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Research Article

Influence of a 6-Month Modified or Traditional Daniel Fast on Measures of Health in Men and Women

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Abstract

We have previously reported on the health impact of the plant-based fasting method known as the Daniel Fast (DF). However, our prior studies have included only short-term (21-day) interventions, rather than interventions spanning multiple months. For long-lasting and robust health effects, dietary modification for longer periods of time may be needed. We determined the 6-month impact of a traditional (vegan) DF (n=12) and modified DF (n=9; allowing for the inclusion of small amounts of meat and milk) on anthropometric and biochemical markers of health in men and women (mean age: 45 years). Outcome measures were obtained on day one of the assigned dietary plan, as well as after 3 weeks, 3 months, and 6 months of adherence to the plan. Multiple improvements were noted for both dietary plans across the 6 month intervention, with limited differences noted across time between the traditional and modified DF. Compliance to both dietary plans was approximately 80% at month 6. These data indicate that both a traditional and modified DF, which allow for *ad libitum* feeding, result in improvements in multiple health-related outcomes. Adopting such a dietary approach may lead to enhanced quality of life, as well as a reduction in disease risk over time. Additional, long-term studies related to the health impact of this fasting method are needed.

Keywords: Fasting; Blood lipids; Body weight; Dietary restriction; Veganism

Introduction

The dietary restriction model known as the Daniel Fast (DF) is a stringent plant-based plan shown to yield multiple health-related benefits when followed for a 21-day period [1-4]. The DF is considered to be a partial fast, in which restrictions are simply placed on the type of foods that may be consumed but not on the amount of food. A traditional DF includes *ad libitum* intake of fruits, vegetables, legumes, whole grains, nuts, seeds, and oils. No animal products are allowed in a traditional DF and items such as caffeine, alcohol, additives, and preservatives are also prohibited. The Biblically-inspired DF (Daniel 1:8-14) is followed by tens of thousands of Christians each year, often as part of a corporate (i.e. church congregation) fast at the start of the New Year, but also by many individuals throughout the year. While the fast is typically done for the purpose of spiritual growth, favorable changes in health outcomes are often observed.

Indeed, as is the case for many plant-based diet plans, we have noted multiple health benefits when individuals adopt the DF. For example, in our 3-week studies with the DF [1,2,4], we have reported reductions in total cholesterol and LDL-cholesterol, C-reactive protein, insulin and/or HOMA-IR, body weight, and blood pressure. We have also noted a reduction in systemic oxidative stress [3]. However, due to the fact that our prior work has spanned only 21 days, we are uncertain of the longer term impact of this dietary plan.

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Moreover, as many individuals have expressed their concern about long-term compliance when restrictions are placed on caffeinated beverages such as coffee and tea, as well as animal proteins such as meat and dairy, these issues need to be considered. In a recent study, we compared the short-term (21-day) effects of a traditional and modified DF on markers of health [1]. Participants in both groups were allowed to consume decaffeinated coffee and tea. The modified DF was identical to the traditional plan with one exception: participants were required to consume one serving (3 ounces) per day of lean meat and one cup per day of skim milk, providing approximately 30 grams per day of additional protein. Results indicated that compared to baseline, both the traditional and modified DF resulted in similar and significant improvements in blood lipids, as well as a reduction in inflammation—when followed for a period of 21 days.

The present study sought to extend these initial findings by following participants over the course of a 6 month intervention period, with assignment to either a traditional and modified DF. It should be noted that the Biblically-described feeding plan followed by the prophet Daniel (Daniel 10:2-3) was done for spiritual purposes during a period of mourning and not as a method to improve health, per se. When Christians embark on the traditional Daniel Fast for spiritual purposes, they often (but not always) follow the plan for 21 days. That said, some individuals will follow the fast for shorter or longer periods of time. Pertaining to human nutrition and the potential health implications of the dietary plan, it is important to know whether or not the plan can be maintained for longer periods of time and whether the maintenance of the plan results in health benefits that are meaningful. This is the reason the current study was extended to six months. If compliance can be maintained at an acceptable levels (e.g., >60%) over this period of time and outcome variables are noted to be changed in a clinically meaningful manner, the DF approach may be considered for further incorporation into the population at large. Such an action may offset the rapid increase in the incidence of obesity, type II diabetes, and cardiovascular disease, while favorably improving not only the overall health of the population but also the ailing healthcare economy.

Materials and Methods

Participants

Twenty-one healthy men (n=7) and women (n=14) completed the entire 6-month intervention. A small number of the participants had prior experience with this fasting method or had heard of the method prior to participating. Participants were not current smokers and did not have a history of cardiovascular disease; however, one subject assigned to the traditional DF group was classified as diabetic (baseline fasting blood glucose of 229 $mg \cdot dL^{-1}$). Most participants were physically active, engaged in an exercise program. For example, the average weekly time spent exercising was 2.3 hours for those assigned to the modified DF and 4.9 hours for those assigned to the traditional DF. Participants completed health history, medication and dietary supplement usage, and physical activity questionnaires. Each participant was informed of all procedures, potential risks, and benefits associated with the study through written form in accordance with the procedures approved by the University Institutional Review Board for Human Subjects Research. All participants provided written consent prior to being admitted.

