THE UNIVERSITY OF RHODE ISLAND

University of Rhode Island
DigitalCommons@URI

Nutrition and Food Sciences Faculty Publications

Nutrition and Food Sciences

7-1-2016

A Nutrition Intervention to Increase Whole Grain Intake in College Students

Jennifer Arts

Catherine English

Geoffrey Greene
University of Rhode Island, ggreene@uri.edu

Ingrid E. Lofgren
University of Rhode Island, ingrid_lofgren@uri.edu

Follow this and additional works at: https://digitalcommons.uri.edu/nfs_facpubs

The University of Rhode Island Faculty have made this article openly available. Please let us know how Open Access to this research benefits you.

Terms of Use
This article is made available under the terms and conditions applicable towards Open Access Policy Articles, as set forth in our Terms of Use.

Citation/Publisher Attribution
Arts, Jennifer PhD, RD, LDN; English, Catherine PhD, RD, LDN; Greene, Geoffrey W. PhD, RD, LDN; Lofgren, Ingrid E. PhD, MPH, RD A Nutrition Intervention to Increase Whole Grain Intake in College Students, Topics in Clinical Nutrition: July/September 2016 - Volume 31 - Issue 3 - p 222-231 doi: 10.1097/TIN.0000000000000075

This Article is brought to you for free and open access by the Nutrition and Food Sciences at DigitalCommons@URI. It has been accepted for inclusion in Nutrition and Food Sciences Faculty Publications by an authorized administrator of DigitalCommons@URI. For more information, please contact digitalcommons-group@uri.edu.

A Nutrition Intervention to Increase Whole Grain Intake in College Students

The University of Rhode Island Faculty have made this article openly available.
Please let us know how Open Access to this research benefits you.

This is a pre-publication author manuscript of the final, published article.

Terms of Use
This article is made available under the terms and conditions applicable towards Open Access Policy Articles, as set forth in our Terms of Use.

This article is available at DigitalCommons@URI: https://digitalcommons.uri.edu/nfs_facpubs/91

INTRODUCTION:

Heart disease is one of the top five leading causes of death in young adults [1]. Many coronary heart disease (CHD) risk factors surface in adolescence [1-4] and track forward to adulthood [5]. Poor dietary choices made by college students including diets low in whole grains [6] and high in saturated fat from dairy sources [7] contribute to these risk factors. Since 80% of cardiovascular events are preventable through diet and lifestyle [8], primordial and primary prevention approaches are emphasized in the American Heart Association's 2020 Strategic Impact Goals [9] and in the National Heart, Lung and Blood Institute's 2012 Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents [10]. Despite this emphasis on the importance of early prevention efforts, little has been done to address heart disease risk in young adults who are unaware [11] and have not been screened for CHD risk [12].

The few cross-sectional studies that have assessed CHD risk in college students ages 18-24 demonstrate the need for increased screening, risk assessment and disease prevention interventions in this age group [13-16]. Burke et al. reported that more than 50% of college students have elevated low-density lipoprotein cholesterol (LDL-C) [17], as many as 27% have elevated total cholesterol (TC) and 47% have hypertension [17]. Similar studies have found that 18% have elevated triacylglycerides (TAG), 20% have low high-density lipoprotein cholesterol (HDL-C) [16] and 13% have elevated glucose [18]. These risk factors are strongly correlated with the extent of atherosclerotic lesions [19].

Some studies have found that college students' diets are high in saturated fat[7] and low in whole grains, [6] which negatively affect these risk factors, especially LDL-C; as many as 70% exceed total and saturated fat recommendations [7]. College students also fail to meet whole grain recommendations [6,20], consuming only 12% (0.37 oz) of the recommended minimum of 3 oz [6]. Low-density lipoprotein cholesterol concentrations can be improved by decreasing saturated fat and increasing whole grain consumption [21,22].

Because 42% of US young adults attend college or universities[23], these campuses provide an ideal opportunity to target young adults at a point in life when lifestyle choices are being made and before disease progression occurs [24,25]. Previous research has demonstrated that increased awareness of healthy options through point-of-selection (POS) signage and benefit-based messages has increased the selection of healthier options in university dining halls [26-29]. Recently, technology has been used to promote behavior change in college students [30-34]. To the best of our knowledge, this is the first study to utilize both point-of-selection and text messaging in a nutrition intervention on a college campus. The purpose of this study was to increase whole grain consumption through a nutrition intervention in campus dining halls. A secondary aim was to improve CHD risk factors. An exploratory aim was to analyze the impact of a text messaging intervention on whole grain and low-fat dairy intake and CHD risk factors in a subsample of participants.

