examine the relevance and exhaustiveness of scale items. The scales were revised based on the feedback provided.

In a three-step process, a separate sample of nine youths was used to pilot test the measures. First, the youths reviewed each scale and identified items that were unclear. Second,

cognitive testing was performed. Items were orally reviewed, and youths were asked to state, in their own words, what each question meant. The staff recorded whether youths understood the item as written, and, if not, explained the intended meaning. Youths provided suggestions for improving the wording and content of questions. Third, respondents rated the relevance of items on a five-point scale ranging from irrelevant (1) to very relevant (5). The scales were refined based on this feedback.

Stages of Change and Fruit and Vegetable Consumption—The staging measure and algorithm developed by the National Cancer Institute was used to assess respondents' stage of change for fruit and vegetable consumption.²² The validity of this measure and algorithm is supported by the consistent differences in fruit and vegetable consumption among persons classified into different stages of change.²³ Fruit and vegetable consumption was measured by self-report using the first item in the staging measure. Response options included seven categories with a range from 0 to 11 servings. For data analysis purposes, fruit and vegetable consumption was converted to a continuous variable by assigning participants the midpoint of the range of values corresponding to their original response choice.

Analysis

Principal components analysis was used to examine the measurement structure of the scales. The number of components to retain was based on scree criteria²⁴ and interpretability. From previous research based on the TTM,^{25–27} two-factor solutions for decisional balance (pros, cons) and processes of change (experiential, behavioral) and a three-factor solution for situational self-efficacy (positive social, negative affect, difficult) were anticipated. Items were considered to represent a component if they achieved factor loadings at or above .50. Internal consistency reliability analyses were performed for each scale component. Items with item-total correlations at or below .40 were deleted.

Descriptive statistics were used to generate a demographic profile of respondents and to examine their stage distribution and fruit and vegetable consumption. Univariate analysis of variance (ANOVA) with Tukey HSD post hoc test was used to examine differences in fruit and vegetable consumption, decisional balance, and situational self-efficacy by stage of change. For fruit and vegetable consumption, the homogeneity of variance assumption was violated; therefore, the Brown-Forsythe *F*-test with Games-Howell post hoc test was used to examine differences in intake by stage of change. To compare the use of change processes across earlier and later stages, precontemplation and contemplation-preparation stages were combined. For determining if the use of experiential and behavioral change processes differed across stages, difference scores were computed by subtracting respondents' behavioral scores from their experiential scores. Differences in action-maintenance and precontemplation-contemplation-preparation stages were examined with two-tailed *t*-tests for independent samples. A .05 significance level was used in this study.

RESULTS

Item Analysis

Two-factor solutions for decisional balance and processes of change and a three-factor solution for situational self-efficacy provided the best fit to the data. Factor-based scores were computed by summing items in each component. This procedure resulted in composite positive social, negative affect, and difficult self-efficacy scores; pro and con decisional balance scores; and experiential and behavioral processes of change scores, with higher scores indicative of greater self-efficacy, pros, cons, and use of change processes. Self-efficacy composites were summed to derive an overall self-efficacy score. To facilitate

comparisons with previous studies based on the TTM, raw scores were converted to standard *t*-test scores (mean = 50, SD = 10). Items, factor loadings, and alpha coefficients of reliability for the decisional balance, situational self-efficacy, and processes of change scales are shown in Table 1.

Stage Distribution and Fruit and Vegetable Consumption

Youths were distributed predominantly across precontemplation (20%) and preparation (58%) stages of change. For data analysis purposes, contemplation was combined with preparation and action was combined with maintenance. According to the revised classification, the largest proportion of youths was in the contemplation-preparation stage (63%), followed by precontemplation (20%) and action-maintenance (17%) stages. Participants' mean (SD) level of consumption was 2.93 (2.32) servings. Less than one-fifth (17%) of participants consumed the recommended five daily servings of fruits and vegetables.

Relationships Among TTM Variables

Participants in earlier stages of change evidenced lower experiential and behavioral processes of change scores ($t_{260} = 3.43, p < .001$) than did participants in action-maintenance stages ($t_{260} = 3.67, p < .001$). In earlier stages of change, a positive difference score (indicative of greater use of experiential vs. behavioral change processes) was observed; the reverse was true in later stages. Differences in the use of experiential and behavioral change processes among youths in the groups were not significant ($t_{260} = .22, p = .823$).

