Randomized Pilot Study Examining the Impact of an Online Diet Among Working Adults

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Abstract

The term "diet" is often associated with restricting certain foods or caloric intake; however, *diet quality* is defined as nutritional epidemiology to evaluate the population's dietary habits and the efficacy of dietary interventions. There is a growing interest in diet quality, specifically increased intake of fruits and vegetables (F&V), as a more appropriate approach for improving health outcomes. This study aimed to test an online, non-restrictive diet among the working population. Participants were randomized to complete an 8-week diet program using an online application or waitlist control that would receive the diet program after an 8-week waiting period. The diet program consisted of a technical application (app) that included ways to incorporate 800g of F&V in their daily diet. The program included a competitive and gamified component to compare with others using a leaderboard. The primary research questions were if there was a differential change in body mass index (BMI), skeletal muscle mass (SMM), fat mass (FM), and work impairment between the control and intervention groups. Participants were asked to complete 2 study visits (Baseline & 8 weeks). During each visit, the participants were asked to complete a standard Bioelectrical Impedance Analysis (BIA) protocol measuring BMI, SMM, and FM and questionnaires including the Lam Employment Absence and Productivity Scale **(**LEAPS) as a measure of work impairment. A two-way ANOVA was performed to compare BMI, SMM, and FM between the groups over time. There was no significant difference in BMI [$F_{(20)} = 0.83$, p= .78], FM [$F_{(20)} = 0.30$, p= .59] between groups following the 8-

week intervention. There was a significant difference in SMM [F (20) = 5.39, p= .03] following the 8-week intervention favoring the intervention group. There was no significant difference in work impairment [F (19) = 1.70, p= .21] between the groups following the 8-week intervention. More research should be conducted on whether a non-restrictive diet intervention focused on F&V intake effectively improves overall health in adults.

Introduction

A *healthy diet* can be defined as a pattern of food intake that has beneficial effects on health or no harmful effects (de Ridder et al., 2017). A term closely used with healthy diet within research is *diet quality*. Within research, diet quality can be used as a risk assessment tool to predict outcomes such as all-cause mortality, cardiovascular disease, and risk for cancer. However, this term can be more challenging to define because of the variety of definitions that can be used when describing an individual's diet and how it conforms to dietary recommendations (Alkerwi, 2014). Healthy diets and diet-quality studies are both wide-ranging and have been evaluated in many ways, such as in randomized clinical trials, animals or cellular biology, intervention in clinical trials, and studies of nutrition and health of global population groups. Generally, any diet study focuses on improving the quality of an individual's health. Some consequences of low-diet quality can be a higher risk of cardiovascular disease, general mortality, and risk for cancer (Alkerwi, 2014).

The Dietary Guidelines for Americans (DGA) provides clear criteria to encourage healthy eating in individuals across the lifespan (2020). The most recent DGA were published in 2020 and spanned 2020-2025. One of the 5 core take-aways from these guidelines was that a healthy diet pattern includes: vegetables of all types, fruits, grains, dairy, and protein foods (Dietary Guidelines for Americans, 2020). Indeed, there are many benefits of F&V intake such

as one recent meta-analysis concluding F&V intake is related to reduced risk of cardiovascular disease, and age-related cataract (Angelino et al., 2019). Further, greater intake of F&V was associated with decreased the risk of colon cancer, depression, and pancreatic diseases (Angelino et al., 2019). Some strategies for increasing F&V intake include offering healthy foods and setting school nutrition standards, pricing strategies, labeling regulations, and stricter restrictions on junk food (Vandevijvere & Knai, 2015). Researchers highlighted a gap between the average consumption of F&V in Americans and the amount by the 2010 DGA, concluding that consumers should obtain their nutrients from their balanced diet with a wide variety of F&V, whole grain, and other plant food for optimal nutrition, health, and well-being (Liu, 2013). A strong body of evidence supports individual health benefits of consuming F&V.

A commonly used diet strategy is called "intuitive eating"; it is defined as having a strong connection between physiological hunger and satiety cues and eating in response to those cues (Linardon et al., 2021). A term closely used with intuitive eating is *non-restrictive dieting*—that is, a diet wherein no energetic restriction is given to the individuals (Stice et al., 2006). In a non-restrictive diet, individuals are advised to focus on portions, physical cues of hunger, or particular food to consume in place of a meal or with a meal. One non-restrictive diet method may be promoting healthy foods such as F&V to improve diet quality and satiety. A recent meta-analysis examined the association between the risk of cardiovascular disease, cancer, and all-cause mortality with the intake of F&V (Aune et al., 2017). The result from the meta-analysis indicated that intake of 800g of F&V per day was associated with a 24% reduction of relative risk (RR) in heart disease, 33% reduction in stroke, 28% reduction in RR in cardiovascular disease, 14% RR of cancer, and 31% reduction in RR of all-cause mortality (Aune et, al., 2017). The results from this study supported the creation of the #800gChallenge®.