Dietary plan assignment

Participants were randomly assigned to either a traditional DF (n=12; 5 men and 7 women) or a modified DF (n=9; 2 men and 7 women) upon completion of screening. Participants in the modified group abided by all guidelines of the traditional DF with the exception of including one serving per day of meat (3 ounces of chicken, fish, beef, pork, or turkey) and one serving per day of skim milk (8 ounces) in their overall diet. Following the initial week of dietary recording and baseline assessments, participants followed their group assignment for 6 months. In both groups, participants were provided an outline of the foods that are allowed and not allowed while following the assigned DF plans. Participants were instructed to consume primarily fruits and vegetables, nuts, seeds, legumes, vegetables, oil, and whole grains. In addition, they were informed that no additives, preservatives, flavoring, caffeine, or alcohol was allowed. Participants were however, allowed to drink decaffeinated coffee and tea, in addition to water. This was the case for participants in both DF plans. Those participants assigned to the traditional DF were not allowed to consume any animal products, while participants assigned to the modified DF were required to consume one serving per day of lean meat (3 ounces) and one serving per day of skim milk (8 ounces)—as noted above. Participants were contacted regularly by the research staff throughout the study period and reminded of all study procedures and requirements. Participants recorded all food and drink consumed during the week leading up to each test visit. The investigators used food models to help participants develop a better understanding of portion sizes to be used in the recording of dietary intake.

Lab visits

During their initial lab visit, participants completed the informed consent form, as well as the health and physical activity questionnaires. A standard health history questionnaire was used, asking of any health related problems, medications and dietary supplements used, and other questions relevant to overall health and physical status. The physical activity questionnaire was the same we have used in many past studies and asks of participants' involvement in aerobic exercise, resistance exercise, and sporting activities. The frequency, duration, and intensity of activity are asked. All completed questionnaires were reviewed by research staff and answers were confirmed with participants as necessary.

Participants were informed of their assigned group (traditional or modified DF) and received study instructions and a study schedule. During all subsequent lab visits during which time outcome data were collected (baseline testing and at the conclusion of week 3, month 3, and month 6), the following was performed: Heart rate (via palpation) and blood pressure (via cuff and stethoscope) was obtained following a 10 minute period of quiet rest, while participants were in a seated position. A blood sample was then taken from participants, as described below. Participants' height, weight, and circumference measures were recorded and body composition (via dual energy x-ray absorptiometry) was determined using a Hologic QDR 4500W scanner. Participants also completed questionnaires related to their overall feelings throughout the study period, as described below.

Blood collection and analysis

Venous blood samples were taken from participants via needle and Vacutainer®. All blood samples were collected following an overnight fast of at least 10 hours, while participants were in a rested state. Following collection, blood collected in tubes with no additives was allowed to clot at room temperature for 30 minutes and then separated to serum by centrifugation at 1500 g for 15 minutes at 4°C. Blood collected in tubes containing ethylenediaminetetraacetic acid (EDTA) was immediately separated to plasma by centrifugation at 1500 g for 15 minutes at 4°C.

Fresh blood samples were analyzed for complete blood count using an automated cell counter (Coulter LH750). A comprehensive metabolic panel was determined using automated procedures (Roche/Hitachi Modular). A lipid panel was determined using enzymatic procedures (Roche/Hitachi Modular). High-sensitivity CRP was determined as a measure of systemic inflammation using a high-sensitivity, particle-enhanced turbidimetric immunoassay (Roche Integra 800). Insulin was determined using an immuno-chemiluminescent assay procedure (Roche Modular E170) and the homeostasis model assessment (HOMA-IR) was used as an index of insulin resistance [42] and calculated as: [fasting glucose ($mg \cdot dL^{-1}$) × fasting insulin ($\mu U \cdot mL^{-1}$)] / 405.

Compliance, subjective feelings, and satiety

Participants were asked to complete an assessment of self-reported compliance, mood (mental outlook), vitality (physical health), and satiety while following the assigned plan. Specifically, they were asked to rate their compliance to the dietary guidelines on a percentage basis, from 0% compliant to 100% compliant—with regards to food choices. For mood, vitality, and satiety, participants rated each item using a scale of 1-10 (1=as low as possible; 10=as high as possible). These data were based entirely on self-report and we used the same questions as in our prior research of the DF [1-4].

Dietary records and activity

During the initial lab visit, a full explanation of dietary recording was provided to participants, along with data collection forms. Participants were instructed to maintain their normal diet until they began the assigned plan following baseline testing. They maintained diet records, including all food and drink consumed, during the week prior to baseline testing. They were also asked to record food and drink consumed during the week prior to each assessment day (end of week 3, month 3, and month 6). Nutritional records for each of these four, one-week periods were analyzed (Food Processor SQL, version 9.9, ESHA Research, Salem, OR). Participants were instructed to maintain their normal physical activity habits during the entire study period but were asked to avoid strenuous exercise during the 48 hours immediately before the assessment days.

Statistical analysis

Data were analyzed using a 2 (group) × 4 (time) analysis of variance (ANOVA). Tukey post hoc tests were used as needed. All analyses were performed using JMP statistical software (version 4.0.3, SAS Institute, Cary, NC). Statistical significance was set at $P \leq 0.05$. The data are presented as mean ± SEM.

