International Journal of
EXERCISE SCIENCE

Original Research

The Effectiveness of MyPlate and Paleolithic-based Diet Recommendations, both with and without Exercise, on Aerobic Fitness, Muscular Strength and Anaerobic Power in Young Women: A Randomized Clinical Trial

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ABSTRACT

International Journal of Exercise Science 11(2): 921-933, 2018. The purpose of this study was to evaluate the effectiveness of recommending a MyPlate or a Paleolithic-based diet, both with and without exercise, on aerobic fitness, strength, and anaerobic power over eight weeks. Participants (n=20) were randomized to one of four groups, (1) a MyPlate diet (MP), (2) Paleolithic-based diet (PD), (3) MyPlate and exercise (MP + Ex), and (4) Paleolithic-based diet and exercise (PD + Ex). The exercise included two days of unsupervised aerobic and resistance exercise. At baseline and final, absolute and relative peak oxygen consumption (absVO_{2peak} and relVO_{2peak}), anaerobic power, and upper and lower body strength were determined. Data were analyzed using repeated measures two-way analysis of variance (ANOVA). The ANOVA indicated that there was no significant interaction between time point (TP)*diet (D)*exercise (Ex) for all variables except relVO_{2peak} ($p = 0.016$). The MP + Ex group (Δ+4.4 ml·kg^{-1}·min^{-1}) had a greater change from baseline compared to the MP group (Δ-2.7 ml·kg^{-1}·min^{-1}, $p = 0.002$), and PD + Ex group (Δ-0.3 ml·kg^{-1}·min^{-1}, $p = 0.03$). The results suggest recommending a MyPlate diet with both aerobic and resistance training are effective at improving aerobic fitness when compared to PD recommendations with exercise, although these conclusions may be confounded by low compliance to exercise recommendations.

KEY WORDS: Dietary Guidelines for Americans, resistance training, aerobic training, pragmatic

INTRODUCTION

The American dietary pattern is energy-dense and insufficient in nutrients (e.g., vitamin D, iron) (1, 38). Over the last few decades, this poor dietary pattern has been associated with increased prevalence of obesity, dyslipidemia, and diabetes (6, 9–11, 25, 37). In contrast, the 2010 Dietary Guidelines for Americans or MyPlate (MP) recommendations are based on an overall "healthy eating pattern" that is low in saturated fat, trans fats, refined carbohydrates, and added sugar (38). Similar dietary interventions include the Dietary Approaches to Stop Hypertension (DASH) and the Mediterranean Diet. Both diets have been shown to decrease hypertension, improving cardiovascular disease risk and reducing body weight (32 ,34, 35).

The popularity of the Paleolithic-based diet (PD) has increased in recent years. PD recommendations are based on a pre-agricultural diet rich in vegetables, fruits, lean meats, eggs, wild game, seafood, nuts, and seeds. The PD is highlighted by the absence of cereal grains, dairy and milk products, and legumes. Studies suggest that a PD has positive effects on waist circumference, insulin sensitivity, fasting blood glucose, blood lipids, blood pressure and satiety (8, 12, 15, 22–24, 28, 29, 33).

Sedentary behavior is associated with an increased risk of mortality (39). Coupling dietary interventions with physical activity, which includes aerobic and resistance exercise, has been shown to benefit healthy adults (27). Studies assessing MP recommendations have been limited to outcomes on adiposity, weight change, blood lipids and blood pressure (5, 13, 36). In contrast, only one study has examined the effects of a PD with exercise on cardiorespiratory fitness. Otten et al. (28) found that a PD with exercise improves VO_{2max} in subjects with type 2 diabetes while participating in supervised exercise training.

The goal of a pragmatic or "effectiveness study" is to measure the degree at which interventions can be applied for practical application. To our knowledge, studies testing the effectiveness of MP and PD have not been performed in healthy individuals. This study aimed to determine and compare the effects of MP and PD recommendations, combined with and without exercise, on aerobic fitness, strength and anaerobic power in healthy, sedentary women over eight weeks. We hypothesize that a combination of PD recommendations, along with aerobic and resistance exercise will result in greater changes in aerobic fitness, upper and lower body strength, and anaerobic power when compared to MP and PD alone and the MP + Ex. We do not predict any significant differences between the MP and PD diet groups.

