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Measuring Children's Self-Efficacy and Proxy Efficacy Related to Fruit and Vegetable Consumption

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Keywords: nutrition and diet; after-school; self-efficacy; fruit and vegetable

ABSTRACT

BACKGROUND: Social cognitive theory describes self-efficacy and proxy efficacy as influences on fruit and vegetable consumption (FVC). Proxy efficacy was defined as a child's confidence in his or her skills and abilities to get others to act in one's interests to provide fruit and vegetable (FV) opportunities. The purpose of this study was to develop a scale assessing children's self-efficacy and proxy efficacy for FVC at after-school programs and at home.

METHODS: Elementary-aged children (n = 184) attending 7 after-school programs completed a self-efficacy questionnaire relevant to FVC. Questionnaire validity was investigated with exploratory factor analysis and mixed-model analysis of covariance. Internal consistency reliability and readability were also assessed.

RESULTS: The questionnaire assessed 4 constructs: self-efficacy expectations for fruit consumption, self-efficacy expectations for vegetable consumption, proxy efficacy to influence parents to make FV available, and proxy efficacy to influence after-school staff to make FV available. Children perceiving FV opportunities in after-school had greater self-efficacy expectations for FVC and greater proxy efficacy to influence after-school staff compared to students who did not perceive FV opportunities. Children attending schools of higher socioeconomic status (SES) and less diversity were more confident they could influence their parents to make FV available than students attending lower SES and

less diverse schools. Adequate internal consistency and test-retest reliabilities were established.

CONCLUSIONS: Self-efficacy is a multicomponent construct that can be assessed in children using the reliable and valid instrument evaluated by the current study.

Social-cognitive theory (SCT) is one of the predominant models for understanding and impacting health behaviors, having been applied in several studies investigating psychosocial influences on fruit and vegetable consumption (FVC). One influence identified by SCT is self-efficacy, which is defined as a child's belief that he or she can execute a behavior at a level necessary to obtain a desired outcome. Several studies have shown that self-efficacy influences FVC in elementary and middle school youth.

Self-efficacy reflects two ways of reaching a desired outcome: direct personal agency and proxy agency.⁷ Direct personal agency has been assessed by having children estimate their confidence in eating fruit and vegetables (FV). Proxy agency is reflected in this self-efficacy judgment, but it can also be assessed directly by measuring children's proxy efficacy. Proxy efficacy is the belief that one can get others to act on their behalf to reach desired outcomes.⁷

Because children are not directly in charge of the social and institutional practices that provide FV opportunities in their environments, they may need to exert proxy efficacy. When children's proxy efficacy is high, they are more likely to request FV from others they perceive to be proficient enough to act on their behalf. These proxy agency efforts may then result in increased FV opportunities, increased self-efficacy, and an increased likelihood of FVC.

Previous FV research has not adequately distinguished between self-efficacy and proxy efficacy in the measurement of these constructs. For example, Reynolds and colleagues⁹ performed statistical analyses that revealed a single factor for self-efficacy, merging direct personal agency and proxy agency into one construct. However, the 21-item self-efficacy questionnaire had 17-items probing children's perceptions of direct agency ("*I can*...") as well as 4-items investigating perceptions of proxy agency ("*I can*...")

ask my mom or dad..."). Specific attention to the conceptual distinction between direct personal agency and proxy agency may reveal that these are separate but related constructs. The specific analytical plan and results for concluding that there was a one-dimensional self-efficacy scale was not discussed in Reynolds and colleagues' paper. Paper Paper

The primary aim of the present study was to determine if self-efficacy and proxy efficacy could be measured with reliability and validity in late elementary school-aged children. Children's self-efficacy for FVC and proxy efficacy for FV opportunities were examined with a self-report questionnaire. The secondary aim was to investigate whether the present measures could detect differences in direct personal agency and proxy agency between groups of children that theoretically should differ (criterion validity). Group differences were examined between children who perceived FV opportunities afterschool compared to children who did not perceive FV opportunities and between afterschool children attending schools with higher concentrations of racial/ethnic diversity and higher concentrations of lower-socioeconomic status (SES) compared to lower concentrations of racial/ethnic diversity and higher concentrations of higher-SES.