Results

Twenty-eight individuals began the 6 month intervention study. However, three participants in the traditional DF group and four participants in the modified DF group stopped their participation due to personal reasons. Only 21 participants successfully completed the entire 6 month intervention and only data for those individuals who completed the study are included here.

For the 21 participants who completed the intervention, self-reported compliance was noted to be excellent, with approximately 80% compliance noted at 6 months (Table 1). Time effects were noted for both mental ($p=0.05$) and physical health ($p<0.0001$). Specifically, mental health was higher at week 3 compared to pre (baseline) and physical health was higher at all times compared to pre ($p<0.05$). Data are provided in Table 1. For remaining data, it should be noted that no baseline (Pre) differences existed between groups for any measure when analyzed using the method of Tukey ($p>0.05$), despite some values being higher than others (Tables 2-5).

With regards to participant characteristics (e.g., body weight, circumference measures, blood pressure), no group, time, or interaction effects were noted ($p>0.05$). However, multiple variables were noted to be improved over time for participants following both dietary plans, as can be viewed in Table 2.

Regarding the biochemical variables, a group effect was noted for both RDW ($p=0.02$) and basophils ($p=0.04$), with values for participants assigned to the traditional DF lower than for those assigned to the modified DF. Complete blood count data are presented in Table 3.

With regards to the metabolic panel, group effects were noted for insulin ($p=0.002$), HOMA-IR ($p=0.02$), glucose ($p=0.02$), and creatinine ($p=0.04$). In all cases, values for participants assigned to the traditional DF were higher than for those assigned to the modified DF. Group effects were also noted for BUN:creatine ($p=0.05$), protein ($p=0.0005$), and globulin ($p=0.0005$). In these cases, values for participants assigned to the traditional DF were lower than for those assigned to the modified DF. A time effect was noted for potassium, with values at week 3 higher than values at pre ($p<0.05$). Metabolic panel data are presented in Table 4.

With regards to the lipid panel, a group effect was noted for triglycerides ($p=0.01$) and VLDL-C ($p=0.01$), with values for participants assigned to the traditional DF higher than for those assigned to the modified DF. A time effect was also noted for triglycerides ($p=0.002$) and VLDL-C ($p=0.002$), with values at month 3 and month 6 lower than values at pre. Lipid panel data are presented in Table 5.

Multiple variables within the dietary intake were noted to be different across time. Specifically, time effects were noted for total kilocalories ($p=0.002$); protein ($p=0.01$), carbohydrate % ($p=0.004$), fiber ($p=0.01$),

Table 1: Participant compliance, subjective mental and physical health, and satiety before and during a 6 month modified or traditional Daniel Fast.

Variable	Modified DF Pre	Modified DF wk 3	Modified DF mo 3	Modified DF mo 6	Traditional DF Pre	Traditional DF wk 3	Traditional DF mo 3	Traditional DF mo 6
Compliance (%) †	NA	94.7 ± 3.1	87.3 ± 2.8	82.6 ± 4.2	NA	96.0 ± 1.1	84.6 ± 2.6	80.0 ± 3.2
Mental Health (1-10) †	7.8 ± 0.4	9.1 ± 0.2	8.6 ± 0.3	8.9 ± 0.2	8.3 ± 0.7	9.0 ± 0.3	8.6 ± 0.2	8.6 ± 0.3
Physical Health (1-10) *†	5.9 ± 0.5	8.6 ± 0.5	8.1 ± 0.3	8.5 ± 0.3	7.7 ± 0.4	8.8 ± 0.2	8.6 ± 0.3	8.5 ± 0.4
Satiety (1-10)	8.3 ± 0.7	9.1 ± 0.3	9.1 ± 0.4	9.1 ± 0.4	8.2 ± 0.5	8.9 ± 0.3	8.4 ± 0.2	8.6 ± 0.3

Values are mean ± SEM.

† time effect for compliance (p<0.0001); Pre and wk 3 > mo 3 and mo 6

† time effect for mental health (p=0.05); Pre < wk 3

* group effect for physical health (p=0.01); traditional DF > modified DF

† time effect for physical health (p<0.0001); Pre < all other times

No other statistically significant differences noted (p>0.05); no baseline (Pre) differences existed between groups for any measure (p>0.05).

Table 2: Participant characteristics before and during a 6 month modified or traditional Daniel Fast.