METHODS

Participants

Participants were recruited via email, flyers, and word of mouth in rural Clemson, South Carolina area from April 2015 to May 2016. The Institutional Review Board at Clemson University approved this study before the commencement of the participant recruitment, and the study was registered at Clinicaltrials.gov (NCT02380833).

Protocol

Screening: Participants were provided the informed consent, and those who were willing to continue in the screening process and study signed the informed consent and then completed a diet and exercise questionnaire, and a physical activity readiness questionnaire (PARQ). Height and weight were measured using a SECA 763 digital scale and stadiometer (SECA North America, Chino, CA, USA). Body composition was performed using dual x-ray absorptiometry (DXA) on a Hologic Discovery QDR Series (Hologic, Inc., Bedford, MA, USA) densitometer to test percent body fat. Finally, participants were fitted with a sense wear armband (SWA) (Body Media, Inc., Pittsburgh, PA, USA), used to measure six full days of free-living physical activity levels. Participants were included in the study if they met all of the following inclusion criteria: female, body fat between 20 and 42%, ≤ 150 min of moderate-intensity activity per week at ≥ 4.5 METs, not pregnant or lactating, non-smoker, no current or previous (within 3 mos) structured resistance training program, no dieting in the last 3 months, no dietary restrictions or food allergies, and weight stable (± 4.5 kg) in the past 3 months. Any participant who was unwilling to adhere to any aspect of the study (i.e., time committed to exercise) was excluded.

Enrollment and Allocation Protocol: Participants were enrolled using rolling enrollment. There were four cohorts of enrollment from May 2015 to February 2016. After screening, participants completed baseline measures for upper and lower body strength, anaerobic power, and peak oxygen consumption (VO_{2peak}). Upon completion of baseline testing, the participants were randomized to one of four groups: (1) MyPlate diet (MP), (2) Paleolithic-based diet (PD), (3) MyPlate diet + exercise (MP + Ex) and (4) Paleolithic-based diet + exercise (PD + Ex). A member of the research team (MMBB) was blinded from group allocation, performed the randomization, and statistical analysis. Randomization was performed using a random number generator in blocks of 4 to 8 to balance treatment groups across cohorts with allocation carryover in the event of an incomplete block. Opaque envelopes labeled with participant number contained the randomized treatment assignment. Participants and all other personnel were blinded to treatments until the first day of the trial. Participants were blinded as best as possible from either treatment by not using the terms “MyPlate,” “Paleolithic diet,” “Paleo diet,” or similar terms in the description of the dietary treatments during the duration of the study.

Dietary Recommendations: Dietary recommendations and daily caloric intake were provided based on energy expenditure results from the SWA at screening. Dietary recommendations, recipes, handouts and a “tool bag,” which included a digital scale/measuring cup, culinary knife, cutting board, and measuring utensils were provided to each participant after they were allocated to a group. A minimum of 2 days was provided to all participants between the group allocation and commencement of the study allowing for grocery shopping and meal preparation. A member of the research team reviewed the requirements of all dietary components one-on-one with each participant. Participants were instructed to follow their prescribed intervention for a period of 8-weeks. Bi-weekly communication by email or laboratory visit was conducted by a member of the research team to discuss their prescribed diet and exercise recommendations and answer any questions.