METHODS:

Design

A single group design was used to assess the impact of a whole grain and low-fat dairy intervention on CHD risk factors. Baseline and post-intervention assessments were conducted in the fall semester immediately before and after the six-week intervention and the follow-up assessment occurred in the spring semester six months after the baseline assessment. A subsample (n=26) was recruited for additional measures. All measurements described were obtained at baseline, post-intervention and follow-up.

Sample

Classroom announcements were used to recruit students from large general education courses at a medium sized northeastern university. Eligibility criteria were age (18-24 years), having a campus meal plan and a BMI ≥18.5 kg/m^2. Of the 1434 students that were invited to participate, 170 completed the initial screener but 13 of these were ineligible due to age and BMI. Other exclusion criteria included being pregnant or lactating, or self-report of one of the following conditions: eating disorder, liver disease, bleeding disorder, diabetes, cancer, or CHD; however, none of these were reported. Of the 157 eligible students, fifty-nine failed to schedule or attend baseline assessment visits resulting in a sample of ninety-eight students who completed baseline assessments. A subsample was recruited for additional measures including 24-hour dietary recalls based on responses to the green eating stage of change question from the Green Eating Questionnaire [35]. Eligible participants were in the precontemplation, action or maintenance stages of change according to the Transtheoretical Model. Twenty-six students consented to participate in the exploratory subsample measures. All participants read and signed an informed consent approved by the University's Institutional Review Board.

Measures

Dietary Intake

The National Health and Nutrition Examination Survey (NHANES) 2009-2010 National Cancer Institute Dietary Screener Questionnaire (NCI Screener) was used to assess intake of fruits and vegetables, dairy/calcium, whole grains/fiber, added sugars, red meat, and processed meat in all participants [36].

Purchasing records from dining services were used as a proxy for whole grain and low-fat dairy consumption. Purchasing records were obtained for bread and dairy products that offered a whole grain or low-fat dairy alternative (bread, rolls, breadsticks, English muffins, milk and yogurt) to determine if students selected the whole grain or low-fat dairy option. Purchasing records were a viable estimate for consumption as dining services indicated that due to the high perishability of these items; what is ordered is what gets consumed. Purchasing records were obtained at baseline, throughout the intervention, post-intervention and 6-month follow-up. Average values were calculated for individual items at each time point and were used for the analyses.

Twenty-four hour dietary recalls were collected and analyzed for the subsample of participants (n=26) using the multiple pass method in conjunction with the Nutrition Data System for Research (NDS-R) software (University of Minnesota, Minneapolis, MN) version 2012. All participants completed three 24-hour dietary recalls: one in-person and two over the phone on three non-consecutive days (including two weekdays and one weekend day) [37,38]. Nasco food models (eNasco, Fort Atkinson, WI) and food amounts booklets were available during the initial in-person 24-hour recall to more accurately estimate portion size [39]. Participants were given the booklets after the initial recall for the phone recalls. The mean values of the three recalls provided dietary data for analysis. Healthy Eating Index 2010 scores were calculated from the mean values from the three 24-hour recalls to assess diet quality in the subsample of participants (n=26).

Biochemical

Following a 12-hour fast, finger sticks were performed on all participants to obtain blood samples for determination of blood lipid and glucose concentrations. Finger sticks were performed by trained study staff. Values for LDL-C, TC, TAG, HDL-C and glucose were obtained using Cholestech LDX tabletop analyzers (Cholestech, Hayward, CA).

Anthropometrics

Height was measured to the nearest 0.1 cm using a Seca 220 stadiometer (Seca Corporation, Hamburg, Germany). Weight was measured to the nearest 0.1 kg using a calibrated digital Seca 769 scale (Seca Corporation, Hamburg, Germany). Measurements were taken in duplicate and the average of the two values was used for the analysis. Body mass index was calculated using the following formula: weight in kilograms/height in meters^2. Waist circumference was measured in duplicate at the top of the iliac crest upon exhalation to the nearest 0.1 cm using a Gulick fiberglass, non-stretchable tape measure with an attached tensometer (Patterson Medical, Mount Joy, PA). The average of the two values was used for the analysis.

