# Nutrient Intake and Diet Quality According to Meal Plan Use in College Students

Fiona H. Shorrock[1], Hawley C. Almstedt[2*]

[1]Johns Hopkins Hospital, United States.

[*2]Department of Health and Human Sciences, Loyola Marymount University

1 LMU Drive, MS 8888, Los Angeles, CA 90045, United States.

## REVIEW

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***Corresponding Author:**

Hawley C. Almstedt,

Department of Health and Human Sciences, Loyola Marymount University, 1 LMU Drive, MS 8888, Los Angeles, CA 90045, United States, Tel: 310-338-1925;

Fax: 310-338-5317; E-mail: Hawley.almstedt@lmu.edu

## ABSTRACT

College years are an important time in life for developing lifelong habits, including a healthy diet. **Objective:** One goal of this study was to analyze nutrient intake and diet quality of college students by comparing consumption of nutrients and MyPlate servings between students who use and do not use a meal plan (MP). A second aim was to assess how the diet changed over a 12-month period in combination with changes in MP use. **Methods:** A food frequency questionnaire measured nutrient intake and MyPlate servings of students (n=147) at baseline and 12 months. Students were placed into 3 groups: those who stopped MP use [MP-NMP (no meal plan), n=43], those who continued with a MP (MP-MP, n=71), and those never using a MP (NMP-NMP, n=33). **Results:** Except for protein and iron, few students met the DRIs for important nutrients. Percent of kilocalories from carbohydrate (P=0.01), added sugar (P=0.02), vitamin D (P=0.03), calcium (P=.01), potassium (P=0.02), and dairy consumption (P=.005) decreased over time for all students. The MP-MP group decreased intake of protein (P=0.02), fiber (P=0.01), calcium (P=0.004), iron (P=0.02), potassium (P=0.009), sodium (P=.05), fruit (P=0.001), and dairy (P=0.001). MP-NMP students had a 4% decrease in percent of kcals from carbohydrate (P=0.05). The NMP-NMP group showed a significant decrease in vitamin D (P=0.04). **Conclusions:** College students consumed a poor-quality diet, lacking essential nutrients, while MP and NMP users displayed similar dietary shortfalls. Further research is needed to explore the decline in nutrient intake and diet quality of long-term MP users.

**Keywords:** Dietary reference intake, added sugar, fruit, vegetables, chronic disease.

## ABBREVIATIONS

AI – adequate intake

AMDR – acceptable macronutrient distribution range

BMI – body mass index

DRI – dietary reference intake

EAR – estimated average requirement

FFQ – food frequency questionnaire

MANCOVA – multivariate analysis of covariance

MP – meal plan

MVPA – moderate to vigorous physical activity

NMP – non-meal plan

SFA – saturated fatty acids

## INTRODUCTION

Emerging adults experience many lifestyle changes associated with increased autonomy and new responsibilities during the transition to college [1]. Lifestyle habits formed during the college years can have a long-term impact on physical health and overall wellbeing [2, 3]. Research among emerging adults is of great importance since most do not perceive themselves at risk for chronic disease [4] and the transition from adolescence to adulthood is when lifelong habits are solidified [2]. Even though the early college years are an important time for developing enduring habits, nutrient status and diet quality among this population have not been researched adequately [3].

The number of young adults forecasted to attend American universities is up to 19.9 million, a 30% increase in the last 10 years [5]. Many college students who live on-campus purchase a meal plan (MP) to use campus dining facilities. With a majority (61%) of college students attending fulltime and 67% at 4-year institutions [5], college students using MPs are an ideal population for nutrition education [6] to promote optimal health and lower risk for chronic disease [7]. Frequent obstacles to healthy eating among college students are time constraints, stress, expensive cost of nutritious foods, and plentiful access to unhealthy options [8]. Some research suggests that use of a MP during college years may offer small nutritional benefits [9], in particular for fruit and vegetable consumption [10-12], however other research found no influence of MP use on dietary patterns [13]. However, in general data suggest that few college students consume a nutritionally adequate diet [9, 10, 14, 15].