Participants were provided with detailed recommendations for each diet. MP recommendations were based on the 2010 Dietary Guidelines for Americans, which included consumption of whole-grains, fat-free or low-fat dairy, fruits, vegetables, protein from lean meat, seafood, nuts, legumes, and cooking oils (i.e., canola, olive oil) (38). MP recommendations limited refined grains, fried foods, foods with added sugar and salt, reduced or full-fat milk, sugar-sweetened yogurt, high-fat meats (i.e., bacon, hot dogs), solid fats, and high-salt seasonings. Alcoholic drinks were limited to no more than one drink per day. The PD recommendations were based on consumption of vegetables, fruits, unsalted nuts and seeds, cooking fats/oils (i.e., olive oil, coconut oil), eggs, lean meats (90% lean), poultry, and seafood. Cereal grains, dairy products, legumes, refined sugars and fats, and added salt were not permitted. Canned or frozen fruits and vegetables were allowed that contained no added sugar or salt. The PD allowed the following, under certain restrictions: ≤ 2 - 3 oz white/sweet potatoes, or 1 cup boiled/mashed white/sweet potatoes, 1 cup 100% fruit juice per day, ≤ one whole egg or 2 egg whites per day, ≤ 2 Tsp coconut oil or lard per day, ≤ 2 - 5 fl oz glasses of red or white wine (10 fl oz total) per week, ≤ 3 - 8 fl oz cups of black coffee, black or green tea (24 fl oz total) per day.

Exercise Recommendations: Participants in the MP + Ex and PD + Ex groups were provided with detailed exercise recommendations. Participants were instructed to perform two days of aerobic exercise (AE) and two days of resistance exercise (RE). Participants were instructed not to perform AE and RE on the same day. Both AE and RE were unsupervised. AE was performed for 30 minutes at 55% max heart rate (220-age = MHR) (±10 bpm) during week 1. Exercise intensity was increased by 10% every two weeks and only by 5% during the last two weeks, so participants finished at 80% max heart rate. Participants were allowed to perform any AE of their choice as long as the target heart rate was attained during each session. Participants were instructed to perform each session with a 5-minute dynamic warm-up that consisted of a low-intensity walk or jog and finished with a 10-minute cooldown of static stretches. Participants were provided with heart rate monitors (Omron HR310, OMRON, Inc., Hoffman Estates, IL, USA) to measure HR during their exercise sessions. RE was performed at the on-campus recreational center for 45 minutes on non-aerobic training days. The RE movements included: leg press, leg curl, chest press, standing push-press, lateral raises, lat pulldowns, tricep pushdowns, bicep curls and seated crunches. Each movement was performed as three sets by 8 – 12 repetitions with 60 seconds' rest in between sets. Participants were instructed to increase workloads after each set and between RE days, so the targeted number of repetitions was attained during each set. Participants were instructed to follow a 5-minute dynamic warm-up and a 10-minute cool down during each session. Before beginning the exercise training, participants met with a member of the research team who instructed them on both the AE and RE training routine. RE movements were demonstrated in detail, showing the range of motion and technique for each movement, and a baseline weight for each RE movement was established.

Aerobic Fitness, Strength and Anaerobic Power Testing: Strength and anaerobic power tests (e.g., Wingate cycle ergometer) were completed on the same day, and 48 hours before the aerobic fitness test was completed. Strength testing was completed before anaerobic power testing. Baseline and final testing were identical, and the same investigator took each measurement. Strength testing included upper and lower body one repetition maximum (1RM), measured at the university recreational center on campus. Participants performed leg press (LP) on a seated leg press machine (LifeFitness, Rosemont, IL, USA). Before beginning the leg press, a member of the research team demonstrated the proper range of motion and technique. The participant was familiarized with the machine and given 1-2 practice sets with little resistance. Each repetition for leg press started and finished in knee extension. A member of the researcher team assisted the participant into extension. The participant was instructed to perform 5 to 8 reps for the first set, 3 to 5 reps for the second set and 1 to 2 reps for the third set, with a progressive increase in load from set to set. All of the following sets included only one repetition until a one repetition maximum (1RM) was achieved. If they had not reached a 1 RM by their sixth set, they were instructed to complete as many repetitions as possible, and a 1 RM was then estimated (4). Chest press (CP) was performed on a seated chest press machine (Life Fitness, Rosemont, IL, USA). The same procedure for measuring or estimating 1RM used for LP was performed for CP.

