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Stages of Change Algorithm for Calcium Intake by Male College Students

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ABSTRACT
Using a sample of college-aged men, we evaluated the validity of a staging algorithm for dairy calcium intake that had been previously validated in a sample of college women. College-aged men enrolled at a private university in the United States were randomly selected to participate. The sample consisted of 180 male participants. Self-reported calcium intake was measured using a 26-item food frequency questionnaire. Stages of change classifications were based on a four-question algorithm for dairy calcium intake and a three-item self-efficacy questionnaire. Significant differences were found between dairy/ calcium intake levels between precontemplation, contemplation/preparation, and action/maintenance groups. Results also showed that 46% of participants were in the action/maintenance stage. There was a significant difference in self-efficacy between members of the preaction and action stages. The study suggests that this stage of change algorithm for dairy calcium intake is valid for use in a male college student population.


Although it is well recognized that more women than men have and are at risk for osteoporosis, as many as 2 million men have osteoporosis and 12 million more are at risk for the disease. Perhaps because it affects fewer men than women, osteoporosis frequently goes undiagnosed and underreported in men, and research in this area is inadequate (2). Furthermore, the 12-month mortality rate for men who suffer a hip fracture is 32%, whereas for women it is 17% (3).

Much of the burden of osteoporosis can be prevented through lifestyle changes like adequate calcium intake (4). According to results from the third National Health and Nutrition Examination Survey, 48% of males between age 9 and 19 years and 46% of men between age 20 and 49 years are not meeting recommended levels of calcium intake (5). In addition, adult men are not meeting recommended minimum levels of physical activity, which would also help prevent osteoporosis and other chronic diseases.

Given the putative preventable burden of osteoporosis, and the numerous benefits associated with physical activity and sound nutrition, the exploration of effective intervention strategies is warranted. The Transtheoretical Model of Behavior Change developed by Prochaska and colleagues (6) is useful to health professionals trying to help individuals change their behavior. An appealing aspect of the Transtheoretical Model of Behavior Change is that interventions can be tailored to individual readiness to change. A majority of the nutrition and Transtheoretical Model of Behavior Change research has been on the development and validation of staging algorithms with fewer intervention studies being reported. Algorithms for fat intake (7-9), fruit and vegetable intake (10-12), and fiber intake (13,14) have all been published in the past decade.

Calcium intake study is in its infancy, with few validation studies reported in the literature (15,16) and no studies reported on male participants. Therefore, the purpose of this study was to evaluate the validity of a stage-of-change algorithm for calcium intake in a sample of college-aged men. This algorithm was previously validated among a sample of female college students.

METHODS
We used a quasirandom sample of 18- to 24-year-old male students from a private university in a metropolitan area in the mid-Atlantic region of the United States. A large database of all undergraduate classes was used; classes that did not contain a minimum of 10 students were eliminated from the database. The classes were then sorted two ways: according to class level (100, 200, 300, or
Table. Characteristics of college-aged men (n=180) who completed a 26-item food frequency questionnaire to determine calcium intake and a four-question algorithm to determine Transtheoretical Model stage of changea

<table>
<thead>
<tr>
<th>Stage of change</th>
<th>n</th>
<th>%</th>
<th>Dairy-related calcium intake (mg)</th>
<th>Self-efficacy</th>
<th>Mean age (y)</th>
<th>Ethnicity (% white)</th>
<th>Smoking history (% non-smokers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precontemplation</td>
<td>55</td>
<td>32.2</td>
<td>651*</td>
<td>10.0</td>
<td>20</td>
<td>76</td>
<td>78</td>
</tr>
<tr>
<td>Contemplation/preparation</td>
<td>38</td>
<td>22.2</td>
<td>975*</td>
<td>9.8</td>
<td>19.5</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>Action/maintenance</td>
<td>78</td>
<td>45.6</td>
<td>1,484*</td>
<td>11.3*</td>
<td>19.8</td>
<td>81</td>
<td>82</td>
</tr>
</tbody>
</table>

a*Totals do not add up to 180 due to missing responses.

*Significant at P<0.05

and level of enrollment (10 to 19 students, 20 to 29 students, or >30 students). Approval from the Institutional Review Board was obtained and protocol followed, and consent forms were collected from all study participants.

Participants in this study were recruited from randomly selected classes as part of another study (15). In that study, power estimates were used to determine sample size for women (α=.05, effect size=0.3, power=0.8) (17); however, it was known a priori that one third of the students were men. Because the power estimates in the original study only applied to women, the power of the current sample was computed (effect size=0.24, power=1).

Permission was obtained to survey 194 male students (34% of the initial sample). Participants (n=14, 7.2%) were omitted if they provided incomplete data (n=6), were outside the 18- to 24-year age range (n=7), or reported calcium intake levels greater than four standard deviations from the mean (n=1). Therefore, the sample for this study consisted of 180 college-aged men between ages 18 and 24 years. The subjects were primarily 20 years old (mean 19.78±1.38 years), white (73.9%), and nonsmokers (78.3%).

Measurement Tools

The questionnaires used in this study included seven items regarding subject characteristics, the Calcium Score Sheet from the Oregon Dairy Council (18), an algorithm to assess stages of change, and a self-efficacy scale developed and validated in a previous study (15).

Subject characteristics included the age, ethnicity, and smoking history of each participant. Age was an open-ended question and the ethnicity question was a forced-choice item that included white, African American, Hispanic, Asian American, and Native American. Current and past smoking habits were also assessed.