Variable	Modified `DF Pre	Modified DF wk 3	Modified DF mo 3	Modified DF mo 6	Traditional DF Pre	Traditional DF wk 3	Traditional DF mo 3	Traditional DF mo 6
Age (yrs)	45.7 ± 4.0	NA	NA	NA	45.2 ± 5.1	NA	NA	NA
Height (cm)	166.3 ± 3.2	NA	NA	NA	167.4 ± 2.5	NA	NA	NA
Weight (kg)	80.4 ± 8.1	78.0 ± 7.5	75.2 ± 6.6	74.3 ± 6.5	79.6 ± 5.3	77.1 ± 5.4	75.5 ± 5.2	75.5 ± 5.5
BMI ($kg \cdot m^{-2}$)	28.7 ± 2.2	27.9 ± 2.0	26.9 ± 1.7	26.5 ± 1.7	28.2 ± 1.4	27.3 ± 1.5	26.8 ± 1.4	26.8 ± 1.4
Waist (cm)	87.8 ± 6.8	85.8 ± 6.4	83.9 ± 6.0	82.6 ± 5.3	89.9 ± 4.3	86.9 ± 4.3	85.8 ± 4.3	85.5 ± 4.5
Hip (cm)	109.4 ± 3.6	107.5 ± 3.6	105.9 ± 3.4	106.1 ± 3.3	106.7 ± 2.7	104.4 ± 2.6	103.1 ± 2.7	102.8 ± 2.7
Total Body Fat (%)	36.4 ± 3.7	36.2 ± 3.7	34.6 ± 3.5	36.5 ± 2.5	33.3 ± 2.4	33.2 ± 2.6	31.8 ± 2.6	31.2 ± 2.5
Trunk Body Fat (%)	35.6 ± 4.0	35.5 ± 3.9	33.0 ± 3.7	33.9 ± 3.4	34.7 ± 2.5	34.6 ± 2.8	32.6 ± 2.9	31.6 ± 2.9
Fat Mass (kg)	29.8 ± 4.7	28.7 ± 4.5	26.3 ± 3.8	27.3 ± 3.4	26.4 ± 2.3	25.5 ± 2.4	24.0 ± 2.4	23.6 ± 2.5
Fat Free Mass (kg)	50.7 ± 5.3	49.3 ± 5.0	48.9 ± 4.9	46.1 ± 4.5	53.3 ± 4.2	51.6 ± 4.3	51.6 ± 4.2	51.9 ± 4.3
Heart Rate (bpm)	69.4 ± 3.3	69.1 ± 3.6	70.1 ± 3.5	67.0 ± 3.7	67.3 ± 2.7	65.2 ± 2.6	65.9 ± 2.1	66.8 ± 2.2
Systolic BP (mmHg)	108.9 ± 4.9	106.6 ± 4.4	109.2 ± 5.7	105.4 ± 4.7	114.3 ± 5.8	111.3 ± 5.6	113.8 ± 5.3	116.0 ± 6.1
Diastolic BP (mmHg)	70.8 ± 3.7	66.2 ± 3.0	74.1 ± 3.4	63.6 ± 2.7	70.3 ± 3.5	69.0 ± 3.6	71.2 ± 3.6	74.0 ± 4.1

Values are mean ± SEM.

No statistically significant differences noted (p>0.05); no baseline (Pre) differences existed between groups for any measure (p>0.05).

sugar (p=0.01), fat (p<0.0001), fat % (p=0.02), saturated fat (p<0.0001), cholesterol (p<0.0001), and vitamin C (p=0.0008). A group effect was noted for protein (p=0.0002), protein percent (p<0.0001), and vitamin C (p=0.03), with values for participants assigned to the traditional DF lower than for those assigned to the modified DF. The most frequently consumed meat appeared to be poultry, followed by fish. Red meat and pork appeared to be consumed only sparingly by participants. Dietary data, including all significant comparisons, are presented in Table 6.

Discussion

To our knowledge, this is the first study of the Daniel Fast to extend beyond 21 days. Our findings indicate that individuals appear to tolerate the DF plan very well, whether involving the ingestion of animal protein or not. Such compliance to the plans leads to multiple positive changes in overall health, inclusive of subjective reports of improved mental and physical health, weight loss, and improvements in blood lipids. Future studies are needed to replicate these findings in a larger sample

Table 3: Complete blood count data of participants before and during a 6 month modified or traditional Daniel Fast.

Variable	Modified DF Pre	Modified DF wk 3	Modified DF mo 3	Modified DF mo 6	Traditional DF Pre	Traditional DF wk 3	Traditional DF mo 3	Traditional DF mo 6
WBC ($10^3 \cdot \mu L^{-1}$)	4.7 ± 0.5	4.6 ± 0.4	4.9 ± 0.6	4.3 ± 0.6	5.4 ± 0.4	5.1 ± 0.4	5.0 ± 0.3	5.2 ± 0.4
RBC ($10^6 \cdot \mu L^{-1}$)	4.2 ± 0.4	4.6 ± 0.1	4.7 ± 0.1	4.6 ± 0.2	4.7 ± 0.1	4.7 ± 0.1	4.7 ± 0.1	4.7 ± 0.1
Hemoglobin ($g \cdot dL^{-1}$)	13.0 ± 0.4	13.1 ± 0.4	13.3 ± 0.5	13.4 ± 0.5	13.7 ± 0.5	13.8 ± 0.4	13.5 ± 0.4	13.7 ± 0.4
Hematocrit (%)	39.4 ± 1.0	39.9 ± 1.1	40.9 ± 1.3	40.3 ± 1.5	41.6 ± 1.1	41.7 ± 0.9	40.9 ± 1.2	41.3 ± 1.1
MCV (fL)	87.2 ± 1.6	87.4 ± 1.8	88.0 ± 1.5	87.2 ± 2.0	88.2 ± 1.7	88.3 ± 1.6	88.3 ± 1.6	87.7 ± 1.5
MCH (pg)	28.7 ± 0.6	28.7 ± 0.6	28.7 ± 0.7	29.0 ± 0.9	29.1 ± 0.7	29.2 ± 0.7	29.1 ± 0.7	28.9 ± 0.7
MCHC ($g \cdot dL^{-1}$)	33.0 ± 0.3	32.9 ± 0.2	32.6 ± 0.2	33.1 ± 0.3	33.0 ± 0.4	33.0 ± 0.3	32.9 ± 0.3	33.0 ± 0.2
RDW (%) *	13.8 ± 0.3	13.7 ± 0.2	13.9 ± 0.4	14.0 ± 0.5	13.4 ± 0.3	13.3 ± 0.3	13.1 ± 0.2	13.5 ± 0.3
Platelets ($10^3 \cdot \mu L^{-1}$)	284.6 ± 34.5	231.6 ± 22.4	252.0 ± 27.3	239.0 ± 23.6	264.6 ± 14.2	266.4 ± 13.9	268.3 ± 8.3	269.6 ± 9.7
Neutrophils (%)	53.2 ± 3.4	53.8 ± 3.1	57.4 ± 1.7	51.7 ± 3.1	55.5 ± 1.6	52.5 ± 1.8	55.8 ± 2.0	53.3 ± 1.7
Lymphocytes (%)	35.2 ± 2.6	34.0 ± 3.0	31.6 ± 1.3	35.9 ± 2.5	32.3 ± 1.4	35.8 ± 2.1	32.0 ± 1.9	34.4 ± 1.8
Monocytes (%)	8.0 ± 0.6	8.9 ± 0.7	8.2 ± 0.8	8.3 ± 0.8	8.5 ± 0.3	8.4 ± 0.4	8.8 ± 0.5	8.3 ± 0.4
Eosinophils (%)	2.9 ± 0.5	2.7 ± 0.3	1.9 ± 0.3	3.0 ± 0.3	3.2 ± 0.8	2.8 ± 0.6	2.8 ± 0.4	3.3 ± 0.4
Basophils (%) *	0.7 ± 0.2	0.7 ± 0.2	0.9 ± 0.3	1.0 ± 0.2	0.5 ± 0.2	0.5 ± 0.2	0.6 ± 0.1	0.7 ± 0.1