Several studies report poor diet quality among college students [16], specifically low fiber and vegetable intake [17] as well as inadequate consumption of some vitamins and minerals [18]. This observation may be influenced by factors such as discipline of study [18], place of residence [19], food security [20], and income or academic performance [21]. Prior work investigating food intake of college students living on or off campus has not considered Dietary Reference Intakes (DRI) or current MyPlate recommendations [12, 14, 22, 23]. DRIs are established guidelines used to evaluate nutrient intake [24, 25]. Specifically, the U.S. Dietary Guidelines consider percent of kcals from saturated fatty acids (SFA) and consumption of whole grains, fiber, added sugar, vitamin D, calcium, iron, potassium, and sodium as items of concern for Americans [26]. MyPlate serving recommendations are also helpful guidelines and, for the purpose of this research, will be used to evaluate diet quality [26]. Previous research on food group consumption [9, 14, 22, 27] and dietary patterns [13, 23] is valuable but lacks specificity needed to properly understand micronutrient intake and dietary implications for risk of chronic disease. Cross-sectional analysis further limits existing research and contributes to a lack of understanding of how the diet changes in conjuncture with longitudinal MP use or cessation [9, 10, 23].

One goal of this study was to analyze nutrient intake and diet quality of college students by comparing consumption of 12 important nutrients and MyPlate servings between students who use and do not use a campus offered MP. In order to fill the current gap in research published to date, we aimed to compare nutrient intake to DRI and MyPlate standards which will better quantify achievement of recommendations for a healthy diet [24, 26]. The 12 nutrients of importance were selected based on their relationship to health and risk for chronic disease among Americans [26]. Further, as much of the literature published thus far on dietary intake among college students is cross-sectional in nature, a second aim was to assess how the diet changed over a 12-month period in combination with changes in MP use. The 12-month analysis explored alterations in nutrient intake or diet quality in students who continued with or transitioned off use of a MP.

## METHODS

### Study design

Analysis of nutrient intake and diet quality was performed as part of a larger study examining lifestyle

choices, alcohol consumption, and health in first and second-year college students [28]. The study underwent full review and was approved by the Loyola Marymount University Institutional Review Board. Students provided their written informed consent after receiving the explanation of the study in detail, reviewing the informed consent document, and screening of inclusion/exclusion criteria.

## Participants

Volunteers were recruited through announcements at Greek life events, in academic courses, via the study website, and social media advertising. Inclusion criteria involved status as a first or second-year student at the university and pregnancy was used as exclusion criteria for females. A total of 179 first and second-year students (n=119 first-year, n=60 second-year) were accepted into the larger study at baseline. Included in this dietary analysis are 147 participants who answered a comprehensive food frequency questionnaire (FFQ) and provided data regarding their MP use. Twenty-seven students did not provide information on their MP status at either baseline or follow up. Another 5 students did not use a MP at baseline, but did at the 12 month assessment. This subgroup of 5 participants was deemed too small for inclusion in the study. The sample of 147 participants used in this analysis represents 5.4% of first and second-year students enrolled at the university during the time of data collection. The FFQ was completed in the spring of the first or second year of college and was repeated 12 months later. Within 7 days of completing the FFQ, students came into the lab for height and weight assessments, measured by a trained research assistant using a stadiometer and electronic scale (Health-o-meter, Boca Raton, FL) [29]. Weight was measured to the nearest 0.1 kg and height to the nearest 0.1 cm, without shoes and in light clothing. Height and weight measurements were taken twice and recorded values were the average of the 2 measurements [29].

## Meal plan and campus dining

This study took place at a private, comprehensive university with approximately 6,500 undergraduate students, where students living in residence halls, are required to purchase a MP for on-campus dining options. Approximately 89% of first and second-year students live on campus, accounting for nearly half of all students enrolled at the University. A contracted vendor provided campus food service mainly through a food-court-style dining hall, which offered three meals per day with 10 food stations. Students procured food items individually with the pre-purchased MP. In addition, over the course of the 15-week semester, 48 buffet-style “community table” events offered students the opportunity to choose from a variety of unlimited foods and beverages (i.e. all you can eat). Beyond the main dining hall, a diner-style restaurant served three meals per day and a second, food-court-style venue, served breakfast and lunch on weekdays. On-campus, fast food options included a pizza chain, an Asian-inspired venue, and a juice/smoothie bar. Additional on-campus venues, included three mini-mart style convenient stores and six coffee shops or carts.