Blood Pressure

Blood pressure was measured after a 5 minute seated rest period using an automatic blood pressure monitor with arm cuff (Omron HEI-711, Omron Health Care

Products, Issaquah, WA). Measurements were re-taken two minutes apart until values were within 2 mmHg. The average of the two values in agreement was used for the analysis.

Intervention

All ninety-eight participants were exposed to a 6-week intervention which consisted of benefit-based nutrition messages in the two student campus dining halls at the university. Students with meal plans were able to eat at either dining hall; all students who ate at the dining halls were exposed to the intervention. Sample messages included: “Make the switch to whole grain breads and wraps to stay full longer” and “Maintain a healthy weight…choose low fat dairy.” Messages were displayed on television monitors and on point-of-selection signs at the deli and dairy stations in the two main dining halls. Messages were visible throughout the day and new messages were displayed each morning (Monday through Friday). A total of five whole grain messages and five low-fat dairy messages were developed by a team of six registered dietitians. Messages were repeated after the initial Monday through Friday sequence for reinforcement.

Prompts to choose whole grain bread were also verbally provided by the deli station staff in both dining halls. These standard prompts were given to all students who visited the deli station. Additionally, nutrition education booths to promote whole grain and low-fat dairy consumption were positioned in a high traffic area outside of dining hall 1 only (due to space constraints in dining hall 2). Message and booth content alternated between whole grains and low-fat dairy each week. Whole grains and low-fat dairy were promoted for a total of three weeks each for a total intervention period of 6 weeks.

Message and booth content addressed specific motivators of healthy eating (increased energy, healthy body weight and staying full) from nine previously conducted focus groups that addressed motivators and barriers to healthful eating in buffet-style dining halls [40]. Additionally, the subsample of participants received the same nutrition message that was displayed on the television monitors in the dining halls each weekday via text message or email, depending on their preference. Google Voice (Google, Mountain View, CA), a web-based application, was used to deliver text messages. A post-intervention online survey was administered to solicit feedback on the preferred method of message delivery.

Analysis

Descriptive statistics were performed and skewness and kurtosis were examined to determine data distribution. Non-normally distributed data were transformed. Body mass index, LDL-C, total grains, low-fat dairy and soluble fiber were log transformed. Triacylglycerides and sugar-sweetened beverages (SSB) were square root transformed. Whole grains, semi-whole grains, total fiber, reduced fat dairy, glucose and systolic blood pressure (SBP) were analyzed using non-parametric tests. Continuous variables were expressed as mean ± standard deviation and categorical variables were expressed as frequencies. Repeated measures analysis of variance with post hoc tests using the Bonferroni adjustment were used to determine if there were significant differences over time. The Friedman test with post hoc Wilcoxon signed rank tests using a Bonferroni adjusted alpha value were used to assess differences over time for whole grains, semi-whole grains, fiber and glucose. Mixed between-within analysis of variance assessed differences between groups over time. Chi-square tests were used to analyze categorical variables. Statistical significance was set at $p<0.05$ for all tests.

RESULTS:

Participants

Participant characteristics at baseline are presented in Table 1. The majority of the sample was female (78%) and Caucasian (81%). The mean age was 18.2 ± 0.6 years. At baseline, more than 50% of females and 36% of males had low HDL-C for gender (<40 male, <50 female mg/dL), 19% had elevated LDL-C (≥100 mg/dL), 14% had elevated TAG (≥150 mg/dL) and 13% had elevated SBP (≥130 mmHg). More than 80% of the sample had never or were unsure as to whether they ever had their cholesterol checked. Sixty-three participants completed all three assessment visits and 18 of these 63 completed additional measurements for subsample analyses. There were no differences in dietary variables or CHD risk factors by attrition status except for TAG (data not shown). Completers (n=63) had higher TAG at baseline compared to non-completers (n=35).