The #800gChallenge® is a non-restrictive diet program aiming to increase daily F&V intake. An underlying premise is that prioritizing 800g or more of F&V daily will lead to greater satiation from fiber and water and reduce the intake of less nutrient-dense, high-calorie foods. The current study used a randomized controlled design to examine the initial efficacy of the #800gChallenge® in healthy full-time working adults. Outcomes of interest for this study included body mass index (BMI), skeletal muscle mass (SMM), fat mass (FM), and work impairment using The Lam Employment Absence and Productivity Scale (LEAPS) questionnaire. The results from this study will contribute to knowledge regarding how diet quality, specifically F&V intake, may improve overall health indicators.

Methods

Participants

Twenty-four faculty/staff at the University of North Texas (UNT) were recruited to participate in the study. The research team advertised the study through various mechanisms, including posting on bulletin boards, emails, social media, and word of mouth. Participants were screened via telephone for eligibility before baseline assessment using a standard telephone script for the following inclusion criteria: (a) 18 years or older, (b) non-pregnant, and (c) full-time employees at the UNT. Before the body composition assessment, the research team confirmed that the participant did not have an electronic medical implant, such as a heart pacemaker or an implantable cardioverter-defibrillator.

Measures

Body Composition: Participants completed the standard bio-electrical impedance analysis (BIA). BIA protocol was completed using a Seca mBCA554 (Hamburg, Germany). The assessment was conducted with participants standing barefoot on the device's platform, placing their feet spread

slightly apart on a pair of flat stainless-steel electrodes. Following height measurement, participants were asked to place their hands on a pair of flat stainless-steel electrodes while their arms were spread slightly apart at a 30–degree angle from their body. While standing still, the very mild, undetectable electrical current passed through their body for approximately 24 seconds. Measures that were generated from BIA that were used in this study were BMI (kg/m^2), SMM (kg), and FM (kg).

Demographics Questionnaire: Participants completed a questionnaire self-reporting their current age, race, sex, education, marital status, employment status, and annual household income.

Work Impairment: The Lam Employment Absence and Productivity Scale (LEAPS) measures how individual's function at work and provides an estimate of work impairment. It is a 10-item, self-rated scale with a total score ranging from 0-28, where higher scores indicate that the individual struggles with more severe work impairment.

Procedures

The UNT Institutional Review Board approved all study procedures.

Baseline: Participants completed written informed consent prior to beginning the study. Participants then completed the body composition assessments (i.e., BIA). Next, participants were asked to use Qualtrics® to complete questionnaires on an iPad in a private, quiet area. After the completion of the baseline visit, participants were provided with a food scale. Following collection of baseline data from all enrolled participants, participants were randomly assigned to either the diet intervention or waitlist condition using 24 opaque envelopes. Participants randomized to the intervention were asked to complete the registration process of the #800gChallenge® application platform with assistance from the research team.

#800g Challenge Intervention: The #800gChallenge® intervention was an 8-week diet program. The participants were emailed to inform them that they were part of the #800gChallenge® and were asked to attend an informative Zoom call prior to beginning the challenge. This informative introductory call was hosted by the creator of the app and program, EC Synkowski. She provided instructions on how to register for the app, tips on including a variety of F&V and opportunity to ask any questions the individuals might have before starting the intervention. The first four weeks of the intervention were intensive, with daily educational content delivered via the app and optional weekly Zoom calls with the research team. Participants used the app daily to indicate (a) whether they met their 800g F&V goal, (b) whether the F&V sources met various criteria (6 or more sources), and (c) if they reviewed the educational content. Weeks 5-8 were autonomous, wherein participants were asked to report (a) whether they met their daily 800g F&V goal and (b) if they were able to get 800g of F&V from a variety of sources. The waitlist control participants were asked not to change their diet and granted access to the platform after the final (8-week) assessments.

Eight weeks: The participants were asked to complete the body composition assessments (i.e., BIA) and questionnaires on an iPad in a private, quiet area using Qualtrics®. After completing the 8-week visit, participants were given a FitBit® Inspire 2 as compensation.

Data Analysis

Data were analyzed using IBM SPSS Statistics for Windows, version 26 (IBM, USA). Descriptive statistics, including frequency and percentage, were calculated for demographic characteristics, body composition measures, and questionnaire scores. Differences in body composition outcomes (i.e., BMI, SMM, and FM) and work impairment (i.e., LEAPS) were assessed using a two-way ANOVA with a $p < 0.05$ indicating significance.