Values are mean ± SEM.

* group effect for RDW (p=0.02); traditional DF < modified DF

* group effect for basophils (p=0.04); traditional DF < modified DF

No other statistically significant differences noted (p>0.05); no baseline (Pre) differences existed between groups for any measure (p>0.05).

of adults, and to possibly extend the time course of investigation into a true lifestyle change in dietary habits that may lead to improvements in health over time.

Unlike most dietary plans that call for a mandated reduction in calorie intake, both DF plans allow for *ad libitum* food intake, which we believe is at least partly responsible for the high compliance rates (Table 1). It is interesting to note that even with *ad libitum* feeding, total calorie intake was reduced by approximately 20-30% (Table 6). We believe that this is likely a result of the high nutrient density of the allowable foods within both plans and the concomitant lack of "empty calorie" foods that are commonplace in many American diets [5]. Indeed, satiety can be influenced by the quality of food ingested, even when the total caloric load is similar [6,7]. This is supported by our finding of slightly increased satiety across time for participants in both dietary plans (Table 1). While a reduction in calories was observed for both plans, a greater reduction was noted for the traditional plan, indicating that the diet plans are not necessarily isocaloric.

As we have noted in prior 3-week studies of the DF, participant self-reported mental and physical health was improved across time (Table 1). Most notably, physical health increased by 44% at 6 months in participants assigned to the modified DF. Related to this finding, we recently completed a long-term rodent study with animals assigned to either a Western diet chow or a customized chow to mimic the DF. In this study, animals consuming the DF chow have been noted to exhibit enhanced physical performance as compared to animals consuming the Western diet, as measured by treadmill run time to exhaustion. Moreover, multiple biochemical health-related benefits have been noted (unpublished findings). It appears that the nutrient dense nature of the DF plans promotes increased physical performance, or at least, the subjective feeling of enhanced performance. The multiple changes in dietary intake, inclusive of a reduction in saturated fat and sugar (Table 6) may be partly responsible for these effects.

Although no statistically significant changes were noted in subject characteristics using either DF plan, it is worth noting the following. First, body weight of participants in both groups was reduced across time approximately 4-6 kg, which has been noted to be "clinically meaningful" [8]. Second, waist and hip circumference was reduced approximately 5 cm and 4

Table 4: Metabolic panel data of participants before and during a 6 month modified or traditional Daniel Fast.

