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Diet and Exercise in Low-Income Culturally Diverse Middle School Students

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Abstract

It is important to understand constructs essential to low-fat-diet and physical-activity behaviors of low-income culturally diverse middle-school-age students, because ethnicity and socioeconomic status influence body weight status, and these groups are most at risk for obesity later in life. In this descriptive study, constructs important in low-fat diet and physical activity in low- to middle-income, culturally diverse middle school students were examined. Revised for cultural/developmental appropriateness and reading level, instruments incorporating constructs from the Health Promotion and Transtheoretical Models were tested with 221 youth. Results demonstrated that percentage of fat in diet, total number of strategies used for a low-fat diet, access to low-fat food, and total number of exercise processes varied significantly ($p < 0.05$) across stages of change for low-fat diet. We concluded that interventions should foster access to low-fat foods and processes for diet and activity

change. Despite significantly lower income and higher grade level (both of which are risks for poor health behaviors), students in the private school demonstrated significantly lower fat in diet, higher perception of benefits, and better access to low-fat food. These findings warrant additional study.

Risk factors track from childhood to young adulthood, and preventing obesity, lowering fat consumption, and increasing physical activity of youth may lead to favorable changes (Ratakari, Porkka, Rosanen, Ronnemaa, & Viikari, 1994). Middle school students are at an age and in a setting that offer great potential for effective and efficient interventions. Evaluating effectiveness of interventions to reduce risk factors requires instruments appropriate to the age and culture of the subjects. In this study instruments based on constructs in the Transtheoretical Model (TM) (Prochaska, Velicer, Rossi, Goldstein, Marcus, Rakowski, Fiore, Harlow, Redding, & Rosenbloom, 1994) and Pender's Health Promotion Model (HPM) (Pender, 1996) were tested with low income, culturally diverse urban students in both a public and a private middle school.

It is important to understand constructs essential to low-fat diet and physical activity behaviors of low-income culturally diverse middle-school-age students, because ethnicity and socioeconomic status influence body weight status, and these groups are most at risk for obesity later in life (McMurray, Harrell, Deng, Bradley, Cox, & Bangdiwala, 2000). Differences in nutrition and diet behavior have been found in public and private high school students in the southeast, and study in other parts of the country was recommended (Pearman, Thatcher, Valois, & Drane, 2000). The variety of factors that may explain relationships between diet and physical activity behaviors also are complex and require further investigation (Bellisle, 1999). These behaviors have been shown to have independent and possibly synergistic effects in ameliorating many chronic diseases and reducing mortality (Blair, Horton, Leon, Lee, Drinkwater, Dishman, Mackey, & Keinholz, 1996).

The TM used with adults demonstrates that behavior change entails a process and strategies that vary with readiness or stage of change. According to this theory, if individuals are approached without regard to their stage of change, the intervention is much less effective (Prochaska et al., 1994). According to the TM as further detailed in Table 1, those not ready to change are said to be in Pre-contemplation; those considering change, but who intend no change within 6 months are in Contemplation; those who intend to change within 1 month are in Preparation; those who have begun change for less than 6 months are in Action; and those continuing the change more than 6 months are in Maintenance. The TM has been used to examine physical activity with elementary (Cardinal, Engels, & Zhu, 1997) and high school (Nigg & Courneya, 1998) youth but not to study low-fat diet or physical activity with middle school youth.

Table 1. Constructs of the Health Promotion and Transtheoretical Models

Construct	**Description**
Stages of Change*	
Precontemplation	People may “wish” to change, but have no plans to do so in the next 6 months
Contemplation	People seriously considering change within 6 months, but have no specific plans
Preparation	People who state the intention to change within 1 month or have a prior unsuccessful attempt within past year

Action	People actively engaging in the new behavior, experiences, or environment for 1 day to 6 months
Maintenance	People sustaining the change 6 months or more
Decisional balance*†	Relative importance of pros and cons for making a behavior change (conceptualized as benefits/barriers in the Health Promotion Model)
Temptation*† (low self-efficacy)	Perception of one's ability to withstand barriers to sustaining behavior change (based on self-efficacy theory in the Health Promotion Model)
Processes of change*	Experiential and environmental strategies used consciously or unconsciously by individuals making changes. It is hypothesized that more total processes are used as individuals move from precontemplation through maintenance stages of change
Access to low-fat foods†	Health Promotion Model construct examining availability of low-fat foods

- *Construct of Transtheoretical Model.
- †Construct of Health Promotion Model.