Whole Grain Intake

As shown in Figure 1, data from the NCI Screener indicated that whole grain intake increased over time (p=0.005). Whole grain intake increased from baseline to follow-up (0.8 ± 1.1 oz to 1.1 ± 1.5 oz, p=0.008) and from post-intervention to follow-up (0.8 ± 0.8 oz to 1.1 ± 1.5 oz, p=0.006). Purchasing record data (used as a proxy for consumption) indicated that percent whole grain consumption doubled (12.7% to 23.9%) in dining hall 1 during the 6-week intervention (data not shown). In dining hall 1, baseline whole grain consumption was significantly lower than the intervention and follow-up period but not different from post-intervention. In dining hall 2, whole grain consumption significantly increased across baseline, post-intervention and follow-up periods. Dining hall 2 had significantly higher whole grain consumption compared to dining hall 1 at all time points.

CHD Risk Factors

As displayed in Table 2, there were no changes in LDL-C over time ($p=0.17$, $\eta^2=0.06$). However, positive changes were seen in HDL-C over time ($p=0.002$, $\eta^2=0.18$). There was also a significant effect of time for glucose (χ^2 (2, n=61) = 11.92, $p=0.003$). Significant increases in body weight ($p<0.001$, $\eta^2=0.28$) and BMI ($p=0.001$, $\eta^2=0.22$) were observed over time.

Dairy Intake

There was no primary measure of low-fat dairy intake. However, purchasing records used as a proxy for dairy intake indicated that nonfat dairy intake increased by 3-4% during the intervention and was significantly higher at follow-up compared to other time points in dining hall 1 (data not shown). Data from the NCI screener showed that total dairy intake decreased over time ($p=0.003$, $\eta^2=0.15$). Sugar-sweetened beverages (SSB) also significantly decreased over time ($p=0.005$, $\eta^2=0.14$).

Exploratory Analyses

Exploratory analyses on the eighteen completers from the subsample of twenty-six revealed no changes over time in whole grain intake as assessed by 24-hr dietary recalls (p=0.678, η^2=0.05). There were no changes in LDL-C over time (p=0.678, η^2=0.05). High-density lipoprotein cholesterol increased (p=0.026, η^2=0.37).

The subsample of participants also had significant increases in weight (p=0.012, η^2=0.42), BMI (p=0.042, η^2=0.33) and WC (p=0.016, η^2=0.40) over time. Significant pairwise comparisons are as follows. Weight increased from baseline to post-intervention (69.1 ± 13.3 kg to 70.1 ± 13.7 kg, p=0.029) and from baseline to follow-up (69.1 ± 13.3 kg to 70.6 ± 13.8 kg, p=0.030). Body mass index increased from baseline to post-intervention (25.1 ± 4.9 kg/m^2 to 25.4 ± 5.0 kg/m^2, p=0.049) and from baseline to follow-up (25.1 ± 4.9 kg/m^2 to 25.6 ± 4.9 kg/m^2, p=0.022). Waist circumference increased from baseline to post-intervention in this subsample (82.5 ± 11.5 cm to 84.0 ± 12.5 cm, p=0.022).

Twenty-four hour recall data showed no changes in total grain, semi-whole grain, refined grain, fiber, total dairy, full fat dairy, reduced fat dairy, low-fat dairy or saturated fat intake in subsample analyses (p>0.05). Energy intake significantly decreased over time (p=0.014, η^2=0.42). Decreases in energy intake occurred from baseline to post-intervention (1896.4 ± 553.3 kcals to 1658.0 ± 491.1 kcals, p=0.009). There were no significant changes over time in overall diet quality as measured by the Healthy Eating Index-2010 (p=0.39).

Mixed between-within ANOVAs comparing the general sample and the subsample indicated that there was a significant effect of time for HDL-C (p=0.004,

η^2=0.17) and total dairy (p=0.024, η^2=0.10) but no significant differences existed between groups. There was also a significant effect of time and group for weight (time: p<0.001, η^2=0.28, group: p=0.033, η^2=0.07) and BMI (time: p=0.001, η^2=0.20, group: p=0.031, η^2=0.02). The mean values for weight and BMI were significantly greater in the subsample compared to the general sample at each time point. Due to data distribution, a mixed between-within analysis could not be performed for whole grains.

A post-intervention survey revealed that nearly 80% of participants noticed the messages. Seventy percent reported that the messages prompted them to choose whole grains, while only 40% indicated that the messages prompted them to choose low-fat dairy. Point-of-selection messaging was perceived to be the most effective messaging delivery method for both whole grains and low-fat dairy.