A significant effect for stages of change was observed for pros ($F_{2,259} = 3.18, p < .05$), cons ($F_{2,230} = 3.20, p < .05$), self-efficacy ($F_{2,259} = 5.85, p < .01$), and fruit and vegetable consumption ($F_{2,70} = 199.49, p < .001$). Post hoc analyses revealed that participants in action-maintenance stages perceived significantly fewer cons and more pros to increasing their consumption than did participants in contemplation-preparation and precontemplation stages, respectively. Adolescents in action-maintenance stages evidenced significantly higher self-efficacy and consumption than did participants in precontemplation and contemplation-preparation stages. *t*-test and ANOVA results for TTM variables and fruit and vegetable consumption by stages of change are shown in Table 2.

DISCUSSION

Summary

The purpose of this study was to determine if relationships between TTM variables and fruit and vegetable consumption reported in previous research with adults would be observed in this sample of economically disadvantaged African-American adolescents. To examine these relationships, scales for measuring decisional balance, situational self-efficacy, and processes of change for fruit and vegetable consumption, among this population were developed. The scales evidenced acceptable internal consistency reliabilities, with alpha coefficients ranging from .77 to .91.²¹ These coefficients are within the range of coefficients reported for pros, cons, self-efficacy, and processes of change measures developed for adults.^{7,10,28}

Findings from analyses of the relationships between TTM variables and fruit and vegetable consumption replicate and extend those from previous applications of the model to adult fruit and vegetable consumption. As is true for adults, participating youths in action-maintenance stages had higher fruit and vegetable consumption than did those in preaction stages of change.¹⁰⁻¹⁴ Moreover, they evidenced higher pros and self-efficacy than did

individuals in precontemplation stages and lower cons than did those in contemplation-preparation stages, which is also consistent with previous research.^{11,18,28} Youths' higher use of change processes in later vs. earlier stages of change was consistent with the TTM. However, findings are not directly comparable with those from previous studies of processes of change for fruit and vegetable consumption. The limited studies conducted to date have examined the use of individual change processes across stages of change.^{10,29} In one study, individuals in action-maintenance stages evidenced greater use of all processes studied than did respondents in precontemplation stages.¹⁰ A separate study found that participants in a combined precontemplation-contemplation stage used significantly less of any change process than did those in preparation or action-maintenance stages.²⁹ Despite differences in the measurement of processes of change for fruit, and vegetable consumption, the consistency of observed findings with those reported in previous studies based on the TTM affords us confidence that, as in adults, youths' use of experiential and behavioral processes is higher in later vs. earlier stages of change. The use of experiential and behavioral change processes within stages did not differ as posited by the TTM.⁹ Additional research using composite experiential and behavioral processes of change measures is needed to determine if the differential use of these processes reported in studies of problem behaviors⁹ also occurs in individuals endeavoring to undertake dietary behavior change. Moreover, studies of individual change processes are needed to determine which processes are required for adolescents to progress to long-term maintenance for consuming five or more daily servings of fruits and vegetables.

Limitations

The use of a self-selected sample restricts the external validity of this study and may have led to biased results. Quite possibly, respondents in action-maintenance stages were more motivated to consume fruits and vegetables than were typical African-American adolescents in this stage. Although relationships among TTM variables were consistent with theory, causal relationships cannot be inferred because of the cross-sectional nature of this study. The staging algorithm used in this study does not follow the classic TTM paradigm for staging populations in preaction stages of change. According to the classic paradigm, individuals are classified in preaction stages if they are not at criterion (e.g., not eating five daily servings of fruits and vegetables) and are not intending to be at criterion in the foreseeable future (precontemplation) or are intending to be at criterion within the next 6 months (contemplation) or within the next month (preparation). The algorithm used in this study classified individuals in preaction stages if they were not at criterion, were not intending to eat *more* servings of fruits and vegetables in the foreseeable future (precontemplation), or were intending to eat more servings of fruits and vegetables within the next 6 months (contemplation) or within the next month (preparation). The approach used may lead to less of an increase in consumption of fruits and vegetables, because individuals simply have to increase their consumption by any amount to be successful. The classic approach encourages them to progress toward five daily servings of fruits and vegetables, which is clearly a higher expectation than encouraging any increase at all. Future research should examine the practical advantages and disadvantages of using the National Cancer Institute's algorithm vs. an algorithm based on traditional TTM criteria.