## Nutrient intake, diet quality, and physical activity

The Block 2014 FFQ was used to measure dietary intake and servings of MyPlate food groups consumed for the previous year. The FFQ was delivered electronically and participants used their own computers to answer the questions at their own pace, requiring approximately 45-60 minutes. The Block 2014 FFQ contained 127 food and beverage items as well as additional questions to adjust for fat, protein, carbohydrate, sugar, and whole grain content [30]. The FFQ provided photos for reference to assist in accurately estimating serving sizes. The Block FFQ has been shown to be a valid and reliable assessment of diet over a 1-year period with similar power and sensitivity as multiple 4-day diet records [31, 32]. Data collected from the FFQ was compared to DRIs and MyPlate guidelines [24, 26]. This paper analyzes the three acceptable macronutrient distribution ranges (AMDRs), percent of kcals from SFAs,

and main nutrients of concern for Americans including fiber, added sugar, vitamin D, calcium, iron, potassium, and sodium [26]. The 12 indicators of nutrient intake listed above were analyzed because they are related to health and risk for chronic disease among Americans [26]. As recommended when using DRIs to assess nutrient intakes of groups [33], the proportion of individuals with usual intake below the Estimated Average Requirement (EAR) were studied, except in the cases of fiber, potassium, and sodium where mean intake of groups were compared to the adequate intake (AI) because an EAR is not available. For evaluation of diet quality, the whole fruit component of MyPlate excluded juices and the protein component of MyPlate included ounces of protein from meats, nuts, seeds, eggs, and legumes [26].

The Block FFQ also includes a physical activity screener with 11 prompts that characterize the principal sources of energy expenditure for Americans [34]. Based on participant responses, the screener computes minutes per day of moderate to vigorous physical activity (MVPA) [35].

## Data analysis

Statistics were calculated for DRIs (AMDRs, EARs, and AIs as indicated in Table 2) and MyPlate servings using SPSS version 24 (IBM Corporation, Armonk, NY, USA). Exploration of potential confounding variables revealed that dietary intake did not differ by race/ethnicity, body weight, or MVPA; however, sex predicted several variables of nutrient intake. Therefore, a multiple analysis of covariance (MANCOVA), with sex as a covariate and Bonferroni correction, evaluated differences in nutrient intake and number of MyPlate servings for MP and non-MP users at baseline. For longitudinal assessments, students were placed into three groups: those who transitioned off meal plan use (meal plan use to no meal plan use, MP-NMP), those who retained meal plans (MP-MP), and those who never used a meal plan (NMP-NMP) during the 12-month study. A repeated measure MANCOVA, with sex as a covariate and Bonferroni post-hoc analysis, evaluated how nutrient intake and diet quality changed in these three groups over time. Statistical significance was set at $\alpha$ of 0.05.

# RESULTS

Descriptive statistics for the 147 participants who fit the study criteria are reported in Table 1. Groups were not different in age, body mass index (BMI), or MVPA at baseline. Additionally, height, weight, BMI, and MVPA did not change significantly over the yearlong study.

## Nutrient intake

Table 2 displays DRIs for students with and without a MP at baseline. Groups were similar in nutrient intake for the 12 nutrients of concern, except for percent of kcals from protein, with the NMP students consuming 1.2% greater percent of energy from protein than the MP users (P=.003). Relatively few students (<50%) met the AMDRs, except for protein intake which was likely to be adequate for over 97% of participants. Additionally, few students met DRIs for important micronutrients, with exception of iron intake in men, where 98.6% were meeting average needs. Less than 10% of students consumed the EAR for vitamin D, regardless of MP status. The mean intake of potassium was below the adequate intake for this mineral.

## Diet quality

Analysis of diet quality according to MyPlate serving recommendations at baseline did not differ between MP and non-MP users (Table 3). A low proportion of students (less than 15%) were consuming the recommended servings of fruit, vegetables, whole grains, and dairy regardless of MP status. More than 40% of students achieved the recommended ounces of protein in both MP and non-MP groups.