DISCUSSION:

The results of this study demonstrate that nutrition POS messaging in campus dining halls is an effective strategy to increase whole grain intake in college students. Improvements in HDL-C were seen. Declines in total dairy intake over time suggest that the focus of interventions should shift from low-fat dairy to total dairy, as this age group is failing to meet total dairy recommendations.

Whole grain consumption (as measured by the NCI screener) increased by nearly 40% from baseline to follow-up. This is supported by the purchasing records, which indicated that percent whole grain consumption doubled during the 6-week intervention. It is also consistent with the findings from pilot testing in the spring of 2012 that showed a 12% increase in whole grains when messages were displayed in dining halls for one-week. Although increases in whole grain consumption were observed, mean intake at follow-up still fails to meet recommendations. This is consistent with findings by Ha et al. [6] that reported a significant increase in whole grain consumption from 0.37 oz to 1.16 oz in college students after a whole grain intervention embedded in a semester-long nutrition course. Despite this increase, whole grain intake after the intervention was >50% less than the minimum recommendation of 3 oz. Similarly, a 2014 review of dietary interventions in college students also indicated that dietary changes made by this group are often minimal and not maintained [41]. Exploratory analyses on Heart Start II participants who received the additional text messages indicated that this subgroup had non-significant increases in their whole grain intake. This may be attributed to the small sample size in this subgroup analysis (n=18).

Baseline CHD risk factor prevalence data was similar to previous cross-sectional estimates of CHD risk factors in this age group [14-16,42]. Despite this documented presence of risk factors in college students, there is a lack of research assessing the impact of nutrition interventions on CHD risk factors in college students. Spinler et al. [7] reported no changes in total fat, saturated fat or plasma cholesterol concentrations over a 3-month period following a nutrition and cardiovascular disease education in pharmacy students. Although there were no changes in LDL-C in the present study, there were improvements in HDL-C and low HDL-C was the most prevalent risk factor in this sample of college students. The significant increase in HDL-C over time may be explained by the dietary changes, as increases in whole grains have been associated with improvements in HDL-C [43].

Weight gain during the first year of college is well documented [44-49]. Our sample gained less weight than has been previously reported in this age group [47,48]. Although weight status was not a primary aim of the intervention, the weight gain observed in this population highlights the need for weight gain prevention efforts in this age group. However, interventions focusing on weight must be sensitive to the higher prevalence of disordered eating in this age group [50,51].

Purchasing records showed a slight increase in non-fat dairy over time but the NCI Screener indicated that total dairy intake decreased over time. Since this screener did not allow for the analysis of components of total dairy (reduced fat, low-fat, nonfat) it cannot be determined whether there was a shift to low-fat dairy over time. A decrease in total dairy, however, is consistent with previous findings [52,53] and provides evidence for the need for additional efforts in this age group to prevent further declines in dairy intake. A reduction in dairy intake typically coincides with an increase in SSB as a result of displacement [54]. In this sample, however, SSB consumption significantly decreased along with dairy consumption over time. Decreased consumption of dairy at follow-up may be a function of weight conscious eating behaviors that occur pre-spring break in anticipation of beaches, as dairy is perceived to be “fattening” [26,55]. Similarly, purchasing records at follow-up showed an increase in whole grain consumption, which may be a function of pre-spring break healthier eating.

Feedback on the individual intervention components revealed that POS messaging was the preferred method of messaging. Point-of-selection messaging has previously been shown to be an effective nutrition strategy to promote healthy choices in college dining halls [56]. In a dining hall intervention that utilized signs, table tents, flyers and benefit-based messages, college students reported increased awareness of healthy options as the primary reason for selecting healthier choices [26].

A major strength of this study was the use of multiple measures to assess dietary intake. To the best of our knowledge, this was the first study to use purchasing records to quantify intake in campus dining halls. An additional strength was the use of multiple methods of message delivery. Although previous studies have used text messaging as an intervention delivery method in this age group [30-33,57], this was the first to use text messages to target dietary choices known to have a positive impact on CHD risk. Participant replies to text messages suggest that text messaging is an effective way to engage this age group.