Implications

This is one of the first studies to examine the application of the TTM to fruit and vegetable consumption among economically disadvantaged African-American adolescents. Similarities with findings from previous studies of adolescents include differences in fruit and vegetable consumption, cons, and self-efficacy between participants in action stages and those in precontemplation-contemplation stages¹⁹; the concentration of youths in precontemplation-contemplation stages, followed by precontemplation and action-

maintenance stages²⁰; and the small proportion of youths found to be meeting current dietary recommendations for fruit and vegetable intake.³⁰ There is a tremendous need for interventions to increase fruit and vegetable consumption among this population. That most participants were in contemplation-preparation stages suggests that, temporally, they are prepared to take action to improve their diets in the near future and are therefore ready for intervention. Health professionals designing programs to increase fruit and vegetable consumption among this population should address the lower pros and self-efficacy for change and higher cons of change characteristic of youths in this stage. Although the TTM suggests that youths in preaction stages of change can benefit, from exposure to experiential vs. behavioral change strategies for modifying their dietary behavior, conclusions regarding which strategies are effective in promoting forward movement to action-maintenance among economically disadvantaged African-American adolescents must await further research.

A difference between this study and those from a previous study of adolescents¹⁹ is the higher fruit, and vegetable consumption observed among participants in action-maintenance stages. The mean (SD) value in our sample of 7.28 (2.15) was fourfold higher than the mean (SD) fruit and juice intake of 1.78 (1.38) and mean (SD) vegetable intake of 1.55 (1.34) reported in a predominantly white sample of similarly staged 9- to 12-year-old girls.¹⁹ Observed intake was similar, however, to the mean (SD) reported intake of 6.50 (0.13) in a sample of rural African-American adults in action-maintenance stages.¹⁸ Future research with representative samples of adolescents should confirm the presence of ethnic-racial differences in intakes among adolescents in action-maintenance stages and identify factors that may account, for such differences.

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Table 1

Items, Factor Loadings, and Alpha Coefficients of Reliability for the Decisional Balance, Situational Self-efficacy, and Processes of Change Scales

Scale/Items	Factor Loading
Decisional balance	
Pros ($\alpha = 0.91$)	
Eating fruits and vegetables could help me improve my strength	0.727
Fruits and vegetables are good for my body	0.719
Eating five or more servings of fruits and vegetables per day could help cleanse my system	0.714
Eating five or more servings of fruits and vegetables per day could help me have better overall health	0.697
Fruits and vegetables provide nutrients that I need to be healthy	0.666
Eating fruits and vegetables could help me live a better, healthier, and longer life	0.661
I would feel good about myself if I ate the suggested five or more daily servings of fruits and vegetables	0.659
I would have more energy if I ate fruits and vegetables regularly	0.633
Eating five or more servings of fruits and vegetables per day could help me prevent cancer	0.608
By trying fruits and vegetables that I have never had before, I could learn about which ones I like/dislike	0.592
Eating fruits and vegetables regularly could help me prevent disease	0.591
Eating fruits and vegetables each day could help me feel better about my life	0.583
Eating fruits and vegetables could help me lose weight or maintain my weight	0.576
Eating fruits and vegetables regularly could help me have clear skin	0.568
Fruits and vegetables are low in fat	0.552
Fruits and vegetables are a good substitute for junk food	0.546
Eating more fruits and vegetables could help me look better	0.537
There are many different fruits and vegetables to choose from	0.507
Cons ($\alpha = 0.85$)	
It takes too much time to prepare fruits and vegetables	0.667
Not knowing how to prepare certain fruits and vegetables stops me from eating more of them	0.665
It is too much trouble to buy fruits and vegetables that I want to eat	0.644
Fruits and vegetables that I enjoy are unavailable at home	0.621
The changing tastes of fruits and vegetables stop me from eating more of them	0.619
Lack of variety of fruits and vegetables (at home or in school) makes it hard to eat more of them	0.605
Fruits and vegetables are too expensive to buy	0.605
Fruits and vegetables that I enjoy are not available at school or other places where I eat out	0.595
Fruits and vegetables make me full too fast	0.574
Fruits and vegetables give me gas	0.542
It is too difficult to eat five or more servings of fruits and vegetables each day	0.531
Fruits and vegetables that I like are available only at certain times of the year	0.531
Some fruits and vegetables (onions, garlic) give me bad breath	0.501
Situational self-efficacy ($\alpha = .86$)	
Positive social ($\alpha = 0.74$)	
At a family gathering where many fruits and vegetables are being served	0.788
With grandparents, aunts, uncles, cousins and other family members and everyone is enjoying fruits and vegetables	0.750