The HPM (Pender, 1996), developed with adults, has been used to predict duration and intensity of physical activity (Garcia, Broda, Frenn, Coviak, Pender, & Ronis, 1995) and cardiovascular risk reduction in middle school youth (Pittman & Hayman, 1997). In contrast to the TM, which focuses on behavioral change, the HPM helps identify and explain antecedents essential in promoting and sustaining healthy behaviors. HPM variables, selected based on prior significance in adolescent physical activity, were included in the present study. These variables, described in Table 1, included demographic variables (age, sex, race, income, school), self-efficacy, benefits/barriers, and access to low-fat foods.

The purpose of this study was to examine low-fat diet and physical activity constructs in low- to middle-income culturally diverse adolescents using a synthesis of the HPM and TM. We hypothesized that subjects would evidence lower temptation (higher self-efficacy), higher pros (benefits), lower cons (barriers), and increased use of low-fat diet and physical activity processes with increasing stages of change (precontemplation through maintenance). Beyond that, we proposed to identify antecedents of a diet lower in fat and to examine relationships between select physical activity variables (stage of change, definition of exercise and exercise processes used) with low-fat diet variables.

Methods

Setting and Subjects

Subjects were drawn from two urban middle schools, one public (n = 164) and one religiously affiliated (n = 57), serving culturally diverse students from low- and middle-income families. The sample consisted of 127 boys and 94 girls of whom 51% were African-American, 27% Caucasian, 4% Hispanic, 2% Laotian, and 14% other races. The students were in sixth (51%), seventh (40%), and eighth (17%) grades. Approximately 52% of the students in the two schools were eligible for free or reduced lunch.

Following review for protection of human subjects, a letter was sent home to parents explaining the study. Parents who did not want their child to participate were asked to inform their child's science

teacher. Two students' parents declined. All remaining students who gave their assent to participate completed the following instruments in addition to providing demographic information.

Instruments

Demographic variables included grade (as a proxy for age), race (coded as described by students), gender, school, and income. These variables were used in congruence with prior research using the HPM to facilitate comparability among studies (Garcia et al., 1995).

The access to healthy foods questionnaire, developed by the authors, is modeled after a similar exercise access instrument for adolescents within the HPM (Garcia et al., 1995). The access instrument contained nine items, with a five-option Likert scale regarding the frequency of availability of typical low-fat foods, such as skim or 1% milk and foods that are baked or broiled rather than fried. The instrument does not include information regarding where foods are available, such as at home, school, or other places. Cronbach's alpha coefficient in the current study was 0.83 and when pretested with 136 middle school students.

Because TM measures had been developed for adults, experts caring for low-income culturally diverse middle school students first reviewed them for cultural and developmental appropriateness. The experts included a postdoctorally prepared African-American pediatric nurse practitioner whose research specialized in culturally competent methods, a Caucasian physician, a masters-prepared pediatric nurse practitioner in a clinic for low-income central-city adolescents, a Caucasian masters-prepared nurse in charge of educational services for the only children's hospital in the state, a Hispanic physician practicing in a teen and young adult clinic, and an African-American nursing graduate student practicing in a central city public health clinic with adolescents. Changes made to improve developmental and cultural sensitivity are described below, incorporating words used by adolescents in Frenn & Porter's (1999) qualitative study of diet and exercise perspectives.

The Food Habits Questionnaire is a 21-item series of questions about frequency of consumption of a variety of foods, including typical high- and low-fat food items. Examples of foods included tacos and other fast foods, fruits, and vegetables. A five-item response format allowed students to indicate how often they ate the foods over the previous month, from never to always. This instrument was found to have exactly the same distributions of stage of change to low-fat diet when tested concurrently with Block's Food Frequency Questionnaire modified to increase sensitivity to high-fat foods (Greene, Rossi, Rossi, Velicer, Fava, & Prochaska, 1999). Low-fat items are reverse scored, and an algorithm was used to calculate percentage of fat, such that the resulting total score indicates percentage of fat in food consumed during the previous month. Cronbach's alpha coefficient for this study sample was 0.70.