Limitations

Despite these strengths, there were some limitations. The majority of the sample was freshmen, female and Caucasian, limiting the extent to which results can be generalized to other populations. The high percentage of Caucasian participants was, however, consistent with the ethnicity makeup at URI (21% non-Caucasian). The low response rate was another limitation. The use of purchasing records as a proxy for consumption also has limitations. Items were chosen that dining services reported as having minimal waste but plate waste could not be accounted for. Another limitation was the lack of a primary measure for low-fat dairy. In addition, the use of finger sticks for lipid determination may have introduced more error than standard laboratory methods but this error is greatly reduced when performed by experienced personnel [58].

Conclusion

College campuses provide an ideal setting to promote healthier dietary choices. Targeting young adults at a point in their lives when lifestyle choices are being made presents an opportunity to influence lifelong eating habits and improve CHD risk factors in this population. Overall, findings from this study indicate that a nutrition intervention was effective in increasing whole grain intake in college students. This study demonstrates that relatively small environmental changes such as POS messaging in campus dining halls can positively impact dietary intake and improve CHD risk factors in college students. A concerted effort from health professionals, policy makers, dining hall managers and on-campus restaurant owners is needed to create an environment that promotes the adoption of lifelong healthy behaviors. Future research should focus on implementing nutrition approaches to promote healthy eating on college campuses as cost-effective ways to guide students in making better dietary choices.

References:

1. Centers for Disease Control and Prevention. Health, United States, 2010. http://www.cdc.gov/nchs/data/hus/hus10.pdf. Accessed June 22, 2011.
2. National Heart, Lung and Blood Institute. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. 2004:1-104.
3. Centers for Disease Control and Prevention. Health, United States, 2008 with Special Feature on the Health of Young Adults. 2008. http://www.cdc.gov/nchs/data/hus/hus08.pdf. Accessed July 12, 2013.
4. National Cholesterol Education Program Expert Panel on Detection Evaluation, Treatment of High Blood Cholesterol in Adults. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation.* 2002;106(25):3143-3421.
5. Camhi SM, Katzmarzyk PT. Tracking of cardiometabolic risk factor clustering from childhood to adulthood. *Int J Pediatr Obes.* 2010;5(2):122-129.
6. Ha EJ, Caine-Bish N. Interactive introductory nutrition course focusing on disease prevention increased whole-grain consumption by college students. *J Nutr Educ Behav.* 2011;43(4):263-267.
7. Spinler SA, de Denus S, Earl G, Cheng JW. Plasma cholesterol concentrations, dietary fat intake, and cholesterol intake in pharmacy students. *J Am Pharm Assoc.* 2003;43(5):590-595.

8. Stampfer MJ, Hu FB, Manson JE, Rimm EB, Willett WC. Primary prevention of coronary heart disease in women through diet and lifestyle. *N Engl J Med.* 2000;343(1):16-22.

9. Lloyd-Jones DM, Hong Y, Labarthe D, et al. Defining and setting national goals for cardiovascular health promotion and disease reduction: the American Heart Association's strategic Impact Goal through 2020 and beyond. *Circulation.* 2010;121(4):586-613.

10. National Heart, Lung and Blood Institute. Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents. 2012. https://www.nhlbi.nih.gov/files/docs/peds_guidelines_sum.pdf. Accessed August 12, 2013.

11. Muñoz LR, Etnyre A, Adams M, et al. Awareness of Heart Disease Among Female College Students. *J Womens Health.* 2010;19(12):2253-2259.

12. Kuklina EV, Yoon PW, Keenan NL. Prevalence of coronary heart disease risk factors and screening for high cholesterol levels among young adults, United States, 1999-2006. *Ann Fam Med.* 2010;8(4):327-333.

13. Huang TT, Shimel A, Lee RE, Delancey W, Strother ML. Metabolic Risks among College Students: Prevalence and Gender Differences. *Metab Syndr Relat Disord.* 2007;5(4):365-372.

14. Huang TT, Kempf AM, Strother ML, et al. Overweight and components of the metabolic syndrome in college students. *Diabetes Care.* 2004;27(12):3000-3001.