Anaerobic power was measured with a 30-second Wingate protocol on a Monark Cycle Ergomedic 894 Ea (Monark Exercise AB, Vansbro, Sweden) cycle ergometer. A resistance of 7.5% of body mass (kg) was set for all tests. Each participant performed a 3-minute warm-up with limited resistance at 70 rpm. Following the warm-up, each subject continued pedaling and a three-second countdown period was begun. Thereafter, the participant pedaled at maximal revolutions per minute. After the participant reached 100 rpm, the resistance basket was dropped, and the 30-second timer started. Verbal encouragement was given throughout the test to work with the greatest effort. At the end of the 30-second test period, the resistance was removed, and participant continued to pedal for an additional 3 minutes at 70 rpm to cool down.

The aerobic fitness test included a graded exercise test. This test was completed on a TrackMaster® treadmill (TrackMaster Treadmills, Newton, KS, USA) to determine VO_{2peak}. A ParvoMedics' TrueOne® 2400 (Parvo-Medics', Sandy, UT, USA) metabolic cart was used to take respiratory measurements. Gas and flow calibration were performed according to the manufacturer's recommendations. Temperature, humidity, and barometric pressure were measured (Vantage VUE Digital Barometer, Davis Instruments, Hayward, CA, USA) before each subject test. Expired air was collected using a 7450 V2 respiratory mask (Hans Rudolph Inc., Shawnee, KS, USA) fitted with a two-way non-rebreathing valve covering the nose and mouth before beginning each test. The respiratory mask was connected to the calorimeter by a nine ft., 35 mm breathing tube (ParvoMedics' Inc., Sandy, UT, USA). Participants wore a Polar heart rate monitor (Polar Electro Inc., Lake Success, NY, USA) around the thoracic region just below the sternum to measure heart rate. The graded exercise test used the Bruce protocol of increasing speed and grade every 3 minutes to determine VO_{2peak} (30). Every minute on the minute, a rating of perceived exertion (RPE) was measured using the Borg scale by having participants point to a number. VO_{2peak} was calculated as the highest rolling 30-second average. The test was voluntarily terminated when the participant could not subjectively continue with the protocol.

Statistical Analysis
The study was conducted using a 2x2 factorial design and data were analyzed by using repeated measures 2-way ANOVA using the MIXED procedure in SAS (Version 9.4, SAS Institute, Cary, NC). A sample size of 20 participants (5 per group) was estimated assuming a change from baseline effect of aerobic fitness ($VO_{2peak}(ml \cdot kg^{-1} \cdot min^{-1})$) with a power of 80% and α of 0.05. Missing data were handled by using a mixed modeling approach which is robust to missing data (2). The model included fixed effects of time point (TP), diet (D), exercise (Ex), D*Ex, TP*D, TP*Ex and TP*D*Ex with a person (D*Ex) as a random effect. When the 3-way interaction was significant, the following four comparisons were made: the change (final – baseline time points) in variable of interest in participants assigned to (1) MP + Ex versus MP without Ex, (2) PD + Ex versus PD without Ex, (3) PD + Ex versus MP + Ex, (4) PD without Ex versus MP without Ex. When the 3-way interaction was not significant, and either or both of the two-way interactions of TP*D and TP*Ex were significant, the following comparisons were tested: for TP*Ex, the comparison of the change (final – baseline TPs) in variable of interest in women assigned to exercise program or no exercise program and for TP*D, the comparison of the change (final – baseline TPs) in variable of interest in participants assigned to PD recommendations compared to the MP recommendations. A one-way ANOVA was used to assess baseline measures, and Tukey HSD post hoc test was used to assess between group differences. For all tests, $p < 0.05$ was considered significant. "Δ" denotes (final – baseline). Primary outcomes include the following: absolute VO_{2peak} ($absVO_{2peak}$), and relative VO_{2peak} ($relVO_{2peak}$), leg press 1 RM, chest press 1 RM, peak power, relative peak power, average power, average relative power, power drop, relative power drop. Secondary outcomes include the following: body weight (BW), body mass index (BMI), total energy expenditure (TEE), active energy expenditure (AEE), average METs, physical activity duration, physical activity level (PAL), sedentary time and steps.

RESULTS

The consort diagram is depicted in Figure 1. Three participants did not complete the full 8-week intervention but did complete the final testing for all variables. Of those three participants, one dropped during week two from the PD + Ex group, another participant dropped from the MP + Ex group during week 5, and the third participant from the PD group dropped during week 6 of the intervention. One participant was lost to follow-up due to ongoing respiratory infection during final testing.