No changes were made to the Food Habits Questionnaire or staging questions used by researchers at the University of Rhode Island (Green et al., 1999), except that anchors such as “At the beginning of the school year” or “in January” were given to add a developmentally appropriate anchor because middle school aged children are usually concrete thinkers. The staging questions included the same seven items used by Green et al. (1999). The first question included a five-option Likert scale regarding intention to avoid eating high-fat food in the next 6 months. The next five items included yes/no options regarding selected high- and low-fat foods consumed to help assure that subjects understood differences between high- and low-fat foods. The seventh question was the staging question used for

analysis. Subjects considered the stage-based time frame in which they intended to eat lower-fat foods. Those in the action or maintenance stages of change were restaged to precontemplation if their fat intake exceeded 30% according to the standard algorithm (Rossi, Rossi, Rossi-Delprete, Prochaska, Bonspach, & Carleton, 1994a).

No changes were made to the pros and cons instrument for low-fat diet (Rossi, Greene, Reed, Prochaska, & Velicer, 1994), except that the five-option Likert scale was placed in boxes next to each item to allow for easy completion by students. Cronbach's alpha coefficient for the four-item “pros” portion of the instrument was 0.74 and 0.59 for the four-item “cons” portion of this study. Shorter versions were used in the present study based on prior item analyses of nine-item scales. Given the low internal consistency found with the shorter scales, the nine-item versions are recommended for subsequent research, where Cronbach's alpha for “pros” = 0.81 and “cons” = 0.73.

The temptation scale for low-fat foods (Rossi & Rossi, 1994) was not modified from the format being used with high-school-aged students. Coefficient alpha for the seven-item, five-option Likert scale in the current study was 0.80. The higher the score, the greater the situation-specific temptation to eat high-fat food, which is conceptualized as having low self-efficacy within the TM (Rossi et al., 1994a).

The adult version of the low-fat diet process-of-change instrument (Cardinal, 1997; Rossi & Rossi, 1994) was modified to improve developmental, reading level, and cultural appropriateness of items. For example, “I make commitments to cut down on the amount of fat I eat” in the adult version was changed to “I make up my mind to cut down on the amount of fat I eat” in the adolescent version, and “I remove tempting high-fat foods from my home” was changed to “I ask my parents not to bring high-fat foods home.” The five-option Likert scale was placed in boxes across from each item and read, “No, never; No, not really; Sometimes; Yes, very often; and Yes, always” compared with “Never, Rarely, Sometimes, Often, and Always in the adult version. Cronbach's alpha coefficient for the 22-item instrument in this study sample was 0.91.

Experts working with low-income culturally diverse adolescents and preadolescents also examined and modified the adult versions of the instruments for developmental level, reading level, and cultural appropriateness, measuring stage of change and processes of physical activity (Cowan, Logue, Milo, Britton, & Smucker, 1997; Marcus, Eaton, Rossi, & Harlow, 1994; Marcus & Simkin, 1994; Potvin, Gauvin, & Nyuyen, 1997). No changes were made to the staging questions except to anchor time in concrete terms, as with the low-fat diet-staging instrument. Further descriptors used in the study of physical activity with adolescents (Frenn & Porter, 1999) were used to describe vigorous exercise as playing or being active enough for at least 20 minutes three or more times a week to breathe fast, get sweaty, or have your heart beat fast. Lifestyle exercise was defined as walking fast, shooting baskets, climbing stairs, or running around for 30 minutes or more (adding them all together) most days of the week. Cronbach's alpha coefficient for the 20-item, five-option Likert-scaled process instrument in this study sample was 0.89.

Analysis

Descriptive statistics for components of the HPM and TM were computed as described in the literature (Brug, Hospers, & Kok, 1997; Lamb & Joshi, 1996; Steptoe, Wijetunge, Doherty, & Wardle, 1996). All

variables were than examined for differences between stages and across all stages using multiple analysis of variance (manova).

Demographic variables (grade, sex, race, school, and income) along with antecedents predicted by the HPM and TM (access, stage of change, pros, cons, temptation, and strategies used) were regressed on percentage of fat in diet. Remaining variables were then regressed on the only significant predictor: access to low-fat foods.

Further analyses of the HPM and TM variables sex, race, and school differences were performed using manova s. Because some significant findings were obtained, multiple analysis of covariance (mancova) was used to examine interactions of demographic and other variables.