The Calcium Score Sheet, developed by the Oregon Dairy Council, assesses daily calcium intake. This tool is easy to use, making it ideal for a college student population. The internal consistency reliability of the calcium intake items in this sample was α=.76, which is acceptable (19). The instrument contains 26 different food entries and foods are grouped from 25 mg/serving to 400 mg/serving. Respondents were asked to mark the number of servings consumed for each food during the prior 24 hours. The Score Sheet was scored by first summing the number of servings of each food entry then multiplying this number by the amount of calcium per serving. Lastly, total calcium intake was computed by summing the above product.

The next part of the questionnaire was the stage of readiness questions. Participants were classified into one of the five stages of change for calcium intake using an algorithm based on a four-question algorithm used by Campbell and colleagues (12). The first question of the staging algorithm asks respondents to estimate the number of servings of dairy products consumed on a daily basis. The decision to base the algorithm on dairy products was based on the recommendation of the Food Guide Pyramid to consume three to four servings of dairy daily, and on the fact that dairy products provide the largest amount of calcium per serving. Respondents who met the behavior criterion of three servings per day were separated into action (<6 months) or maintenance (≥6 months) groups by a question about duration of behavior. Respondents consuming less than three servings a day were asked if they were planning to increase their consumption. These respondents were then placed in the preaction stages of precontemplation, contemplation, or preparation.

A three-item scale was used to measure self-efficacy regarding calcium consumption. The scale was based on prior research measuring stages of change and self-efficacy for fruit and vegetable intake (12) and was previously employed in the validation of this calcium algorithm among women (15). These items included confidence in knowledge of calcium, ability to increase intake, and ability to increase intake of dairy products. Response options on a 5-point scale ranged from 1=not confident to 5=very confident. The self-efficacy items were summed to form a composite variable. The reliability of the scale was α=.70, which was deemed acceptable.

Frequencies were performed to determine the number of participants in each of the five stages of change. Analyses using a five-stage model were planned; however, there were few subjects in the contemplation (5.0%) and action (3.0%) stages. Thus, the five stages were collapsed into three stages, as shown in the Table. Previous studies, such as those by Campbell and colleagues (12) and Auld and colleagues (14), collapsed action and maintenance into one group. Combining the action and maintenance stages is reasonable because both include individuals who have adopted the identified behavior. The contemplation and preparation stages were combined using the rationale that both stages include participants who have
an intention to change and differ only by the anticipated amount of time for the change. Because precontemplation respondents have no intention to change, this group was left intact.

To answer the question of whether or not mean calcium intake differed according to stage of change, a one-way analysis of variance with Tukey’s post-hoc test was performed with total calcium intake from dairy sources as the dependent variable and stage of change as the independent variable. The Statistical Package for the Social Sciences (version 11.0.3 for Macintosh, 2004, SPSS Inc, Chicago, IL) was used for all statistical analyses.

RESULTS AND DISCUSSION

The study sample consisted of men aged between 18 and 24 years with a mean age of 20 years. Seventy-four percent of students were white, 3% were African American, 5% were Hispanic, 5% were Asian American, and 10% were other.

The mean calcium intake was 1,268 mg. This mean was derived from both dairy and nondairy sources of calcium. The mean dairy-related calcium intake was 1,117 mg. Thus, 88.1% of all calcium intake came from milk or milk products. Because a majority of the calcium was from dairy sources and the initial question on the staging algorithm asked the number of servings of dairy calcium, the dependent variable employed in subsequent analyses was calcium intake from dairy sources. However, to check the validity of this decision, analyses were also performed with total calcium intake as the dependent variable and the results were essentially identical. We believe that focusing exclusively on dairy sources of calcium will facilitate application of these findings by practitioners.

One-way analysis of variance revealed a significant difference in dairy-related calcium intake among the three groups ($F=26, P=0.001$). Post hoc analysis revealed that mean dairy-related calcium consumption in all pairwise comparisons differed significantly (651 mg [precontemplation] < 975 mg [contemplation and preparation] < 1,454 mg [action and maintenance]), with all differences significant at $P=0.05$ (see the Table). One-way analysis of variance indicated a significant difference in self-efficacy among the three groups ($F=7.33, P=0.001$). Post hoc analysis revealed that whereas the mean self-efficacy score between the precontemplation group (10.0) and contemplation/preparation group (9.8) did not differ, both groups were significantly different from the action/maintenance group (11.3). Hence, self-efficacy expectations toward increasing calcium consumption were positively associated with stage placement but only between the preaction and action stages.

This study provides support for the validity of a staging algorithm to measure dairy-related calcium intake in a sample of college-aged men. The findings indicate that a significant difference exists between the dairy-related calcium intake among precontemplation, contemplation/preparation, and action/maintenance stages of the Transtheoretical Model of Behavior Change.

Limitations of this study include that the population was a homogenous group of men at a private institution, and the results are therefore not generalizable. The reliance on self-reported nutrient intake rather than detailed food diaries is also noted as a limitation. In addition, no data were collected on supplement use. Furthermore, the Calcium Score Sheet has not been validated among college-aged men. In addition, similar to previous research, the contemplation and preparation stages, and the action and maintenance stages were collapsed. Although this is not consistent with the theoretical parameters outlined by Transtheoretical Model of Behavior Change developers, it is routinely done in research to facilitate meaningful analysis (12,14).

CONCLUSIONS

During the past decade, advances have been made in assessing stage of change in regard to dietary behavior. Fat, fiber, fruit, and vegetables have all been studied. These studies have consistently demonstrated that although challenges remain, progress is being made to establish staging algorithms for a variety of nutrition behaviors. This study on college-aged men provides preliminary evidence to support the validity of a staging algorithm for calcium intake among collegiate men and supports the potential usefulness of a dairy calcium algorithm tool by dietetics professionals. The addition of this algorithm may move us closer to the development of a multinutrient staging mechanism.

References