Table 1 shows the screening characteristics for all participants allocated to an intervention arm. For all variables, only baseline $relVO_{2peak}$ was significantly greater in PD +Ex group ($p = 0.025$) compared to the MP +Ex group. For the primary outcomes, the ANOVA indicated that there was no significant interaction between TP*D*Ex for strength (leg press ($p = 0.427$), chest press ($p = 0.753$)), peak power ($p = 0.732$), relative peak power ($p = 0.498$), power drop ($p = 0.708$), relative power drop ($p = 0.855$), and $\Delta absVO_{2peak}$ ($p = 0.093$) (See supplemental material). Based on the ANOVA there was a significant 3-way interaction of TP*D*Ex for $\Delta relVO_{2peak}$ ($p = 0.016$). Comparing the MP and MP + Ex groups, there was a significant difference between

$\Delta relVO_{2peak}$ in participants who exercised versus those that did not exercise (p = 0.002). In addition, comparing both the MP+ Ex and PD + Ex groups, there was a significant difference between $\Delta relVO_{2peak}$ in participants who consumed the MP diet recommendations versus those that consumed the PD recommendations (p = 0.03). The secondary variables are presented in the supplemental material.

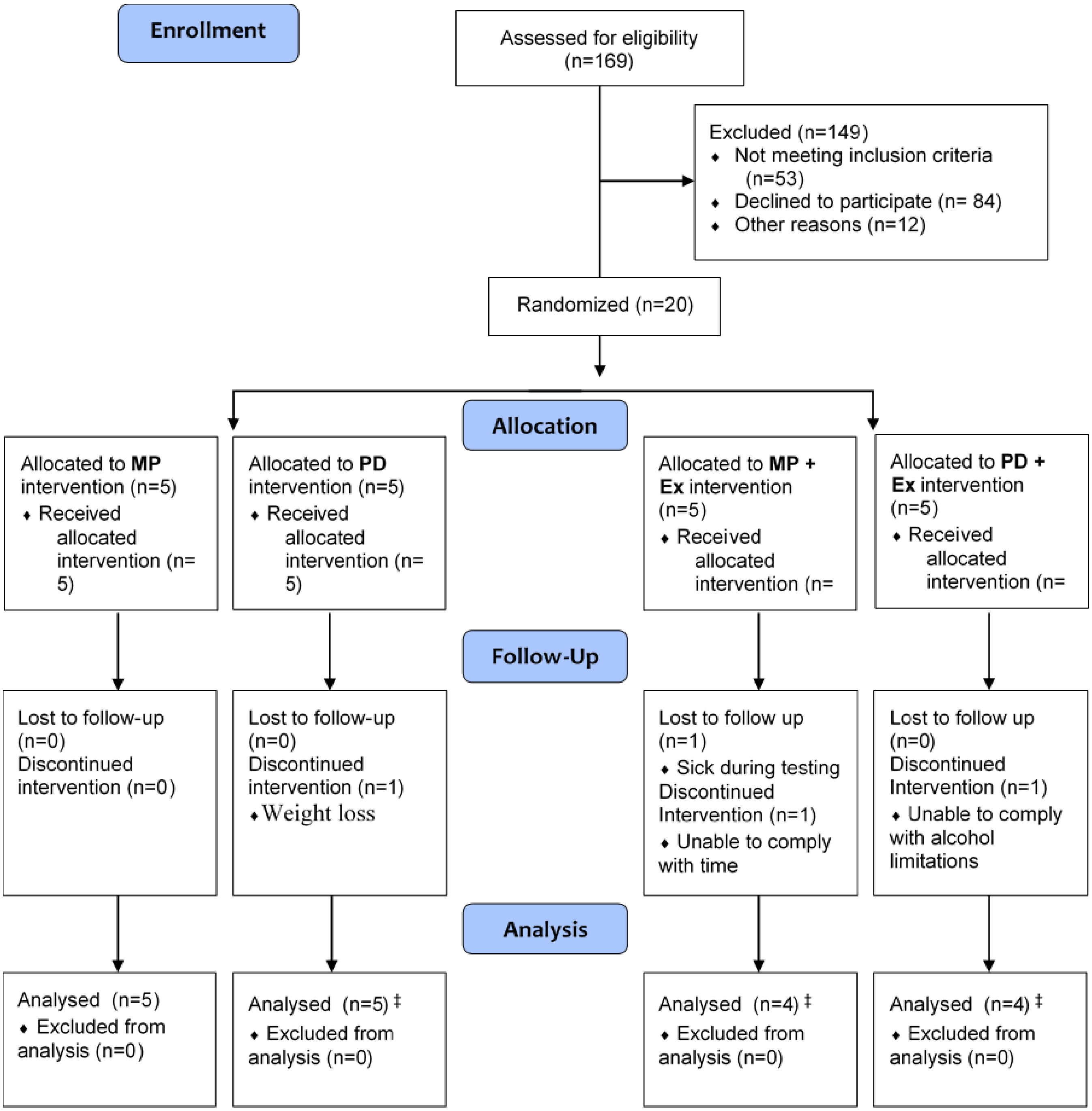

Figure 1. Consort diagram. ‡Participant withdrew from the study but returned for final testing.

Table 1. Baseline Characteristics[1].

	MP (n=5)	PD (n=5)	MP + Ex (n=5)	PD + Ex (n=5)
Age (years)	21.8 ± 0.5	21.4 ± 1.0	22.0 ± 1.5	22.8 ± 1.5
Height (cm)	169.6 ± 2.2	163.7 ± 3.6	162.7 ± 1.6	165.4 ± 3.6
Weight (kg)	76.6 ± 8.4	68.0 ± 4.0	77.6 ± 4.9	67.1 ± 2.9
BMI ($kg \cdot m^{-2}$)	26.7 ± 2.9	25.5 ± 1.5	29.4 ± 1.8	24.5 ± 0.5
BMC (kg)	2.0 ± 0.1	2.0 ± 0.1	2.1 ± 0.1	2.1 ± 0.1
LBM (kg)	46.6 ± 4.9	42.3 ± 2.2	44.2 ± 3.0	41.9 ± 2.5
FM (kg)	28.0 ± 3.9	23.9 ± 2.5	31.5 ± 1.9	23.6 ± 1.0
BF (%)	36.1 ± 1.4	34.8 ± 2.4	40.6 ± 0.8	35.1 ± 1.5
VO_{2peak} ($L \cdot min^{-1}$)	2.3 ± 0.2	2.3 ± 0.1	2.2 ± 0.2	2.4 ± 0.1
VO_{2peak} ($ml \cdot kg^{-1} \cdot min^{-1}$)	30.5 ± 1.0	34.3 ± 2.5	28.1 ± 2.1[a]	36.1 ± 0.7[b]

Values are reported as mean ± SEM. [a,b] Different letters indicate statistical significance between groups; $p < 0.05$ MP, MyPlate; PD, Paleolithic-based; MP + Ex, MyPlate + Exercise; PD + Ex, Paleolithic-based + Exercise; BMI, Body Mass Index; BMC, Bone Mineral Content; LBM, Lean Body Mass; FM, Fat Mass; BF, Body Fat. [1]BMC, LBM, FM and BF (%) were estimated using dual x-ray absorptiometry.