Overall, the questionnaire was expected to emerge as multidimensional, containing both a self-efficacy scale and proxy efficacy scale. Additionally, the direct personal agency scale was expected to distinguish between direct personal agency for fruit and direct personal agency for vegetable consumption, coinciding with research reporting fruit consumption and vegetable consumption as two separate behaviors. 10-12 Two separate subscales for proxy agency were also expected, one representing proxy agency from parents and the other proxy agency from after-school staff. Finally, the establishment of criterion validity was expected such that there would be differences between groups on the direct personal agency and proxy agency measures based on their perception of opportunities for FVC in their after-school programs and the diversity-SES classification of their school. It was hypothesized that children attending after school environments with greater opportunities for FVC would have higher self-efficacy and proxy efficacy compared to children attending after school environments with fewer opportunities. Also, it was hypothesized that children in high-resource environments

(higher-SES schools) would have greater self-efficacy and proxy efficacy compared to children in low-resource environments (lower-SES schools).

Methods

Subjects

Participants were fourth-, fifth- and sixth-grade children recruited from seven after-school programs located in Lawrence Kansas. Children completed a 61-item questionnaire (approximately 30 minutes) regarding their physical activity and nutritional beliefs and behaviors. Of those enrolled in the after-school program, 74% participated in fall 2005 and 70% in fall 2006. Some children participating in fall 2005 also completed the questionnaire in fall 2006, but were dropped from the fall 2006 database. The final database used for statistical analysis included 54% of children surveyed in fall 2005 and 46% in fall 2006. Of the 187 children, 184 (98%) had complete self-efficacy data (14-items) and complete perceived opportunity for FV data (2 items). All demographic data (i.e., gender, age, lunch status/SES, and ethnicity) were obtained directly from school records.

The 184 children were among an after-school group primarily composed of fourth-graders, but containing other grades of similar age (8% fifth-grade, and 2% sixth-grade). The mean age during the time of questionnaire completion was 9 years, ranging between 8 and 12 years. Forty-seven percent of the sample was female and 41% was lower-SES (i.e., receiving free and reduced meal program assistance). The sample was primarily white (n=131), with some diversity (Black, n = 29; American Indian/Alaska native, n = 15; Hispanic/Latino, n = 6; Asian, n = 2; Native Hawaiian/other, n = 1).

Procedure

The current analysis drew data from the Healthy Opportunities for Physical Activity and Nutrition (HOP'N) project, a school-randomized controlled trial targeting the prevention of obesity. All data were collected during baseline prior to intervention from youth whose parents or guardians provided active informed consent. The Institutional Review Board (IRB) at Kansas State University approved all procedures. During after-school programs at seven elementary school sites, research assistants led

groups of children through a paper-and-pencil survey assessing psychosocial variables related to physical activity and nutrition.

Using a verbatim script, all instructions and questions were simultaneously read aloud to all participating children. Children completed the questionnaire individually, but were asked to wait and follow along as a research assistant read each question aloud to all children in the class. The script included questionnaire instructions and definitions of FV serving sizes. Children were also shown realistic FV food models, functioning as visual aids that insured their understanding of FV serving sizes. Finally, a large poster board displaying written definitions and example questions was presented to the group. Following completion, all children who participated in the survey were privately given small incentives (i.e., colorful pencils, small toys); however, no penalty for non-participation was employed.

Instruments

Direct Personal Agency and Proxy Agency Measures

Four groups of items were developed by the research team based on SCT and FV literature. ¹⁰⁻¹¹ The construct of personal agency, labeled in this study as self-efficacy, was assessed with the first group of items (n = 3) for both fruit consumption (SE-FRUIT) as well as a second group of items (n = 3) for vegetable consumption (SE-VEG). A third group of items (n = 4) captured proxy agency relevant to parents, which is referred to as proxy efficacy for FV availability from parents (PEFV-P). A final group of items (n = 4) captured proxy agency relevant to the after-school staff, labeled here as proxy efficacy for FV availability from staff (PEFV-S).