Variable	Modified DF Pre	Modified DF wk 3	Modified DF mo 3	Modified DF mo 6	Traditional DF Pre	Traditional DF wk 3	Traditional DF mo 3	Traditional DF mo 6
C-Reactive Protein (mg·L^{-1})	1.6 ± 0.7	0.8 ± 0.3	1.1 ± 0.5	0.9 ± 0.3	1.3 ± 0.3	0.6 ± 0.1	1.1 ± 0.3	1.3 ± 0.3
Insulin (µU·mL^{-1}) *	8.0 ± 1.7	6.1 ± 1.3	6.6 ± 0.9	5.7 ± 1.3	15.2 ± 3.9	11.3 ± 2.5	10.3 ± 2.4	12.2 ± 2.7
HOMA-IR *	1.8 ± 0.4	1.4 ± 0.3	1.5 ± 0.2	1.2 ± 0.3	4.9 ± 2.1	3.2 ± 1.2	2.7 ± 0.9	2.8 ± 0.7
Glucose (mg·dL^{-1}) *	88.4 ± 2.1	88.6 ± 2.6	88.8 ± 1.5	84.8 ± 2.4	105.8 ± 11.5	98.8 ± 7.8	97.7 ± 5.5	90.8 ± 3.0
BUN (mg·dL^{-1})	11.3 ± 1.1	10.3 ± 1.1	13.6 ± 2.2	12.8 ± 1.3	12.8 ± 0.9	10.3 ± 1.0	8.9 ± 0.9	12.3 ± 1.7
Creatinine (mg·dL^{-1}) *	0.8 ± 0.0	0.8 ± 0.0	0.8 ± 0.0	0.7 ± 0.0	0.8 ± 0.0	0.9 ± 0.1	0.8 ± 0.0	0.8 ± 0.1
BUN:Creatinine *	15.1 ± 1.5	12.9 ± 1.1	17.6 ± 2.8	17.7 ± 1.8	15.6 ± 1.3	11.8 ± 1.0	11.3 ± 1.2	15.5 ± 1.7
Sodium (mmol·L^{-1})	140.4 ± 0.6	140.5 ± 1.2	140.9 ± 1.0	140.2 ± 0.7	139.5 ± 0.6	140.2 ± 0.7	139.5 ± 0.8	139.9 ± 0.9
Potassium (mmol·L^{-1}) †	4.0 ± 0.1	4.5 ± 0.2	4.4 ± 0.2	4.3 ± 0.1	4.2 ± 0.1	4.6 ± 0.1	4.3 ± 0.1	4.4 ± 0.1
Chloride (mmol·L^{-1})	103.0 ± 0.7	102.9 ± 0.7	103.0 ± 0.8	102.4 ± 0.4	102.5 ± 0.7	102.9 ± 0.7	102.3 ± 0.8	102.5 ± 0.9
CO_2 (mmol·L^{-1})	24.1 ± 0.6	24.9 ± 1.2	24.4 ± 0.4	23.2 ± 0.8	24.6 ± 0.5	25.3 ± 0.7	24.4 ± 0.7	24.3 ± 0.5
Calcium (mg·dL^{-1})	9.3 ± 0.1	9.5 ± 0.2	9.5 ± 0.1	9.5 ± 0.1	9.4 ± 0.1	9.4 ± 0.1	9.4 ± 0.1	9.5 ± 0.1
Protein (g·dL^{-1}) *	6.9 ± 0.1	6.9 ± 0.1	7.0 ± 0.1	7.1 ± 0.1	6.7 ± 0.1	6.8 ± 0.1	6.6 ± 0.1	6.7 ± 0.1
Albumin (g·dL^{-1})	4.2 ± 0.1	4.3 ± 0.1	4.4 ± 0.0	4.4 ± 0.1	4.2 ± 0.1	4.4 ± 0.1	4.2 ± 0.1	4.4 ± 0.1
Globulin (g·dL^{-1}) *	2.6 ± 0.2	2.6 ± 0.1	2.6 ± 0.1	2.7 ± 0.1	2.4 ± 0.1	2.4 ± 0.1	2.4 ± 0.1	2.3 ± 0.1
A:G	1.7 ± 0.1	1.7 ± 0.1	1.8 ± 0.1	1.7 ± 0.1	1.8 ± 0.1	1.9 ± 0.1	1.8 ± 0.1	1.9 ± 0.1
Bilirubin (mg·dL^{-1})	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.1	0.5 ± 0.0	0.5 ± 0.1	0.5 ± 0.0	0.5 ± 0.1
Alk Phos (IU·L^{-1})	68.6 ± 6.0	69.0 ± 4.6	71.7 ± 3.7	69.8 ± 5.2	67.4 ± 4.7	67.8 ± 4.1	68.3 ± 4.5	68.9 ± 4.4
AST (SGOT) (IU·L^{-1})	19.0 ± 1.3	27.1 ± 5.3	19.0 ± 1.8	23.7 ± 2.4	20.5 ± 1.4	24.3 ± 2.3	22.8 ± 2.3	23.0 ± 1.8
ALT (SGPT) (IU·L^{-1})	18.0 ± 1.7	27.1 ± 4.1	19.0 ± 1.9	23.7 ± 2.5	20.5 ± 2.4	24.3 ± 2.3	22.8 ± 2.6	23.0 ± 2.6

Values are mean ± SEM.
* group effect for insulin (p=0.002); traditional DF > modified DF
* group effect for HOMA-IR (p=0.02); traditional DF > modified DF
* group effect for glucose (p=0.02); traditional DF > modified DF
* group effect for creatine (p=0.04); traditional DF > modified DF
* group effect for BUN:creatine (p=0.05); traditional DF < modified DF
† time effect for potassium (p=0.02); Pre < wk 3
* group effect for protein (p=0.0005); traditional DF < modified DF
* group effect for globulin (p=0.0005); traditional DF < modified DF
No other statistically significant differences noted (p>0.05); no baseline (Pre) differences existed between groups for any measure (p>0.05).

cm, respectively. This may translate into lower cardio-metabolic disease risk over time [9], in particular when coupled with the reduction in trunk body fat assessed via DXA (Table 2). It is possible that a longer-term intervention may yield even greater weight loss and associated changes. Of course, this would need to be determined through further investigation.