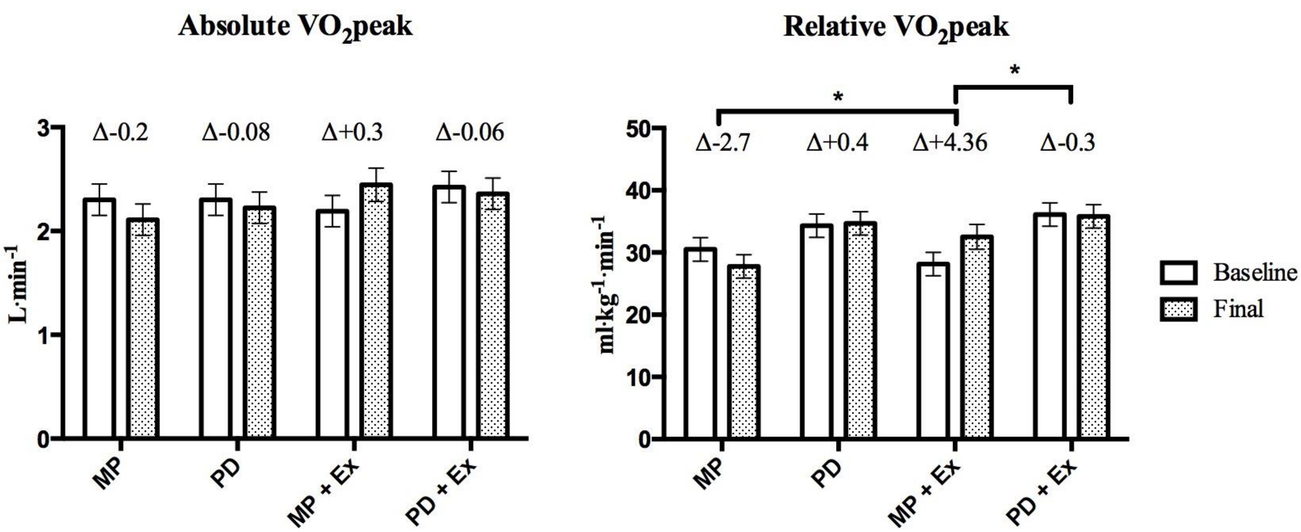

Figure 2. Aerobic Fitness. Absolute VO_{2peak} (absVO_{2peak}) and relative VO_{2peak} (relVO_{2peak}) comparisons in the MP, PD, MP + Ex and PD + Ex groups. There was a non-significant difference for ΔabsVO_{2peak} for all groups. There was a significant three-way interaction for TP*D*Ex for between the MP and MP + Ex group, and MP + Ex and PD +Ex groups for ΔrelVO_{2peak}. TP, time point; D, diet; Ex, exercise; MP, MyPlate diet; PD, Paleolithic-based diet; MP + Ex, MyPlate diet + exercise; PD + Ex, Paleolithic-based diet + exercise. Data represent mean ± SEM. *$p <$ 0.05.

DISCUSSION

The design of the present study allows us to provide initial insight into the interactions between specific dietary and exercise recommendations. The aim of this study was to determine the effectiveness of MP and PD recommendations, combined with and without exercise, on aerobic fitness, strength, and anaerobic power in healthy, sedentary women over eight weeks. The results of this study do not support the original hypothesis that a combination of PD recommendations, aerobic and resistance exercise would result in greater changes in aerobic fitness, strength, and anaerobic power compared to MP and PD alone and the MP + Ex. We assumed that a drastic change in dietary intake, specifically the absence of grains, dairy, and legumes associated with a PD would be more effective at changing cardiorespiratory and physical fitness variables than MP recommendations. The results indicate an effect of MP and exercise recommendations on increasing the peak volume of oxygen consumed during an aerobic fitness assessment.

Cardiorespiratory fitness is a strong predictor of metabolic syndrome, type 2 diabetes, and mortality (7, 18, 19). In a cross-sectional study, women who had a VO_{2peak} below the median of 35.1 $ml \cdot kg^{-1} \cdot min^{-1}$ were five times more likely to have a cluster of cardiovascular risk factors compared to those with a $VO_{2peak} > 40$ $ml \cdot kg^{-1} \cdot min^{-1}$ (3). As expected, we found that women who consumed an MP diet and exercised had a greater $relVO_{2peak}$ compared to women who consumed MP diet alone. Counter to our hypothesis, the change in $relVO_{2peak}$ was greater in women who consumed an MP and exercised than women who consumed a PD and exercised. Studies have shown similar changes in cardiorespiratory fitness as a result of aerobic training in the absence and presence of a dietary intervention (20, 26, 28). Baseline measures of $relVO_{2peak}$ indicate participants in the PD + Ex group had significantly greater $relVO_{2peak}$ levels compared to the MP + Ex group. Unfortunately, randomization did not equally distribute aerobic fitness levels among groups. The AE recommendations we provided may not have been within an effective intensity to increase aerobic fitness in the PD +Ex group considering they had the highest baseline $relVO_{2peak}$. Also, large individual differences in cardiorespiratory fitness in response to aerobic and resistance training have been observed previously and may explain some of the responses to exercise (14).