15. Morrell JS, Lofgren IE, Burke JD, Reilly RA. Metabolic syndrome, obesity, and related risk factors among college men and women. *J Am Coll Health.* 2012;60(1):82-89.
16. Fernandes J, Lofgren IE. Prevalence of metabolic syndrome and individual criteria in college students. *J Am Coll Health.* 2011;59(4):313-321.
17. Burke JD, Reilly RA, Morrell JS, Lofgren IE. The University of New Hampshire's Young Adult Health Risk Screening Initiative. *J Am Diet Assoc.* 2009;109(10):1751-1758.
18. Pan Y, Pratt CA. Metabolic syndrome and its association with diet and physical activity in US adolescents. *J Am Diet Assoc.* 2008;108(2):276-286; discussion 286.
19. Berenson GS, Srinivasan SR, Bao W, Newman WP, 3rd, Tracy RE, Wattigney WA. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. The Bogalusa Heart Study. *N Engl J Med.* 1998;338(23):1650-1656.
20. Rose N, Hosig K, Davy B, Serrano E, Davis L. Whole-grain intake is associated with body mass index in college students. *J Nutr Educ Behav.* 2007;39(2):90-94.
21. Anderson JW, Hanna TJ, Peng X, Kryscio RJ. Whole grain foods and heart disease risk. *J Am Coll Nutr.* 2000;19(Sup 3):291S-299S.
22. Grundy SM, Denke MA. Dietary influences on serum lipids and lipoproteins. *J Lipid Res.* 1990;31(7):1149-1172.

23. U.S. Department of Commerce U.S. Census Bureau. School Enrollment. 2011; http://www.census.gov/hhes/school/data/cps/2011/tables.html. Accessed January 28, 2012.

24. Goldstein CM, Xie SS, Hawkins MAW, Hughes JW. Reducing Risk for Cardiovascular Disease: Negative Health Behaviors in College Students. *Emerg Adulthood.* 2015;3(1):24-36.

25. Spencer L. Results of a heart disease risk-factor screening among traditional college students. *J Am Coll Health.* 2002;50(6):291-296.

26. Peterson S, Duncan DP, Null DB, Roth SL, Gill L. Positive changes in perceptions and selections of healthful foods by college students after a short-term point-of-selection intervention at a dining hall. *J Am Coll Health.* 2010;58(5):425-431.

27. Freedman MR, Connors R. Point-of-Purchase Nutrition Information Influences Food-Purchasing Behaviors of College Students: A Pilot Study (Reprinted from American Dietetic Association, vol 110, pg 1222-1226, 2010). *J Am Diet Assoc.* 2011;111(5):S42-S46.

28. Driskell JA, Schake MC, Detter HA. Using Nutrition Labeling as a Potential Tool for Changing Eating Habits of University Dining Hall Patrons. *J Am Diet Assoc.* 2008;108(12):2071-2076.

29. Nikolaou CK, Hankey CR, Lean ME. Preventing weight gain with calorie-labeling. *Obesity (Silver Spring).* 2014;22(11):2277-2283.

30. Mason M, Benotsch EG, Way T, Kim H, Snipes D. Text Messaging to Increase Readiness to Change Alcohol Use in College Students. *J Prim Prev*. 2014;35:47-52.

31. Bicard DF, Lott V, Mills J, Bicard S, Baylot-Casey L. Effects of text messaged self-monitoring on class attendance and punctuality of at-risk college student athletes. *J Appl Behav Anal.* 2012;45(1):205-210.

32. Obermayer JL, Riley WT, Asif O, Jean-Mary J. College smoking-cessation using cell phone text messaging. *J Am Coll Health.* 2004;53(2):71-78.

33. Napolitano MA, Hayes S, Bennett GG, Ives A, Foster GD. Using Facebook and Text Messaging to Deliver a Weight Loss Program to College Students. *Obesity (Silver Spring).* 2012.

34. Brown ON, O'Connor LE, Savaiano D. Mobile MyPlate: a pilot study using text messaging to provide nutrition education and promote better dietary choices in college students. *J Am Coll Health.* 2014;62(5):320-327.

35. Weller KE, Greene GW, Redding CA, et al. Development and validation of green eating behaviors, stage of change, decisional balance, and self-efficacy scales in college students. *J Nutr Educ Behav.* 2014;46(5):324-333.

36. National Cancer Institute. Dietary Screener Questionnaire. 2010. Accessed May 25, 2012.

37. Casey PH, Goolsby SL, Lensing SY, Perloff BP, Bogle ML. The use of telephone interview methodology to obtain 24-hour dietary recalls. *J Am Diet Assoc.* 1999;99(11):1406-1411.