## Changes in nutrient intake

Thirty-eight percent of the MP users at baseline (n=43 of 114) transitioned off MP use during the 12-month study, while 62% of MP users at study entry (n=71) retained

use of the MP. A total of 33 non-MP users maintained this status at the 12-month follow up. Figures 1 displays the percent change in nutrient intake over time for the three groups. A repeated measures MANCOVA comparing the three groups revealed that MP-NMP students had a significant 4% decrease in percent of kcals from carbohydrate (P=0.05), however no other differences were observed between groups for the other macronutrients. The NMP-NMP group ate a greater percent of kcals from protein than the MP-NMP group at baseline (P=0.001) and 12-months (P=0.02), though these differences did not change over time. The MP-MP group significantly decreased intake of many nutrients including protein (P=0.02), fiber (P=0.01), calcium (P=0.004), iron (P=0.02), potassium (P=0.009), and sodium (P=0.05). Overall, consumption of percent of kcals from carbohydrates (P=0.01), added sugar (P=0.02), vitamin D (P=0.03), calcium (P=0.01), and potassium (P=0.02) decreased significantly, without consideration of MP groups. For vitamin D, the NMP-NMP group showed a significant decrease (P=0.04) in consumption from baseline to follow-up. The MP-MP group showed a trending decline (P=0.058) in vitamin D intake of 12.5%, whereas vitamin D intake for the MP-NMP did not change meaningfully. Significant changes in percent of kcals from fat, saturated fatty acids, and protein were not observed.

## Changes in diet quality

Changes in diet quality for the three groups over the yearlong study are displayed in Figure 2. The MP-MP group significantly decreased in fruit (P=0.001) and dairy (P=0.001) consumption over time. At follow-up, the NMP-NMP group ate significantly more fruit than the MP-MP group (P=0.05). Overall, dairy consumption decreased over time for the 147 students (P=0.005). No significant changes were observed for servings of vegetables, whole grains, or protein foods.

## DISCUSSION

Nutrient intake and diet quality appear to fall short of most DRIs and MyPlate recommendations for first and second-year college students included in this analysis; however, a large proportion of students met the AMDR and EAR for protein. In general, nutrient intake and diet quality exhibited negligible changes when students no longer used on a pre-paid MP.

The many vegetarian and vegan options available at on-campus dining venues may explain the difference in protein intake observed between the NMP-NMP and MP-NMP groups. Perhaps MP use exposed students to vegetarian meals slightly lower in protein and may have encouraged regular adoption of an adequate, but lower protein diet. Further long-term studies are necessary to explore this concept. Students who used a MP at baseline and follow-up significantly decreased intake of fruits, dairy, and many nutrients (Figures 1 and 2). Continued use of the MP for 2 years possibly contributes to boredom with food choices and loss of interest in nutritious foods. This concept could be considered “meal plan fatigue” and warrants further investigation in future research. Although menu choices at on-campus dining venues vary throughout the week and year, the perceived monotony of options and venues may contribute to the overall decreases reported in this study. The overall reduction in dairy consumption may explain the decline in vitamin D intake for two groups (16% for the NMP-NMP and 12.5% for the MP-MP), as fortified milk is a primary dietary source for vitamin D in the American population [36]. Added sugar consumption among participants in this study, was considerably lower than previous reports [10]. Similar to the work of Small et al. [12], one positive change for all students involved in the study was a significant decline in consumption of added sugars over time. Parallel with previous research [12], whole grain consumption did not differ according to MP status, however all three groups showed a nonsignificant increase in the percent of grains consumed as whole grains.

Previous research has suggested that college students using campus offered MPs have greater fruit and vegetable intake compared to non-MP users [9-12], however this was not the case with our study population. In fact, a greater proportion of non-MP users achieved recommended servings of fruits and vegetables in this

study, compared to MP users. Further, if MP use enables increased fruit and vegetable consumption, the 43 students who stopped MP use would have decreased produce intake in our longitudinal analysis. In contradiction to previous work [9-12], Figure 2 displays how participants who retained MP use for the entire study exhibited a 30% reduction in fruit consumption. Furthermore, all groups showed a non-significant decline in vegetable servings over the year. The contradictory findings of the current study, in comparison to previous research, could be explained by differences in methods of dietary assessment. We used a FFQ to assess habitual intake while others used diet records [9], screeners [10, 12], or standardized survey questions [12]. Additionally, our population was approximately half men and half women, while previous findings were reported on predominantly female college students [9-11]. Overall, in this analysis, MP users and non-MP users had analogous low nutrient intake and diet quality.