Results

Descriptive data for variables of the HPM and TM by stage of change for low-fat diet are shown in Table 2. The staging questions accurately reflected percentage of fat in diet and total number of strategies used to accomplish a low-fat diet across all stages as predicted by the TM. Access to low-fat food from the HPM was also directly aligned with stage of change when examined across all stages. Percentage of fat in food was significantly greater in precontemplation than in contemplation and in preparation to action. Access was significantly less in contemplation than in preparation. Temptation (low self-efficacy) was significantly greater for preparation than for action. Total number of exercise processes increased significantly across categories based on stages of change for low-fat diet, as shown in Table 2.

Table 2. Means and Standard Deviations by Stage of Change for Low-Fat Diet

Variable	**Mean ± Standard Deviation**				
	Precontemplation	**Contemplation**	**Preparation**	**Action**	**Maintenance**
	(*N* = 87: 41%)	**(*N* = 39: 18%)**	**(*N* = 39: 18%)**	**(*N* = 27: 13%)**	**(*N* = 21: 10%)**
Fat in diet, % (past month)	33.64 ± 3.58	31.89 ± 3.59*	31.17 ± 3.04	29.39 ± 4.13*	27.76 ± 3.98‡
Access	16.54 ± 7.66	18.24 ± 7.06	21.63 ± 7.86†	21.89 ± 9.19	27.74 ± 7.79‡
Low-fat processes	30.35 ± 17.39	37.21 ± 14.42	45.17 ± 15.05*	45.73 ± 17.37	50.00 ± 17.31‡
Pros mean	57.56 ± 1.63	58.25 ± 1.54	57.77 ± 1.80	58.13 ± 1.54	58.05 ± 1.78
Cons mean	57.94 ± 1.53	58.49 ± 1.15	57.67 ± 1.80	58.30 ± 1.49	57.71 ± 1.89
Temptation (low self-efficacy)	13.55 ± 7.16	15.74 ± 7.55	12.50 ± 6.96	10.62 ± 5.16†	11.43 ± 7.08

Exercise processes	44.79 ± 16.74	44.27 ± 13.30	50.17 ± 12.62	52.94 ± 14.24	58.88 ± 9.93‡

- Significantly different from prior stage: *p < 0.05; †p < 0.01; ‡significantly different across all stages p < 0.005.

Total processes for exercise stage of change were significantly greater between action and maintenance (p = 0.02) and significantly different across all exercise stages (p = 0.015). The distribution of middle school students by exercise stage of change was precontemplation, eight (4%); contemplation, 15 (8%); preparation, 16 (9%); and maintenance, 96 (53%).

A regression of antecedents on percentage of fat in diet is shown in Table 3. Access to low-fat foods and sex were the only direct antecedents. Remaining variables were regressed on access to examine mediating effects using previously described methods (Garcia et al., 1995). The resulting diagram of antecedents for percentage of fat in diet is shown in Fig. 1.

Table 3. Regression of Antecedents for Higher Fat in Diet

	Beta	**t-score**	**Significance**
(Constant)		5.679	0.000
Race: African American = 0 Other = 1	−0.029	−0.250	0.803
Income	0.031	0.244	0.808
Grade	−0.205	−1.605	0.113
Sex	0.239	2.060	0.043
Stage: Low Fat	0.021	0.107	0.915
Temptation High Fat (Low Self-Efficacy)	0.131	1.107	0.273
Processes Low Fat	0.009	0.060	0.952
Access Low Fat Total	−0.373	−3.042	0.003
Cons to Low Fat	0.124	1.090	0.280
Pros to Low Fat	−0.016	−0.118	0.906
School: Private = 0 Public = 1	0.057	0.270	0.788

- $F_{(11,65)}$ = 3.079; p = 0.002; Adj. R^2 = 0.23.