Results

Participants

Twenty-three participants were enrolled in the study. Eleven participants were randomized into the control group and 12 were randomized into the intervention group. Demographic characteristics are provided in Table 1. Fifteen of the participants identified as female biological sex. Seventeen of the participants were married and seventeen identified as Caucasian. Twelve participants had a high education of either a Master's degree or above, and five had earned a Ph.D. One participant in the intervention group dropped out of the study during week two after sustaining a wrist injury that limited the capacity to participate fully in the intervention (i.e., prepare F&V). Another participant was unable to complete the LEAPS questionnaire during their 8-week visit. The remaining 22 participants were used for the analyses for the 8-week study.

Body Composition

The mean and standard deviations of BMI, SMM, and FM at baseline, eight weeks, and change among the 22 participants that completed the study are provided in Table 2. A two-way ANOVA was performed to compare BMI, SMM, and FM among the groups from baseline to 8-weeks. There was a significant difference in SMM [$F_{(20)} = 5.39$, $p = .03$] following the 8-week intervention favoring the intervention group. There was no significant difference in BMI [$F_{(20)} = 0.83$, $p = .78$], FM [$F_{(20)} = 0.30$, $p = .59$] between groups following the 8-week intervention. There was a significant increase in mean with SMM the intervention group (23.34 ± 7.64) compared with a decrease in the control group (21.86 ± 7.15). The mean and standard deviation of the LEAPS questionnaire, measuring work impairment at baseline, eight weeks, and change,

are provided in Table 2. No significant difference in work impairment [$F_{(19)} = 1.70$, $p = .21$] existed between the groups following the 8-week intervention.

Discussion

This study aimed to compare the change in body composition and work impairment between the control and intervention groups following the 8-week #800gChallenge®. There was no significant difference in BMI, FM, or work impairment. There was, however, a significant change in SMM between the control group compared to the intervention group. The intervention group experienced an increase in SMM following the 8-week intervention, while the control group experienced a decreased of SMM. Overall, the positive results in SMM—coupled with no changes in work impairment, as observed in this study—urges further research of both the health advantages of adding more F&V to diet and the convivence of technical applications for the working populations.

A pilot study completed in 2015 examined dietary intake using calorie restriction (CR) and intuitive eating (IE) to achieve weight loss by assessing the BMI and WC of obese adults (Anglin et al., 2015). The study included 16 participants, with 8 participants randomized into the control group (CR) and the other eight randomized into the intervention group (IE). All participants were required to be physically active at least three times per week within the research lab and record, in a food diary, their daily food intake. Participants assigned to the CR group were given dietary instructions with daily portions, portion sizes, and sample menus. In contrast, the IE group received instructions but did not discuss portion control. At baseline, mid-point (3 weeks), and endpoint (6 weeks), researchers measured the participants' waist circumference (WC), BMI, and BF%. The control group (CR) had a statistically significant greater weight loss than did the intervention group (IE). However, no statistically significant

difference was observed between groups in BMI and WC (Anglin et al., 2015). This study provides evidence that dietary intervention studies focused on IE may not yield drastic significant changes in body composition. However, other measures such as quality of life (QOL), physical activity, and diet quality would be valuable in future research.

A study completed in 2016 by Järvi et al. investigated the effect of increased intake of F&V in overweight and obese men and in women functioning on dietary habits and metabolic control. It was a 16-week randomized controlled intervention with thirty men and women randomized in either the intervention group (IN) or reference group (RG). All participants in the intervention group received 500g of F&V to eat, along with general dietary advice. The RG group received only general dietary advice. Results from this study indicated that an increased intake of F&V in the IN group was accompanied by favorable changes in body weight, WC, and BMI. But those outcomes featured no significant changes when compared to those of the RG group. BMI was the only outcome that decreased significantly from baseline from the 16-week visit in both groups. The results of this study suggest that an increase in an individual's F&V intake can provide positive changes in anthropometry (i.e., body weight, WC, and BMI; Järvi et al., 2016).

The current #800gChallenge® study lasted longer than most research studies regarding F&V and provided support via an application. The application guided participants on incorporating the diet through daily life and interactive components with other individuals within the intervention group. Many studies have examined F&V with the QOL, overall health, and chronic diseases (Grimmett et al., 2011). Studies focused on F&V intake and overall health report that the overall diet profile improves when F&V intake is increased (Tuck et al., 2019). In this #800gChallenge® study, results provided information for future literature about a general

approach to diet that is non-restrictive and promotes the intake of F&V. The study approach provides a guide for how to make healthy eating not as overwhelming and provide easy ways to access healthy meals along with allowing friendly competition between other individuals. Body composition outcomes BMI and FM were not significant between the intervention and control group; however, SMM significantly increased in the intervention group.