Similar to previous research [16-18], dietary assessment among college students revealed poor diet quality and inappropriate intake of some vitamins and minerals. Akin to the 2015 study by Perez-Gallardo et al., college students consistently display low intake of fiber, calcium, vitamin D and greater than necessary intake of fat, iron, and sodium. Our findings are also comparable to work of Mei et al. [20] studied over one thousand college students, of a similar age to those in the current study, reporting comparably low fiber intake with high intake of added sugars. Nutrients of concern for Americans were specifically chosen for analysis in this study [26]. Of particular interest is the average percent of kcals from SFA measured to be over 10% in this study's population that may increase risk for cardiovascular disease [26]. Further, the low intake of potassium (<10% met AI), and high intake of sodium (mean intake >3000 mg), may elevate risk for hypertension [37]. The majority of participants (>50%) were consuming less than the recommended maximum for added sugars (12.5 tsp) [26]. However, although not statistically different, MP users consumed on average 1 tsp more added sugars per day than non-MP users. This may suggest that foods and beverages high in added sugars are readily available for MP users. Previous studies have examined intake of sugary sweets or beverages among college students [6, 12, 22], however, none have specifically measured consumption of added sugars, a dietary risk factor for cardiovascular disease [38]. Participants with MPs in our study had access to unlimited consumption of sugar-sweetened beverages during "community table" meals, which occurred 3-4 times per week. This may have contributed to the slightly higher added sugar intake among MP users in this study. Differences in added sugar consumption among this population were measureable, however it is not clear whether differences as small as 1 tsp are clinically relevant to health outcomes.

A common limitation of research on dietary intake is the nature of self-reported data. The FFQ was used to measure dietary intake because it better reflects habitual intake and is less susceptible to daily variations of diet records and short-term recalls [39]. Also, it was preferred to avoid modifications to dietary intake, which often occurs when burdening research participants with maintaining a food log. The Block FFQ is established as a valid and reliable measure of dietary intake [30, 31], however, no method of dietary assessment is perfect and it is possible that some participants consumed uncommon foods not included in the FFQ. Assessment for blood levels for some nutrients could improve this research. For example, less than 10% of participants achieved the EAR for vitamin D, however with our geographic location in southern California, it is possible that serum levels of vitamin D are adequate due to hormone production via skin exposure to the sun.

This study is limited by restrictive external validity because of the small sample size and situational specifics of the relatively small, private University located in a large metropolitan area. Strengths of the study include the longitudinal measurements, with evaluation of how diet may change when use of MP ceases. Previous research investigated the diet of college students [6, 8-11, 13], however very few publications reference the most recent DRI and MyPlate standards.

## CONCLUSIONS

Results of this study indicate that first and second year college students may need to improve their nutrient intake and diet quality by increasing consumption of fruits, vegetables, and low fat dairy foods while reducing intake of SFAs and sodium to lower risk for chronic disease. Further research is needed to explore whether the concept of "meal plan fatigue" may explain the decline in nutrient intake and MyPlate servings for students who use a MP for multiple years. Considering that college students often have a limited budget, it would be possible for campus offered MPs to encourage healthy diets by offering fruit, vegetable, and low fat dairy options as "all you can eat" while items high in SFA and sodium are sold individually [8, 10, 11]. These changes to MP offerings may encourage healthier dietary intake among emerging adults, fostering adoption of a lifetime of healthy eating habits with potential long-term impact on physical health and overall wellbeing. Considering the number of college students in the U.S. and the importance of establishing healthy habits during this transitional time in life, MP users may be an ideal population for nutrition education interventions [8]. Specifically, future research should explore the degree to which MP users are shaped by on-campus dietary behaviors during their collegiate experience and how this potentially influences the eventual transition to off-campus nutritional choices.

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**PEER REVIEW**

Not commissioned. Externally peer reviewed.

## TABLES

**Table 1:** Demographics at baseline for 147 first and second year college students who volunteered for a study of nutrient intake and diet quality according to meal plan use.

| Variable (n=147) | Mean or Frequency | Standard Deviation or % |
|---|---|---|
| **Age (years)** | 19.3 | 0.57 |
| **Height (cm)** | 170.8 | 9.5 |
| **Weight (kg)** | 67.5 | 11 |
| **BMI (kg/m$^2$)** | 23.1 | 2.9 |
| Normal weight | 111 | 75.5% |
| Overweight | 32 | 21.8% |
| Obese | 4 | 2.7% |
| **Sex** | | |
| Female | 75 | 51% |
| Male | 72 | 49% |
| **Physical Activity** | | |
| MVPA (min/d) | 84.1 | 83.6 |
| **Class year** | | |
| Freshman | 97 | 66% |
| Sophomore | 50 | 34% |
| **Meal plan** | | |
| yes | 114 | 77.6% |
| no | 33 | 22.4% |
| **Race/Ethnicity** | | |
| White | 77 | 52.4% |
| Black/African American | 16 | 10.9% |
| Asian | 31 | 21.1% |
| Hispanic/Latino-a | 20 | 13.6% |
| Multi-Ethnic | 3 | 2% |