The SMOG test was chosen for performing readability tests on the entire 14-item questionnaire, as well as each of the four subscales. The SMOG readability analyses gave the 14-item questionnaire a seventh-grade score, and each subscale ranged from third- to eighth-grade (SD= + 1.5). Although these grade-levels exceed that of the present subjects (fourth-, fifth-, and sixth-graders), it should be noted that all instructions and each individual question was read out-loud to the children before they responded. Furthermore, only six different polysyllabic words were included among the questionnaire items including: vegetable(s), favorite, refrigerator, banana, apricots and

applesauce. These words, although polysyllabic, are usually highly recognizable by children when read aloud.

Self-Efficacy for Fruit Consumption (SE-FRUIT). The self-efficacy for fruit consumption items were generated to correspond to the recommendation of one to three servings of fruit or 100% fruit juice each day. Serving sizes were established from the food guide pyramid; therefore, one serving of fruit and one serving of fruit juice was defined to the children as I medium piece of fresh fruit, 1/2 cup of fruit salad, 1/4 cup of raisins, apricots or other dried fruit, 6 oz. of 100% orange, apple or grape juice (Do not count fruit punch, lemonade, Gatorade, Sunny Delight or fruit drink). Each question began with How sure are you that you can eat, assessing in three separate questions confidence to eat one, two and three servings of fruit each day (Table 2.1). Children responded using a three-point scale, Not sure at all, Somewhat sure and Very sure.

Self-Efficacy for Vegetable Consumption (SE-VEG). Similar to SE-FRUIT, self-efficacy for vegetable consumption items were generated based on the food guide pyramid (one to three servings each day). One serving of a vegetable was defined for the children as "1 medium carrot or other fresh vegetable, 1 small bowl of green salad, ½ cup of fresh or cooked vegetables, ¾ cup of vegetable soup (Do not count French fries, onion rings, potato chips or fried okra)." These questions were grouped with fruit consumption items, beginning with "How sure are you that you can eat." Three separate questions were included assessing children's perceived ability to consume one, two and three servings of vegetables. Children responded using the same three-point scale ("Not sure at all," "Somewhat sure" or "Very sure)."

Proxy Efficacy for Fruit and Vegetables- Parent (PEFV-P). Proxy efficacy for FV availability was defined as children's confidence in their skills and abilities to get parents to make FV available. Specifically, PEFV-P assessed children's confidence in having a parent or guardian provide them with fruits, fruit juices, and vegetables (Table 2.1). An example question was, "How sure are you that you can get your parents to buy fruit for a snack." Children responded to each item using a three-point scale, "Not sure at all," "Somewhat sure" and "Very sure."

Proxy Efficacy for Fruit and Vegetables- Staff (PEFV-S). PEFV-S was defined as children's confidence in their skills and abilities to get the after-school program staff

members to make fruit, fruit juice and vegetables available (Table 2.1). Similar to PEFV-P, children responded to each item using a three-point scale, "Not sure at all," "Somewhat sure" and "Very sure." An example question was, "How sure are you that you can get the teachers or staff members of the after-school program to offer fruit and vegetable snack options."

After-School Environment Measures

Perceived School Fruit and Vegetable Opportunity. Two items assessed children's perceived opportunities for FV during the after-school program. Children responded on a three-point scale choosing among "yes," "don't know," or "no" to "There are a lot of chances to eat fruit and vegetables at the after-school program" and "We are satisfied with the fruits and vegetables offered at the after-school program." The sample of children whose response was "yes" was categorized as perceiving FV opportunities in after-school. Internal consistency of the two-item scale was 0.65.

School Diversity and SES. Seven schools were grouped into two categories based on the percentage of youth qualifying for free and reduced lunch and percentage of youth who were white or of diverse race/ethnicity. The higher diversity and lower-SES schools (n=4) ranged from 63% of the youth qualifying for free and reduced school meals to 89%. These schools had approximately 50% racial/ethnic diversity with one school having slightly lower diversity (28%). The lower diversity and higher-SES schools (n=3) ranged in free and reduced status from 32% to 4% and in diversity from 13% to 24%.