38. Dwyer J, Picciano MF, Raiten DJ, Comm S. Collection of food and dietary supplement intake data: What We Eat in America-NHANES. *J. Nutr.* 2003;133(2):590S-600S.

39. Serdula MK, Alexander MP, Scanlon KS, Bowman BA. What are preschool children eating? A review of dietary assessment. *Ann Rev Nutr.* 2001;21:475-498.

40. Hirshberg S LJ, Lofgren I. What do college students want? A qualititative study exploring nutrition language and knowledge. *FASEB J.* 2012;26:246.243.

41. Kelly NR, Mazzeo SE, Bean MK. Systematic review of dietary interventions with college students: directions for future research and practice. *J Nutr Educ Behav.* 2013;45(4):304-313.

42. Huang TT, Harris KJ, Lee RE, Nazir N, Born W, Kaur H. Assessing overweight, obesity, diet, and physical activity in college students. *J Am Coll Health.* 2003;52(2):83-86.

43. Behall KM, Scholfield DJ, Hallfrisch J. Lipids significantly reduced by diets containing barley in moderately hypercholesterolemic men. *J. Am. Coll. Nutr.* 2004;23(1):55-62.

44. Vella-Zarb RA, Elgar FJ. The 'freshman 5': a meta-analysis of weight gain in the freshman year of college. *J Am Coll Health.* 2009;58(2):161-166.

45. Morrow ML, Heesch KC, Dinger MK, Hull HR, Kneehans AW, Fields DA. Freshman 15: fact or fiction? *Obesity (Silver Spring).* 2006;14(8):1438-1443.

46. Economos CD, Hildebrandt ML, Hyatt RR. College freshman stress and weight change: differences by gender. *Am J Health Behav.* 2008;32(1):16-25.

47. Anderson DA, Shapiro JR, Lundgren JD. The freshman year of college as a critical period for weight gain: an initial evaluation. *Eat Behav.* 2003;4(4):363-367.

48. Levitsky DA, Halbmaier CA, Mrdjenovic G. The freshman weight gain: a model for the study of the epidemic of obesity. *Int J Obes Relat Metab Disord.* 2004;28(11):1435-1442.

49. Gropper SS, Simmons KP, Gaines A, et al. The freshman 15-a closer look. *J Am Coll Health.* 2009;58(3):223-231.

50. Kelly-Weeder S, Phillips K, Leonard K, Veroneau M. Binge eating and weight loss behaviors of overweight and obese college students. *Journal of the American Association of Nurse Practitioners.* 2013.

51. Unwin BK, Goodie J, Reamy BV, Quinlan J. Care of the college student. *Am Fam Physician.* 2013;88(9):596-604.

52. Storey ML, Forshee RA, Anderson PA. Beverage consumption in the US population. *J Am Diet Assoc.* 2006;106(12):1992-2000.

53. Ranganathan R, Nicklas TA, Yang SJ, Berenson GS. The nutritional impact of dairy product consumption on dietary intakes of adults (1995-1996): the Bogalusa Heart Study. *J Am Diet Assoc.* 2005;105(9):1391-1400.

54. Rampersaud GC, Bailey LB, Kauwell GP. National survey beverage consumption data for children and adolescents indicate the need to encourage a shift toward more nutritive beverages. *J Am Diet Assoc.* 2003;103(1):97-100.

55. Nolan-Clark DJ, Neale EP, Probst YC, Charlton KE, Tapsell LC. Consumers' salient beliefs regarding dairy products in the functional food era: a qualitative

study using concepts from the theory of planned behaviour. *BMC Public Health.* 2011;11:843.

56. Reed JA, Powers A, Greenwood M, Smith W, Underwood R. Using "point of decision" messages to intervene on college students' eating behaviors. *Am J Health Promot.* 2011;25(5):298-300.

57. Schembre SM, Yuen J. Project TwEATs. A feasibility study testing the use of automated text messaging to monitor appetite ratings in a free-living population. *Appetite.* 2011;56(2):465-468.

58. Santee J. Accuracy and precision of the Cholestech LDX System in monitoring blood lipid levels. *Am J Health Syst Pharm.* 2002;59(18):1774-1779.