Few changes were noted for variables within the complete blood count (Table 3) or metabolic panel (Table 4). The noted group effects for insulin, HOMA-IR, and glucose were due partly to the inclusion of one diabetic subject within the traditional DF plan. That said, when removing this subject from the analysis, the group effects for each of the above variables remained statistically significant. It is interesting to note that this one subject, a 66 year old man, experienced a reduction in insulin (µU·mL^{-1}) from 49.8 (pre) to 35.1 (week 3), 33.8 (month 3), and 36.4 (month 6). A reduction in glucose (mg·dL^{-1}) from 229 (pre) to 180 (week 3), 145 (month 3), and 107 (month 6) was also observed. Considering a mere change in dietary intake over the course of a 6 month period, the above changes are impressive and may parallel the results from diabetic medication usage. Future studies of the Daniel Fast inclusive of diabetic or pre-diabetic subjects may be considered.

Table 5: Lipid panel data of participants before and during a 6 month modified or traditional Daniel Fast.

Variable	Modified DF Pre	Modified DF wk 3	Modified DF mo 3	Modified DF mo 6	Traditional DF Pre	Traditional DF wk 3	Traditional DF mo 3	Traditional DF mo 6
Cholesterol ($mg \cdot dL^{-1}$)	182.2 ± 15.5	154.8 ± 15.2	156.6 ± 15.4	167.3 ± 15.5	196.4 ± 16.4	163.4 ± 11.6	165.7 ± 15.3	174.7 ± 14.2
Triglycerides ($mg \cdot dL^{-1}$) *†	87.8 ± 9.3	68.4 ± 8.9	58.9 ± 8.2	63.2 ± 8.9	111.4 ± 12.7	85.3 ± 7.3	70.0 ± 6.2	80.5 ± 9.3
HDL-C ($mg \cdot dL^{-1}$)	57.2 ± 6.1	52.7 ± 5.0	56.8 ± 5.2	59.2 ± 6.4	54.0 ± 4.6	48.8 ± 4.3	53.1 ± 4.5	54.8 ± 4.6
VLDL-C ($mg \cdot dL^{-1}$) *†	17.8 ± 1.9	13.7 ± 1.7	11.9 ± 1.6	12.7 ± 1.8	22.3 ± 2.5	17.0 ± 1.5	14.2 ± 1.2	16.0 ± 1.9
LDL-C ($mg \cdot dL^{-1}$)	107.2 ± 14.1	88.4 ± 12.5	87.9 ± 14.0	95.4 ± 12.5	120.1 ± 14.1	97.6 ± 9.6	98.4 ± 12.6	103.9 ± 11.9
Total:HDL-C	3.5 ± 0.5	3.1 ± 0.3	2.9 ± 0.4	3.0 ± 0.3	3.8 ± 0.3	3.5 ± 0.2	3.2 ± 0.2	3.3 ± 0.3

Values are mean ± SEM.

* group effect for triglycerides ($p=0.01$); traditional DF > modified DF

† time effect for triglycerides ($p=0.002$); Pre > mo 3 and mo 6

* group effect for VLDL-C ($p=0.01$); traditional DF > modified DF

† time effect for VLDL-C ($p=0.002$); Pre > mo 3 and mo 6

No other statistically significant differences noted ($p>0.05$); no baseline (Pre) differences existed between groups for any measure ($p>0.05$).

As we have noted in our prior 21 day studies of the DF, blood lipids were favorably impacted. For example, total and LDL cholesterol was reduced by approximately 16% at week 3 and an approximate 10% reduction was maintained at 6 months. The decrease in dietary compliance from week 3 to month 6 is likely responsible for this change across time. This is supported by dietary data demonstrating an increase in both cholesterol and saturated fat intake from week 3 to month 6 (Table 6). While participants did not maintain perfect compliance, it appears that approximately 80% compliance is adequate to promote positive changes in the lipid panel. Interestingly, as in past studies of the DF [1,2,4], at the 3 week time period, HDL-C was reduced slightly. However, at the 3 and 6 month time period, values were slightly higher as compared to pre, indicating that the decrease in HDL-C when adopting the DF plan may be transient. This is encouraging, as a reduction in HDL-C may be viewed as problematic [10,11]. While the total and LDL cholesterol decreases are not as robust at month 6 as compared to week 3, the total:HDL-C was improved at month 6 (approximately 15% for both the traditional and modified DF). In addition to cholesterol, favorable changes were also observed for triglycerides, which were approximately 30% lower at month 6 as compared to pre, for both the traditional and modified DF. Collectively, these changes in blood lipids may have implications for improved cardiovascular health over time [12,13]. Longer term animal or human studies are needed to confirm this possibility.

The positive findings noted for our two dietary plans are not dissimilar to those noted for vegetarian diets, for which health benefits have been previously described [14,15]. For example, a recent mea-analysis indicated favorable glycemic control with adherence to a vegan dietary plan [16], with other work detailing the impact of plant-based diets on metabolic syndrome [17]. Moreover, an emerging area of literature has focused on the favorable impact that plant-based diets may have on the gut microbiota [18]. Indeed, such diets may be viewed as favorable from a health perspective and deserve further attention. While the DF may prove even more beneficial for overall health than traditional vegetarian diets due to the elimination of all processed foods, plant-based diets in general do appear to have health-enhancing properties.