Data Analysis

Exploratory Factor Analysis (EFA) was performed using SPSS 13.0 with principal axis factor extraction method, followed by direct oblique (oblimin) rotation. This rotation method was used due to hypothesized correlations among the underlying factor structures of self-efficacy. The number of factors retained was determined using the following criteria: (a) Factors with unrotated eigenvalues exceeding 1, 14 (b) a scree test, 15 and (c) factor loadings exceeding 0.40. 16 Item reliability was estimated with Cronbach's alpha (α) and equal-length Spearman-Brown correlation coefficients.

Criterion validity analyses were performed using SAS software (version 9.1; SAS Institute. Cary, NC). Differences in FV self-efficacy and proxy efficacy variables were

evaluated for significance using a mixed-model analysis of covariance (PROC MIXED). To examine between group differences, the model included gender, ethnicity, household SES, and child weight status as fixed effects. Furthermore, children were nested within the after-school program as a random effect to address the possible clustering of children within any one of the seven after-school programs.

Results

Exploratory Factor Analysis

A principal axis factor (PAF) analysis of the 14 self-efficacy questionnaire items extracted four factors with eigenvalues greater than 1. In addition, a scree plot indicated the existence of four factors. The Keiser-Meyer-Olkin test of sampling adequacy coefficient was 0.76, exceeding the 0.60 minimum required for factor analysis. Thus, the four-factor solution met all statistical criteria and accounted for approximately 68.1% of the variability among the 14-items. Following oblique (oblimin) rotation, all items had factor loadings exceeding 0.40 on only one of the four identified factors, confirming the inclusion of all 14-items. Table 2.1 depicts the percent variance accounted for by each factor and the factor pattern coefficients for each item.

The first factor, labeled Self-Efficacy for Vegetable Consumption (SE-VEG), included three items capturing children's confidence in their ability to consume one, two and three servings of vegetables daily. Factor two was labeled Proxy Efficacy for Fruit and Vegetable Availability from After-School Staff (PEFV- Staff), and consisted of four items identifying children's perceptions of their ability to influence after-school staff members to make FV available. The third factor, labeled proxy efficacy for Fruit and Vegetable Availability from the Parent (PEFV-Parent), also consisted of four items and reflected children's perception of their ability to influence their parent(s) to make FV available. Finally, the fourth factor, labeled Self-Efficacy for Fruit Consumption (SE-FRUIT) captured children's confidence in consumption of one, two and three servings of fruit.

Reliability of the questionnaire was quantified using all 184 child responses. There was high internal consistency for the entire 14-item questionnaire (Cronbach's Alpha=0.81), ranging between 0.75 and 0.84 for the four subscales. Additionally, split-

half internal consistency method was employed to determine reliability. The reliability of the 14-item questionnaire was 0.56 (equal-length Spearman-Brown, n = 184). The coefficients of the four subscales were acceptably high, ranging between 0.74 and 0.80.

Criterion Validity

Table 2.2 reports the group least squared means and standard errors. Group differences were found such that children perceiving FV opportunities during after-school were significantly greater in SE-FRUIT than children not perceiving these opportunities (F (1, 176) = 18.25, p=.001). There were also group differences in SE-VEG scores based on children's perceptions of FV opportunities during after-school (F (1, 176) = 6.46, P =. 01). Similar to SE-FRUIT, children perceiving FV opportunities during after-school were significantly higher on SE-VEG compared to children not perceiving FV opportunities.

In addition to self-efficacy, differences emerged regarding children's proxy efficacy. Specifically, children in schools with low racial/ethnic diversity and higher-SES were significantly greater on PEFV-P than children in schools with high racial/ethnic diversity and lower-SES (F (1, 176) = 5.44, P = .02). Moreover, children who perceived that their after-school environments provided more FV opportunities, were significantly greater on PEFV-S compared to youth not perceiving FV opportunities after-school (F (1, 176) = 25.46, P = .0001).