BMI=body mass index, MVPA=moderate to vigorous physical activity

**Table 2:** Nutrient Intake and Dietary Reference Intakes at Baseline for Important Nutrients in 147 First and Second Year College Students According to Meal Plan Use.

| Nutrients | Dietary Reference Intake | Meal Plan Mean ± SE[a] n=114 | No Meal Plan Mean ± SE[a] n= 33 | *P* | Meal Plan % Rec[b] | No Meal Plan % Rec[b] |
|---|---|---|---|---|---|---|
| % kcals[c] CHO[d] | 45-65%[e] | 46.6 ± 0.6 | 46.3 ± 1.1 | 0.79 | 61.4% | 64% |
| % kcals[c] fat | 20-35%[e] | 35.8 ± 0.5 | 35.9 ± 0.9 | 0.92 | 48.2 % | 46% |
| % kcals[c] SFA[f] | ≤10%[g] | 11.3 ± 0.2 | 11.3 ± 0.4 | 0.93 | 29.8 % | 24% |
| % kcals[c] protein | 10-35%[e] | 15.1 ± 0.2 | 16.3 ± 0.4 | 0.003* | 100% | 97% |
| Protein (g/kg)[h] | ≥0.66[i] | 1.1 ± 0.05 | 1.3 ± 0.1 | 0.09 | 81.6% | 81.8% |
| Fiber (g) | F[j]: 25[l]; M[k]: 38[l] | 20.4 ± 1.0 | 19.6 ± 1.9 | 0.74 | 16.7% | 18% |
| Added Sugar (tsp) | ≤12.5[g] | 11.3 ± 0.7 | 11.7 ± 1.3 | 0.78 | 67.5% | 73% |
| Vitamin D (mcg) | 10[i] | 4.5 ± 0.3 | 5.6 ± 0.6 | 0.10 | 8.8% | 12.1% |
| Calcium (mg) | 800[i] | 956 ± 41 | 1007 ± 77 | 0.55 | 49.1% | 54.5% |
| Iron (mg) | F[j]: 8.1[i]; M[k]: 6[i] | 14.2 ± 0.7 | 14.7 ± 1.3 | 0.76 | 84.2% | 81.8% |
| Potassium (mg) | F[j]: 2600[l]; M[k]: 3400[l] | 2555 ± 114 | 2714 ± 213 | 0.52 | 30.7% | 36.4% |
| Sodium (mg) | 1500[l] -2300[g] | 3129 ± 135 | 3263 ± 253 | 0.64 | 29.8% | 27% |

[a]Estimated marginal means adjusted for sex as a covariate presented with SE=standard error, [b]%Rec=percent of participants achieving recommended intake, [c]kcals=kilocalories, [d]CHO=carbohydrates, [e]Acceptable macronutrient distribution range, [f]SFA=saturated fatty acids, [g]Recommended by the U.S. Dietary Guidelines, [h]g/kg= grams consumed per kilogram of body weight, [i]Estimated Average Requirement, [j]F=female, [k]M=male, [l]Adequate intake, *P<.05. Differences between groups was tested via MANCOVA. Non-MP users were significantly greater in percent of kcals from protein.

**Table 3.** Diet Quality of 147 First and Second Year College Students Assessed at Baseline According to Meal Plan Use with MyPlate Recommendations.

| | MyPlate Recommended Servings | Meal Plan Mean ± SE[a] n=114 | No Meal Plan Mean ± SE[a] n= 33 | *P* | Meal Plan % Rec[b] | No Meal Plan % Rec[b] |
|---|---|---|---|---|---|---|
| **Whole Fruit (cup eq)**[c] | F[e]: 2 cups<br>M[f]: 2-2.25 cups | 0.90 ± 0.07 | 0.92 ± 0.13 | .92 | 8.8% | 12% |
| **Vegetables (cup eq)** | F[e]: 2.5-3 cups<br>M[f]: 3.5-4 cups | 1.67 ± 0.09 | 1.57 ± 0.17 | .61 | 7.9% | 15.2% |
| **% Whole Grains** | 50% | 26.0% ± 1.5 | 23.8% ± 2.7 | .48 | 14% | 9.1% |
| **Protein Foods (oz)**[d] | F[e]: 5-6.5 oz<br>M[f]: 6.5-7 oz | 5.86 ± 0.34 | 6.90 ± 0.65 | .16 | 49.1% | 51.5% |
| **Dairy (cups)** | 3 cups | 1.59 ± 0.09 | 1.74 ± 0.17 | .44 | 14% | 9.1% |