Scale/Items	Factor Loading
At home, when enjoying the company of friends and family	0.678
When having a good time with others at a picnic or barbeque	0.645
Negative affect ($\infty = 0.85$)	
When I am sad or down	0.720
When I have had a bad day and am not feeling good about myself	0.710
When I have an argument with someone close to me and feel upset	0.693
When I am angry (or irritable)	0.683
When I am doing poorly in school and feel worried or upset	0.678
When I am nervous	0.611
On days when things are not going my way and I feel frustrated	0.586
When having friendship or relationship problems and feeling sad	0.577
Difficult situations ($\infty = 0.70$)	
When I am sick and do not feel like eating	0.719
At home, when there are no fruits and vegetables in the refrigerator	0.657
After dinner, when I am too full to eat	0.625
When I am hungry but feel too lazy to prepare a fruit or vegetable	0.611
At school, when there are no fruits and vegetables in the cafeteria	0.576
Processes of Change	
Experiential ($\infty = 0.77$)	
I would set a good example for others to follow if I ate fruits and vegetables regularly	0.690
I find the world changing in ways that make it easier to eat healthfully	0.645
I am thinking about the idea that eating five or more servings of fruits and vegetables a day could make me a healthier, happier person to be around	0.626
I remember what people tell me about the benefits of eating fruits and vegetables	0.608
Rather than thinking about eating fruits and vegetables as a chore, I try to think about eating them as something that I'm doing for myself	0.590
I remind myself that only I can decide whether or not I will eat five servings of fruit and vegetables a day	0.587
I realize that I might be able to influence others to be healthier by eating fruits and vegetables more often	0.579
Behavioral ($\infty = 0.89$)	
I keep things at school to remind me to eat fruits and vegetables	0.756
I invite friends over and serve only fruits, juices, and vegetables	0.709
I surround myself with people who are trying to eat more fruits and vegetables	0.702
I avoid spending long periods of time in places where it is difficult to eat fruits and vegetables	0.694
I remove things (like junk food) that prevent me from eating five or more servings of fruit and vegetables a day	0.693
I put things around my home to remind myself to eat fruits and vegetables	0.657
I purchase fruits and vegetables instead of junk food	0.617
I reward myself when I eat fruits and vegetables	0.601
I keep fruits and vegetables in sight to remind myself to eat more of them	0.598
I make myself eat fruits and vegetables even if I do not like the smell or taste of them	0.592
I have a healthy friend who encourages me to eat fruits and vegetables when I do not feel up to it	0.571
Instead of sweets or ice cream, I have fruit as a dessert	0.555

Table 2

Means, SDs, Analysis of Variance, and *t*-test Results for Transtheoretical Model (TTM) Variables and Fruit and Vegetable Consumption by Stages of Change*

TTM Variables and Fruit and Vegetable Consumption	Stage of Fruit and Vegetable Consumption					
	P(n = 52)		C-PR (n = 166)		A-M (n = 44)	
	Mean	SD	Mean	SD	Mean	SD
Pros	47.11 ^a	9.93	50.38 ^{a,b}	9.96	51.96 ^b	9.72
Cons	49.58 ^{a,b}	10.80	50.98 ^a	9.50	46.76 ^b	10.33
Self-efficacy	47.78 ^a	8.70	49.53 ^a	9.54	54.36 ^b	11.89
Fruit and vegetable consumption	1.94 ^a	0.95	2.08 ^a	1.08	7.28 ^b	2.15

	Dichotomized Stage of Fruit and Vegetable Consumption			
	P-C-PR (n = 218)		A-M (n = 44)	
	Mean	SD	Mean	SD
Experiential	49.06 ^a	9.67	54.63 ^b	10.40
Behavioral	49.00 ^a	9.84	54.93 ^b	9.36
Difference score (experiential - behavioral)	0.06 ^a	9.78	-0.30 ^a	10.67

* P indicates precontemplation; C-PR, contemplation-preparation; and A-M, action-maintenance. Means with differing superscript letters are significantly different at $p < 0.05$ by Tukey HSD post hoc and Games-Howell post hoc test for analysis of variance or *t*-tests for independent samples.