Discussion

The current study supports the global hypothesis that self-efficacy and proxy efficacy are separate but related constructs within the FV context. The 14-item measure had two self-efficacy subscales and two proxy efficacy subscales. The measure demonstrated impressive factorial and criterion validity, as well as acceptable reliability among late elementary-aged children. Contrary to previous studies reporting self-efficacy and proxy efficacy as a one-dimensional construct, the present measure is consistent with SCT, hypothesizing that children's beliefs for personal agency and proxy agency are based on distinct skills and abilities. The property of the present measure is consistent with SCT, hypothesizing that children's beliefs for personal agency and proxy agency are

Two subscales measured children's self-efficacy for FVC, one self-efficacy scale for fruit consumption and another for vegetable consumption. This finding is consistent with previous research revealing that fruit consumption and vegetable consumption are

independent behaviors.¹⁰⁻¹² For example, Reinaerts and colleagues¹⁰ found the habitual eating behavior among 4-12-year old children explained 13% of the variance for their fruit consumption, but only 3% of the variance for their vegetable consumption.¹¹ Additionally, Gibson et al¹² discovered children's consumption of fruits are related to different psychosocial and environmental factors compared to their consumption of vegetables. These results demonstrate that FVC are different behaviors involving different antecedents; thus, supporting the present employment of separate self-efficacy measurements for each.

Similar to self-efficacy, two separate scales for proxy efficacy were established. One subscale captured children's proxy efficacy to influence parents and another concerned their confidence to influence after-school staff. This finding supports our hypothesis, that children's proxy efficacy varies depending on the authority figure in control of the environmental opportunities for FV (parents versus after-school staff). This finding may contribute to a future explanation for why children's FVC during the weekday at school-lunch differs from FVC at home. ¹⁸⁻²⁰

Criterion validity analyses provided further validity for the current measures. The hypothesis that self-efficacy for consumption of both fruits and vegetables would vary across groups was supported. Specifically, those children perceiving FV opportunities in after-school had higher self-efficacy for consuming fruit, higher self-efficacy for consuming vegetables and higher proxy efficacy for influencing after-school staff compared to children who did not perceive FV opportunities during after-school. This suggests that children's perceptions of FV opportunity in after-school may influence their self-efficacy and proxy efficacy, verifying adequacy of the current measure and its ability to capture and distinguish these differences.

Another finding emerging from the current analyses highlights differences in proxy efficacy at the school level. In the present study, the hypothesis that proxy efficacy will vary differently across school classification (diversity and SES) was supported. Specifically, those children attending lower diversity and higher-SES schools were significantly more confident they could influence their parents to make FV more available compared to children attending schools with higher racial/ethnic diversity and lower-SES. Racial/ethnic diversity and lower-SES are expected influences of FV

availability; therefore, the distinction uncovered in this analysis further supports the criterion validity of the current measure and its use in future studies.

The present study offers several specific contributions, extending the FV research literature. There is limited research investigating the direct personal agency and proxy efficacy constructs, and even fewer evaluating measurement of these constructs. The present study not only extends understanding of specific efficacy constructs within the FV context, it also offers a reliable and valid measurement tool that may be applied in future research. Additionally, the measurement evaluation is strengthened with the inclusion of two types of validation as well as two types of reliability tests. Specifically, construct validity (factor analysis) unveiled four measurement constructs that also demonstrated appropriate criterion validity. Furthermore, appropriately high internal consistency was confirmed using both Cronbach's α coefficients and equal-length Spearman-Brown coefficients.

Along with strengths of the present research, the following limitations should also be noted. First, the sample may not represent the national population of elementary-aged children, but does include ethnic variability common in Kansas' public schools. Future research needs to test these self-efficacy constructs in more diverse samples and varying age groups to determine how self-efficacy develops over time, and how FVC is impacted. Secondly, the PEFV-P and PEFV-S subscales did not ask separate questions distinguishing fruit availability from vegetable availability. It may be possible that children's proxy efficacy from staff or parents varies dependent on whether they are requesting fruit versus requesting vegetables. Additionally, test-retest reliability (stability reliability) should be assessed for the scales.

In conclusion, the measure of self-efficacy for FVC and proxy efficacy for FV availability demonstrated acceptable factorial validity, reliability, and criterion validity in late elementary-aged youth. Results illuminate four valid constructs within the FV context, contributing a better understanding of the separate influences of self-efficacy and proxy efficacy. Future investigations are needed to determine if the self-efficacy and proxy efficacy constructs are central variables of the causal process determining changes in children's FVC. Development and evaluation of interventions aimed at increasing children's FVC may be one way to examine this question. Specifically, interventions

targeting self-efficacy for FVC and proxy efficacy for FV availability can examine whether these variables mediate effectiveness of the intervention. Because self-efficacy for fruit consumption is separate from self-efficacy for vegetable consumption, interventions may need to consider separate strategies for improving each. Additionally, proxy efficacy for parents is a separate construct from proxy efficacy for after-school staff; thus, interventions may also need to consider separate strategies for increasing proxy efficacy for FV availability at home versus in the after-school environment.