[a]Estimated marginal means adjusted for sex as a covariate with SE=standard error, [b]%Rec=percent of recommended intake, [c]Cup eq = cup equivalents, whole fruit only, does not include fruit juices, [d]oz = ounces, protein foods include ounces of all meats, nuts, seeds, eggs, and legumes, [e]F=females, [f]M=males. Differences between groups was tested via MANCOVA.

## FIGURES

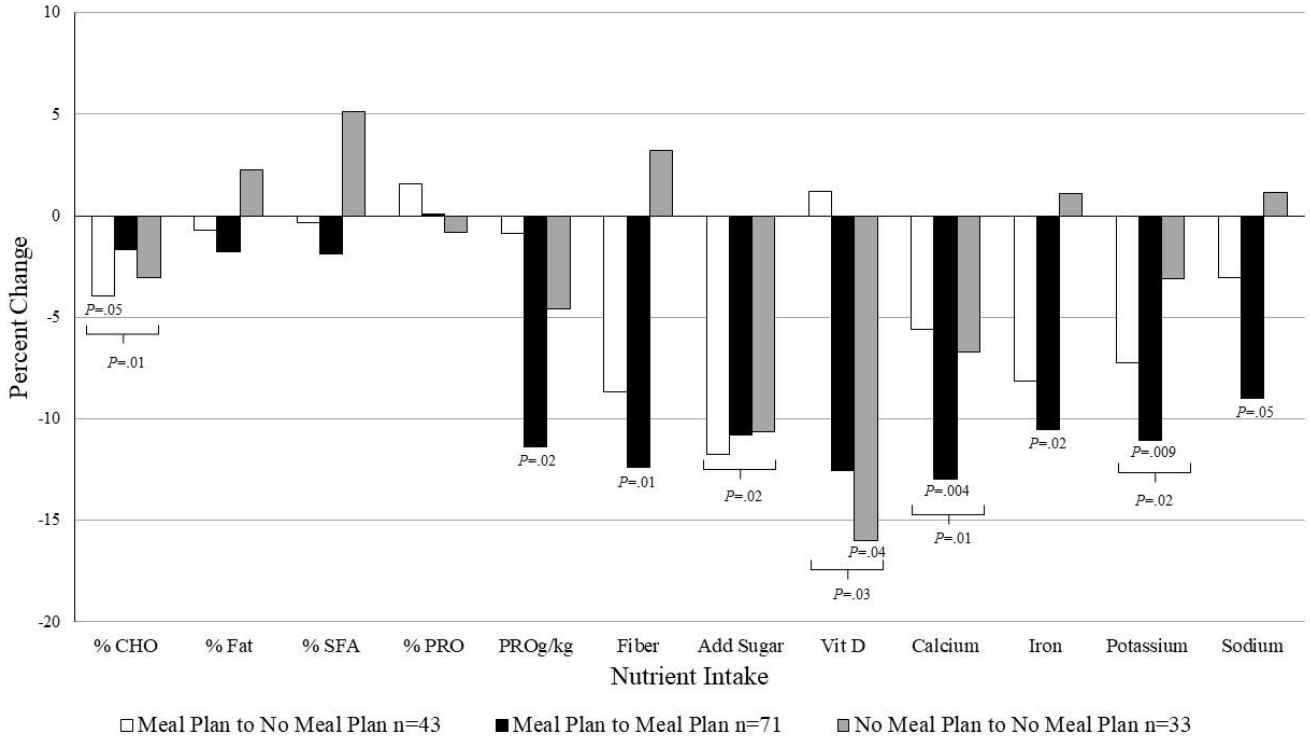


**Figure 1.** Changes in Nutrient Intake for First and Second Year College Students According to Changes in Meal Plan Status over 12 Months. Dietary intake declined significantly for eight variables of nutrient intake with the group which retained the meal plan experiencing the most changes. P-vales indicate significant changes for a particular group over time and overall changes by time without respect to group. % CHO = percent of kcals from carbohydrates; % SFA = percent of kcals from saturated fatty acids; % PRO = percent of kcals from protein; g/kg = grams per kg of body weight; add sugar = added sugars; vit D = vitamin D