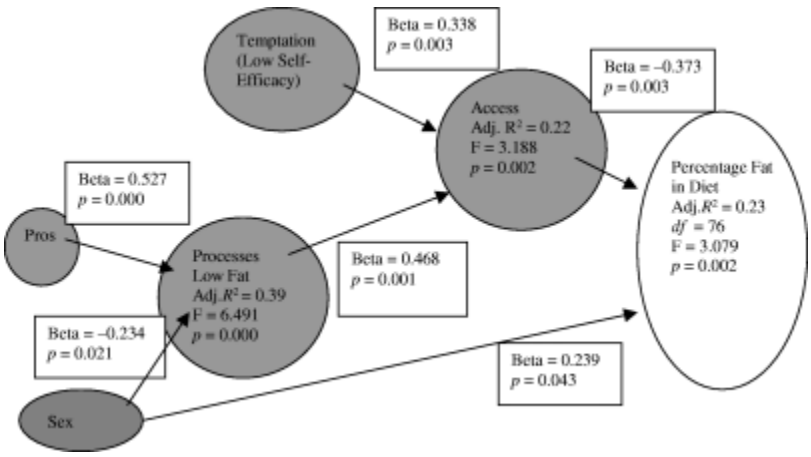

Figure 1 Diagram of antecedents for percentage fat in diet.

To examine whether the HPM or the TM alone predicted as much variance as the combined model, separate regressions were run with constructs included in the individual models as shown in Table 1. The adjusted R^2 for the HPM constructs was 0.20 ($p = 0.001$). For the TM constructs, the adjusted R^2 was 0.13 ($p = 0.023$). These values compare with adjusted $R^2 = 0.23$ ($p = 0.002$) for the combined model. Subtracting the HPM regression mean square from the combined mean square and dividing by the difference of residual means squares yields an F of 8.123 (1, 68 *df* ; $p < 0.01$). Similarly, comparing differences between TM and combined model mean squares yields an F of 32.78 (1, 46 *df* ; $p < 0.01$).

The data then were examined for differences in HPM and TM variables by race, sex, grade, income, and school using manova . The only significant difference for race (divided into African-American and other for this analysis) was income. The only significant difference for sex was percentage of fat in food ($p = 0.02$). Boys had a mean 32.36% (SD = 3.80), whereas girls had a mean of 33.18% (S.D. = 3.49). Cons of a low-fat diet were higher for seventh than for sixth grade students ($p = 0.04$). Stage of change for low fat was higher in eighth than for seventh grade students ($p = 0.005$). There were several significant differences by school, as shown in Table 4. Because several cells had expected frequencies of less than 5, making interpretation difficult, chi-square differences of demographic variables by stage are not reported here.

Table 4. Significant Differences in Variables by School

Variable	**Mean ± Standard Deviation**		**Significance**
	Private (*n* = 57)	**Public (*n* = 164)**	
% Fat in food, 21 items × algorithm for % fat	33.11 ± 3.2	33.61 ± 3.7	0.006
Access to low fat foods (9 items)	21.08 ± 7.0	16.27 ± 7.6	0.008
Stage low-fat diet* (1 item)	2.50 ± 0.5	1.11 ± 0.3	0.000
Pros of low-fat diet (4 items)	6.79 ± 4.6	5.31 ± 4.0	0.049
Cons of low-fat diet (4 items)	6.30 ± 3.7	6.34 ± 3.8	0.683
Low fat processes (22 items)	42.13 ± 14.2	30.50 ± 17.1	0.397
Temptation (low self-efficacy for low fat diet) (7 items)	14.72 ± 7.3	13.51 ± 7.3	0.500
Stage exercise† (1 item)	1.83 ± 0.9	1.96 ± 1.3	0.397
Exercise processes (20 items)	46.05 ± 12.5	44.73 ± 16.7	0.064
Income, $	7,544 ± 7,700	9,996 ± 4,878	0.002
Grade	6.89 ± 0.9	6.43 ± 0.5	0.015

- *Stage Low Fat: 1 = precontemplation; 2 = contemplation; 3 = preparation; 4 = action; 5 = maintenance.

- †Stage Exercise: 1 = maintenance; 2 = action; 3 = preparation; 4 = contemplation; 5 = precontemplation.

Because the school manova and several univariate analyses were significant, mancova for demographic variables was run for stage of change for low-fat diet and stage of change for physical activity. None of the mancova were significant.