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Figures and Tables

Table 0-1 Exploratory Factor Analysis Results and Factor Loadings for FV Self-Efficacy and Proxy Efficacy Scales

Factor Label	Items	Factor Loadings			
racioi Labei	items		2	3	4
1. SE-Vegetable	One serving (1/2 cup) of vegetables each day	.672	.004	.162	.048
	Two serving (1/2 cup) of vegetables each day	.914	.050	063	095
	Three serving (1/2 cup) of vegetables each day	.695	.038	083	264
2. PEFV- School	Get the after-school staff to offer dried fruit snacks (like raisins, banana chips and apricots	013	.733	012	018
	Get the after-school staff to offer applesauce cups or fruit cups (like fruit cocktail)		.823	040	.158
	Get the after-school staff to offer fruit and vegetable snack options	012	.692	.112	005
	Get the after-school staff to offer 100% real fruit juice	.019	.589	042	099
3. PEFV- Parents	Get your parents to buy fruit for snacks	.063	080	.711	.045
	Get your parents to fix your favorite vegetable dish	.238	.003	.607	.152
	Get your parents to keep 100% juice in the refrigerator	037	.075	.495	234
	Get your parents to fix a fruit and vegetable snack	184	.106	.766	139
4. SE-Fruit	One serving (1/2 cup) of fruit each day	.151	.076	.088	581
	Two serving (1/2 cup) of fruit each day	.071	.026	.040	767
	Three serving (1/2 cup) of fruit each day	.028	061	018	808
Eigenvalues		4.23	2.12	1.81	1.38
% Percentage		30.19	15.15	12.94	9.85
Cumulative %		30.19	45.34	58.28	68.13

Table 0-2 Group Leas Square Means and Standard Errors for FV Self-Efficacy and FV Proxy Efficacy

Group	Self-Efficacy		Proxy Efficacy		
	Fruit	Vegetable	Parent	Staff	
Gender					
Male (n =97)	2.65 ± 0.06	2.48 ± 0.08	2.60 ± 0.06	2.10 ± 0.08	
Female (n=89)	2.56 ± 0.06	2.39 ± 0.08	2.53 ± 0.06	2.11 ± 0.08	
Ethnicity					
Diverse (n=53)	2.62 ± 0.08	2.45 ± 0.10	2.59 ± 0.08	2.14 ± 0.10	
White $(n=132)$	2.59 ± 0.05	2.41 ± 0.07	2.54 ± 0.05	2.07 ± 0.07	
Household SES					
Not Eligible (n =109)	2.58 ± 0.07	2.38 ± 0.08	2.55 ± 0.07	2.05 ± 0.09	
Eligible ($n = 73$)	2.63 ± 0.06	2.48 ± 0.08	2.58 ± 0.07	2.16 ± 0.08	
Weight Status					
Normal (n= 141)	2.52 ± 0.05	2.40 ± 0.06	2.50 ± 0.05	2.13 ± 0.07	
At Risk/Overweight (n= 43)	2.69 ± 0.08	2.46 ± 0.10	2.63 ± 0.09	2.09 ± 0.10	
Perceived School FV Opportunit	y				
Opportunity (n=77)	2.77 ± 0.07 *	2.55 ± 0.08 *	2.56 ± 0.07	$2.34 \pm 0.09*$	
No-Unsure (n=109)	2.44 ± 0.06	2.31 ± 0.07	2.57 ± 0.07	1.87 ± 0.07	
School Diversity-SES					
High DivLow SES	2.53 ± 0.07	2.35 ± 0.08	2.45 ± 0.07 *	2.17 ± 0.09	
Low DivHigh SES	2.68 ± 0.07	2.51 ± 0.09	2.68 ± 0.07	2.04 ± 0.10	

Note: *P