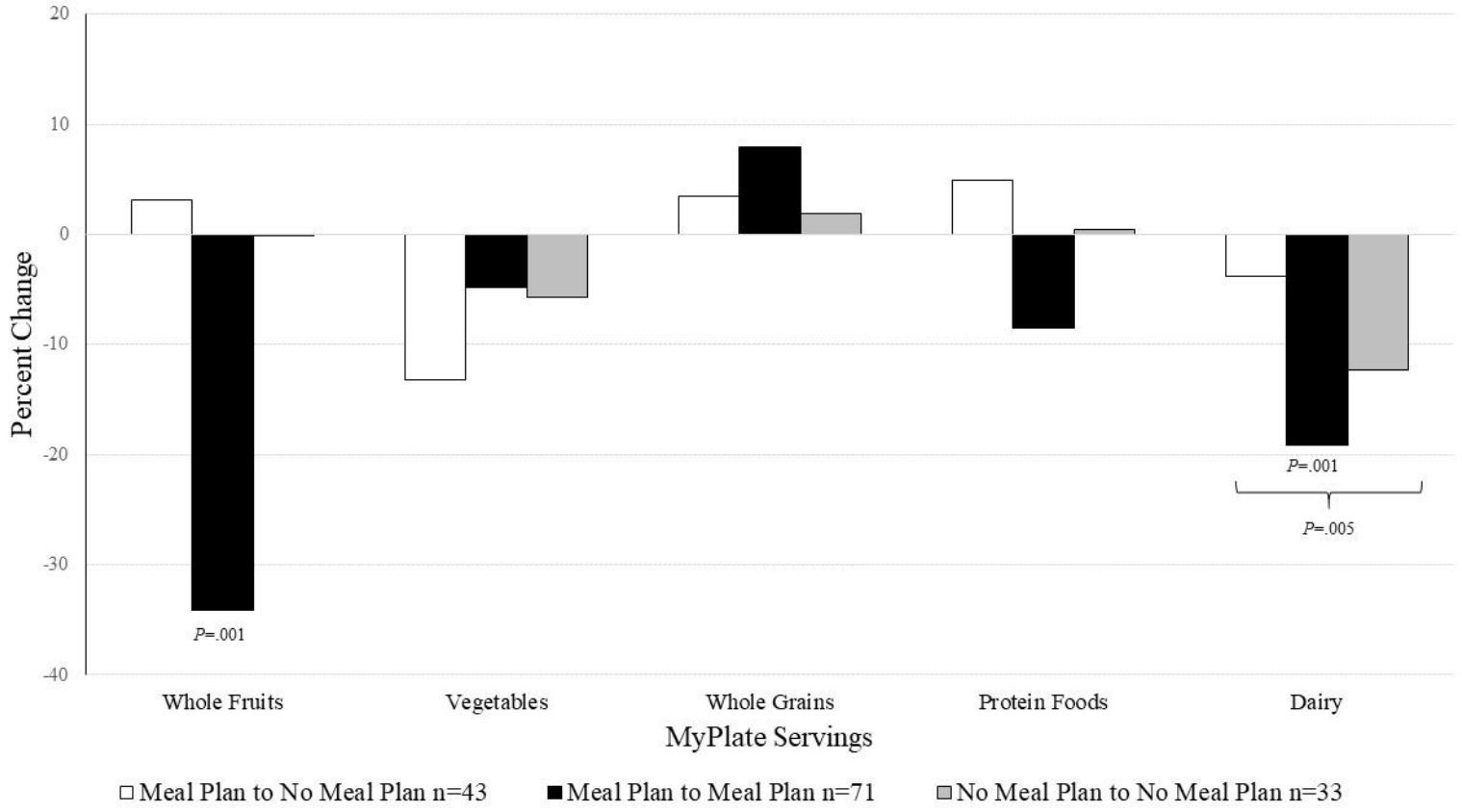


**Figure 2.** Changes in MyPlate Servings of First and Second Year College Students According to Change in Meal Plan Status over 12 Months. Students who retained the meal plan from baseline to follow-up significantly declined in whole fruit and dairy consumption. P-vales indicate significant changes for a particular group over time and overall changes by time without respect to group.