The dietary recommendations for both groups were designed to be similar minus the consumption of grains, dairy, and legumes in the PD group. We did not report dietary intake during the duration of this study, but we consider the lack of change in aerobic fitness in PD + Ex group may be explained by the composition of the diet. Prior studies report low carbohydrate contents of individuals who consumed a PD (16, 28, 29). Genoni et al. (12) found that when compared to baseline, the carbohydrate content of an *ad lib* PD was significantly reduced at follow-up. By default, the PD group may have consumed lower energy intake from carbohydrates when compared to MP group. This decrease in dietary carbohydrates may have led to compromised glycogen stores (17). Acute low glycogen availability does not compromise performance during moderate duration exercise but may limit glucose availability at higher intensities leading to a decrease in overall VO_{2peak} (21).

The results also demonstrate no significant differences in the change from baseline when comparing all groups for strength and anaerobic power measures. Although, this could be due to the power of the current study for those specific measures. The study was powered based on changes in $relVO_{2peak}$ ($ml \cdot kg^{-1} \cdot min^{-1}$). Furthermore, all exercise sessions were unsupervised. Taken together, we cannot come to a concrete conclusion regarding changes in strength and anaerobic power in this study.

Effectiveness trails (i.e., pragmatic) sacrifice internal validity for external validity (i.e., generalization). The present study offers insight as to the effects of diet and exercise recommendations in a 'real-world' scenario, although, our study had a few limitations. We recognize the small sample size and underpowered nature of the secondary outcomes, but realize the importance this study may have as a framework for future diet and exercise interventions. In addition, we did not analyze compliance to exercise recommendations, but participants were instructed to complete exercise logs for both AE and RE training. We found 60% of the participants in the MP + Ex group had complete records of both activities, whereas only 40% of participants in the PD + Ex groups had complete records. The low self-reporting of exercise activities in both groups may explain discrepancies between groups. This may further explain the lack of change in exercise-related variables in the PD + Ex group. Furthermore, we recruited from a narrowly defined sample of young, women from a university in a rural area of South Carolina. We found recruitment to be extremely difficult as the university we recruited from does not conduct clinical research trials. Lastly, we did not include a control group. Assigning a control group in a dietary intervention study can be difficult considering participants follow different dietary patterns upon enrollment. A run-in period of 2 -3 weeks using a weight maintenance diet prior to randomization would address this issue.

Future studies should assess the effects of MP and PD recommendations with exercise in a larger heterogeneous sample of adults. We also suggest that future studies assess the impact of ≥ 3 days of unsupervised RE coupled with MP and PD interventions. Peterson et al. (31) concluded in a review of meta-analytical findings on the dose-response to resistance training that for untrained individuals, a mean training intensity of 60% one repetition maximum (1RM), three days per week and with a mean training volume of 4 sets per muscle group may be necessary.

In conclusion, simply recommending young, sedentary women follow a MP diet coupled with both aerobic and resistance exercise may be effective at increasing relative aerobic fitness. Although, these conclusions may be confounded by low compliance to exercise recommendations. Improvements in strength and anaerobic power with MP and PD recommendations warrant further evaluation. A larger more heterogeneous sample of adults with increased frequency of RE sessions is recommended to assess the impact of these recommendations over a longer duration.

ACKNOWLEDGEMENTS

The authors want to thank all study participants for their dedication and willingness to volunteer. The authors also thank Nadia Najm at Clemson University for her contribution to the data collection and manuscript writing process. We want to thank Deborah Hutcheon for her contribution with regards to the dietary interventions. The authors would also like to thank the following undergraduate volunteers for their assistance during data collection:

Nicolas Osborne, Katherine Shaw, Finley Wiles, Dalton Meers, Catherine Tenenbaum, Alie Match, and Lauren Ladelfa.

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