Discussion

Results shown in Table 2 demonstrate that the HPM and TM variables are distinguished by stage of change for low-fat diet. The low-fat-diet staging questions accurately reflect percentage of fat in diet, and total number of processes used to reduce fat in diet are higher in stage-of-change categories, increasing from contemplation through action and maintenance, as has been previously demonstrated using the TM (Bowen, Meischke, & Tomoyasu, 1994; Rosen, 2000). Access to low-fat food from the HPM is also directly aligned with stage of change. Total processes used for exercise also increased significantly across stage-of-change categories for low-fat diet, identifying linkages between exercise and diet not previously reported in the literature.

The only significant decrease in temptation (improvement in self-efficacy) was between preparation and action stage categories in this study sample. This is similar in direction to findings among adults (Brug et al., 1997) that self-efficacy was significantly higher in maintenance than in preparation and contemplation stages of change.

As shown in Table 3, when demographics and variables from the HPM and TM were regressed on percentage of fat in food, access to low-fat foods was the only significant (nondemographic) predictor. Access has not been examined in other studies using the TM, so it remains to be examined whether access is the essential factor in adopting a low-fat diet for other population groups. Because middle-school-age youth are dependent on others for the foods available to them at home and through school meal programs, access may be especially important in this age group. As shown in the resulting diagram of antecedents in Fig. 1, access was a mediating variable for low-fat diet processes used and temptation (low self-efficacy).

Processes used similarly mediated the pros of low-fat diet, as shown in Fig. 1. These findings are congruent with interventions suggested by the TM, in that improving pros and reducing cons facilitates stage of change (Prochaska et al., 1994). Findings that processes used may mediate pros (perception of benefits of a low-fat diet) have not been previously reported. Further research examining relationships between access, processes of change, and pros (perceived benefits) is needed in other samples of adolescents and in other age groups.

Similar to that used in an adult sample in the United Kingdom (Steptoe et al., 1996), the staging question itself was not a significant component in the antecedents of fat in diet for this study sample. In contrast to these findings with adults, differences in pros and cons by stage of change for low-fat diet were not significant in the present study. The low alpha coefficient for the cons instrument, which requires further refinement in subsequent research may explain this.

The fact that number of exercise strategies varied significantly across stage of change, both for physical activity and for low-fat diet, provides impetus for further study examining interrelationships between low-fat diet and exercise processes of change. Distributions of middle school students by stage of change for physical activity were similar to those reported for elementary (Cardinal et al., 1997) and high school youth (Nigg & Courneya, 1998) but more active than adults (Cowan et al. 1997; Marcus et al., 1994; Potvin et al., 1997).

Stage distributions for low-fat diet were much more prevalent in early stages (i.e., precontemplation and contemplation) than reported for the general population of adults (Lamb, & Joshi, 1996: Bowen et al., 1994), but similar to those reported for adults with chronic conditions (Boyle, O'Connor, Pronk, & Tan, 1998). These comparisons illustrate the need for further research using the TM for various behaviors and population subgroups and the need for longitudinal study of subjects from adolescence into adulthood.

Because the two schools provided a convenience sample, we cannot conclude that differences between the private and public school sampled have external validity. Despite significantly lower income and higher grade level (both of which are risks for poor health behaviors), students in the private school demonstrated significantly lower fat in diet, higher perception of pros, and better access to low-fat food. These findings warrant additional study, especially given that a larger study with high school students demonstrated that private school students made healthier food choices (Pearman et al., 2000).

Conclusions

The HPM and TM combined provided greater understanding of low-fat diet and physical activity in middle school youth than either model alone, supporting previous conceptual review suggesting such a combination (Frenn & Malin, 1998). Study findings suggest that, after revisions in items for cultural, developmental, and reading level, the models developed with adults are appropriate for low- to middle-income culturally diverse middle school youth. The instruments used are sensitive enough to discern differences within a population of middle school students. Initial evidence was found in this study for important interrelationships between low-fat diet and physical activity variables that require additional research. Further exploration of access to low-fat foods is needed in studies with adolescents and other age groups, especially in low-income groups such as this study sample. Having lower-fat foods accessible is an important policy consideration prerequisite to any behavioral interventions.

Because those with low income are at greatest risk for obesity later in life, and nutrition and exercise behaviors track from adolescence into adulthood, these study findings are an important basis for further developing interventions and additional policy recommendations. The middle school years are important times to improve health behaviors, and schools represent effective environments for policy implementation to improve health in groups that remain underserved by traditional health systems.

Acknowledgments

Partial support for this project was awarded through the Graduate School of Marquette University.

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