A weakness of the present study is the omission of biochemical measures related to oxidative stress and antioxidant activity, as we have included in prior studies [3]. This, coupled with the failure to include a more detailed analysis of inflammation, perhaps as measured by a cytokine profile, should be considered a limitation of this work. Inclusion of these measures in future studies, along with a larger sample of subjects and possibly a “usual diet” control group, should be considered.

Conclusion

Individuals following either a traditional and modified DF for a period of 6 months experience favorable

Table 6: Dietary data of participants before and during a 6 month modified or traditional Daniel Fast.

Variable	Modified DF Pre	Modified DF wk 3	Modified DF mo 3	Modified DF mo 6	Traditional DF Pre	Traditional DF wk 3	Traditional DF mo 3	Traditional DF mo 6
Kilocalories †	1978 ± 213	1451 ± 203	1553 ± 233	1554 ± 228	2018 ± 268	1155 ± 94	1222 ± 130	1368 ± 114
Protein (g) *†	76 ± 14	64 ± 9	65 ± 9	67 ± 8	70 ± 7	36 ± 3	38 ± 5	47 ± 4
Protein (%) *	15 ± 2	18 ± 1	17 ± 1	18 ± 1	14 ± 1	13 ± 1	12 ± 1	14 ± 1
Carbohydrate (g)	262 ± 34	206 ± 44	241 ± 44	234 ± 40	248 ± 31	182 ± 16	195 ± 19	204 ± 15
Carbohydrate (%) †	53 ± 3	55 ± 6	60 ± 3	59 ± 3	50 ± 3	64 ± 3	66 ± 3	60 ± 2
Fiber (g) †	19 ± 3	31 ± 5	31 ± 6	30 ± 6	20 ± 2	27 ± 3	31 ± 4	29 ± 3
Sugar (g) †	107 ± 21	63 ± 9	64 ± 13	64 ± 13	81 ± 11	36 ± 6	38 ± 6	44 ± 7
Fat (g) †	70 ± 11	41 ± 5	42 ± 5	46 ± 9	81 ± 15	36 ± 7	38 ± 7	44 ± 6
Fat (%) †	32 ± 3	27 ± 3	25 ± 2	27 ± 3	35 ± 2	27 ± 3	26 ± 3	28 ± 2
Saturated Fat (g) †	20 ± 3	7 ± 1	8 ± 1	9 ± 2	24 ± 4	7 ± 1	8 ± 2	10 ± 2
Monounsaturated Fat (g)	16 ± 3	16 ± 3	15 ± 2	17 ± 3	21 ± 6	11 ± 2	11 ± 2	13 ± 3
Polyunsaturated Fat (g)	11 ± 2	8 ± 1	9 ± 1	10 ± 2	11 ± 3	7 ± 1	8 ± 2	7 ± 2
Trans Fat (g)	2 ± 1	0 ± 0	0 ± 0	0 ± 0	4 ± 3	0 ± 0	0 ± 0	1 ± 1
Cholesterol (mg) †	225 ± 36	58 ± 6	64 ± 8	147 ± 38	246 ± 41	16 ± 6	24 ± 8	68 ± 23
Vitamin C (mg) *†	61 ± 15	118 ± 25	133 ± 27	157 ± 35	47 ± 6	93 ± 12	105 ± 10	102 ± 20
Vitamin E (mg)	5 ± 1	8 ± 2	6 ± 1	7 ± 1	7 ± 2	6 ± 1	6 ± 2	6 ± 1
Vitamin A (RE)	243 ± 68	468 ± 113	577 ± 199	400 ± 119	261 ± 101	724 ± 177	308 ± 95	439 ± 186

Values are mean ± SEM.

† time effect for kilocalories ($p=0.002$); Pre > all other times
* group effect for protein ($p=0.0002$); traditional DF < modified DF
† time effect for protein ($p=0.01$); Pre > wk 3 and mo 3
* group effect for protein % ($p<0.0001$); traditional DF < modified DF
† time effect for carbohydrate % ($p=0.004$); Pre < mo 3 and mo 6
† time effect for fiber ($p=0.01$); Pre < all other times
† time effect for sugar ($p=0.01$); Pre > all other times
† time effect for fat ($p<0.0001$); Pre > all other times
† time effect for fat % ($p=0.02$); Pre > mo 3
† time effect for saturated fat ($p<0.0001$); Pre > all other times
† time effect for cholesterol ($p<0.0001$); Pre > all other times; mo 6 > wk 3
* group effect for vitamin C ($p=0.03$); traditional DF < modified DF
† time effect for vitamin C ($p=0.0008$); Pre < all other times
No other statistically significant differences noted ($p>0.05$)

health outcomes. While our ability to detect statistically significant findings may have been impaired by our small sample size, future studies should extend this work by including a much larger sample of men and women, possibly followed over a longer period of time. Considering the relatively high compliance as compared to traditional diet plans [19], either a traditional or modified DF should be considered by those individuals seeking enhanced health through dietary intake. Moreover, clinicians working with patients should consider this dietary approach as a complementary plan to other lifestyle interventions such as regular exercise, in an attempt to improve the health of their patients. This may have particular application for those with pre-diabetes or metabolic syndrome, as the dietary plan may be able to address important health parameters related to these conditions.

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Author Contributions

RJB was responsible for overseeing all aspects of this work, including the study design, data collection, analysis, and writing of the manuscript.

Conflict of Interests

The author declares no competing interests related to this work.

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