Although the current study was conducted with full-time employees, it would not be considered a workplace wellness intervention. One future direction may be to leverage a shared work environment to enhance social support that may encourage change in work impairment. Additional changes to strengthen the #800gChallenge® that may be possible in a structured workplace intervention include posters around the individuals' offices as prompts or adding healthy options to shared-food spaces. Some positive benefits within previous studies examining workplace wellness included: improved nutrition knowledge, decreased BMI, BF%, and improvements in such biochemical indices as fasting blood sugar, HbA1C, total cholesterol level, LDL-cholesterol level, and hemoglobin level. All such factors may strengthen the impact of the #800gChallenge® within the workplace (Rachmah et al., 2022).

Limitations

One limitation of this study was the brevity of the current program, since more than eight weeks might be needed to elicit significant changes in body composition (Millstein, 2014). Another area for improvement was the participant demographic characteristics. Most participants in this study were highly educated and of higher income, which differs from more customary demographics. Another factor that could have provided more evidence for the study was whether the researchers included a blood-sample collection for each participant. Blood work can provide information regarding cholesterol levels, free fatty acids, inflammation, and glucose. These

variables and others are associated with diabetes risk scores, providing valuable information to the researcher about the individual's health and the program's efficacy. Another factor that should be studied in future research is the impact on psychological components. The research demonstrated that improvements in diet quality were mirrored by improvements in mental health (Jacka et al., 2011). While the current study included a competitive component through the application, no social support was incorporated, which could have limited the individual's mental motivation to incorporate F&V into a daily diet. Another limitation in this study was the "point" structure when participants recorded their consumption of 800g of F&V a day. Some individuals could have been unmotivated to consume a lower value that is beneficial, such as 500g, because they would not be able to "count" it on the app. Improvements would be allowing individuals to log their consumption of F&V intake daily, regardless of their hitting 800g. Another idea would be to ask the individual to keep a log of their food to record how many F&V the individual consumed.

Conclusion

The findings from this study support previous literature and provide evidence that diet quality studies may not elicit significant changes in body composition. However, participants reported positive benefits from completing the study, such as their being more aware of what they were consuming. There was a significant change in SMM, with a significant increase in the intervention group and a decrease in the control group. This study provides information about the intake of F&V among working adults and supports future research that may examine biomarkers and psychosocial outcomes with dietary approaches for improving diet quality.

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Tables:

Table 1. Participant Demographic Characteristics for the #800gChallenge® Diet Study			
Variable	**Total Sample n=23**	**Control Group n=11**	**Intervention Group n=12**
Age *Mean±SD*	44.8±13.6	44.7±14.4	44.9±13.4
Biological Sex *n(%)*			
Male	8(34.8)	4(36.4)	4(33.3)
Female	15(65.2)	7(63.6)	8(66.7)
Marital Status *n(%)*			
Married	17(73.9)	8(72.7)	9(75.0)
Single	4(17.4)	3(27.3)	1(8.3)
Divorced/Separated	2(8.7)	0(0)	2(16.7)
Race *n(%)*			
Black or African American	3(13.0)	1(9.1)	2(16.7)
Caucasian	17(73.9)	8(72.7)	9(75.0)
Latino/a	2(8.7)	2(18.2)	0(0)
Other	1(4.3)	0(0)	1(8.3)
Education *n(%)*			
High School Graduate	2(8.7)	1(9.1)	1(8.3)
1-3 years of College	2(8.7)	0(0)	2(16.7)
College/University Graduate	2(8.7)	1(9.1)	1(8.3)
Master's Degree	12(52.2)	7(63.6)	5(41.7)
PhD or Equivalent	5(21.7)	2(18.2)	3(25.0)
Annual Household Income *n(%)*			
$20,000-$44,999	2(8.7)	1(9.1)	1(8.3)
$45,000 – $139,999	13(56.5)	7(63.6)	6(50.0)
$140,000 or more	8(34.8)	3(27.3)	5(41.7)

Table 2: Mean & Standard Deviation of Outcome Variables of Interest

Variable	Baseline Mean±SD	8-Week Mean±SD
BMI		
Control	14.32 ± 4.92	14.29 ± 4.77
Intervention	13.14 ± 3.09	13.15 ± 2.90
SMM		
Control	22.46 ± 6.74	21.82 ± 7.15*
Intervention	24.54 ± 8.25	23.34 ± 7.64
FM		
Control	38.43 ± 24.19	38.64 ± 24.53
Intervention	33.06 ± 16.60	35.78 ± 20.47
Work Impairment		
Control	3.27 ± 2.68	3.64 ± 4.01
Intervention	3.63 ± 4.00	2.90 ± 3.70

Note: Body Mass Index (BMI); Skeletal Muscle Mass (SMM); Fat Mass (FM)
* $p < .05$