Comparison of animal and plant based protein diets on weight loss

Research Proposal

Draft study design and methodology

Obesity is an increasingly common problem around the world caused by consuming more calories than are expended and excess energy is then stored as fat. The world health organization (WHO, 2018) found that there were more than 1. 9 billion (39%) adults are overweight and 650 million (13%) obese globally. In the UK, 1 in 4 adults are obese. Obesity is a main risk factor of several serious health problems, including type 2 diabetes, hypertension, liver and kidney disease, coronary heart disease, cardiovascular diseases and stroke and musculoskeletal disorders (osteoarthritis). In obese individuals, the increased amount of non-esterified fatty acids, glycerol, hormones, cytokines, proinflammatory markers, and other substances that are involved in the development of insulin resistance and the development of type 2 diabetes (Al-Goblan et al, 2014). Studies have shown that obesity is associated with a greater risk of multiple disease risk factors (Burke et al, 2008).

Physical activity is considered as a lifestyle factor which can prevent obesity and help maintain healthy weight. Low physical activity is associated with greater increase in weight gain in both women and men, with women at higher risk for weight gain compared to men (Swift et al., 2014). A Systematic Review by Swift et al. (2014), comparing different types of training methods and their effectiveness on weight loss and weight maintenance found individuals taking part in training programs without caloric restrictions can expect minimal weight loss of up to 2kg after

approximately 6 months but for clinically significant weight loss, obese and overweight individuals need to exceed the current recommendations of 150 min per week to over 225 minutes per week without caloric restrictions being applied. However, the review did not look at different types of protein or carbohydrate restriction with combination of resistance and aerobic exercise (circuit training).

As the prevalence of obesity is increasing, there is a need for low-risk and potent long term approaches to weight loss. Ketogenic diet, in which one consumes a very low-carb diet and thus depriving the body of carbohydrates for fuel and relying on ketones produced in the liver instead, has the potential to be an effective approach to reduce body weight in overweight and obese people. A randomized controlled trial (RCT) of 24 men in Spain reported that after 8 weeks, there was a significant reduction in fat mass and visceral adipose tissue in subjects following a ketogenic diet in addition to resistance training compared to those who only did resistance training and those in a control group (Vargas et al., 2018). These results denote that low-carb ketogenic diet might be an effectual dietary approach to decrease body weight without decreasing lean body mass. Another RCT reported greater weight loss in a group following a ketogenic diet compared with a group following a low-fat reduced-calorie diet (-12. 9% vs. -6. 7%) as well as a greater decrease in serum triglyceride levels, and greater increase in high-density lipoprotein cholesterol levels (Yancy Jr., et al. 2004). Several other trials also indicate greater weight loss for those following ketogenic diet compared to the alternative (Nickols-Richardson et al., 2005; Foster et al., 2003; Samaha et al., 2003). There is, however, a lack of evidence regarding

the effect of ketogenic diet based on the protein source in addition to physical activity in overweight population.

A systematic review carried out by Gilbert et al. (2010) evaluating the effect of plant-protein vs animal-protein based diets on body composition reported enhanced muscle synthesis with animal protein compared to plant-based diets, however, these diets did not restrict carbohydrate intake. Similarly, Demersay et al. (2017) compared the impact of plant- and animal-sourced proteins on several features of metabolic syndrome not in combination with a low carbohydrate diet and reported a greater decrease in LDL cholesterol in soy protein and other plant protein diets compared with animal-sourced protein consumption. Another RCT showed a decrease in fat mass associated with increased intake of plant protein, while the same trend was found by decreasing animal protein intake (Kahleova et al. 2018). Nevertheless, the study carried out by Farnsworth et al. (2003) which used a parallel showed no significant differences in weight and fat loss suggesting the effect of replacing carbohydrate with animal- or plant-based protein on body composition in obese adults is still inconclusive. The aim of this study is to compare animal and plant based low carbohydrate diets combined with physical activity in overweight adults and compare their effect on body composition; metabolic disease risk factors; and satiety.

Participants from greater Glasgow will be recruited through social media, newspapers, poster and email advertising. Those fitting the inclusion criteria will also be invited by their. Inclusion criteria includes all overweight (BMI > 27. 3 for females and > 27. 8 for males) sedentary adults aged 18 – 65 whose weight remained stable in the 3 months prior to the study.

Participants will be contacted via telephone and screened. Those already suffering from disease; smokers; taking medication (any that could affect body composition or metabolic disease risk factors) or weight loss supplements in the past 3 months; or following any specific diets (vegan, vegetarian, gluten free, allergies etc.) are excluded. The number of participants recruited will be determined by power analysis using the software GPower. All participants must consent to following diet and training plans for 6 months; agree to body composition analysis; and provide blood and urine samples at various intervals. As a reward, a sum of £500 will offered to participants who completed the study at the end of the 6 months.

Participants will be invited to a screening session, when fasted, where several measurements will be conducted by trained nurses and physicians who are unaware of which diet will be allocated to each subject. Transport will be provided for all. Energy expenditure will be determined by the doubly labelled water technique explained elsewhere (Westerterp, 2017). In summary, the subjects drink the doubly labelled water at the session and are provided with labelled containers to provide urine samples in over the next 10 days. The samples are then collected from their homes via courier after the 10 days and analysed as described. The body composition of participants will be analysed by dual-energy X-ray absorptiometry scanning and magnetic resonance imaging to determine lean body mass, fat mass and analyse the distribution of fat as well as coronary endothelial function. Blood pressure when seated will be measured using an automated sphygmomanometer. Participants will provide multiple blood samples which will be analysed by trained laboratory workers to determine their lipid profile, insulin sensitivity

and levels of C-Reactive Protein (CRP) which will be used to detect inflammation.

Once all baseline measurements have been conducted, participants will be randomly assigned to one of the three groups based on a computer-generated randomisation protocol, the control group will continue consuming their habitual diet. All diets will last for a period of 6 months. The low-carbohydrate and high-protein diet will be composed of 30% of calories from carbohydrates, 33% from fat and 37% from protein and total energy will be matched to the subject’s energy expenditure. Carbohydrate sources will be comprised of fibre-containing foods and low-starch vegetables. Plant-based protein sources will include fruits and vegetables, nuts and seeds, beans, peas and legumes and gluten; while animal-based protein sources include meat and meat products, egg and egg dishes, fish and fish dishes and milk and dairy products. Food preparation will be made as simple as possible for participants. Dry, refrigerated and frozen diet foods will be packed in a central location and shipped in separate boxes, ready for microwave, oven cooking or prepared with boiling water. Participants will be sent weekly text reminders encouraging them to continue their diet and will be asked to provide fortnightly urine samples which will be collected by courier for laboratory analyses of urinary ketones to confirm diet adherence. Participants found to have urinary ketone levels below 0. 5 mmol/L in two samples will be excluded.

Subjects will follow a specifically designed training program for a period of 24 weeks (6 months) at a private gym facility. Transport will be provided for all.

All three groups: control (CON), plant based high-protein-low-carbohydrate

group (PLC) and animal-based high-protein low-carbohydrate (ALC) diets will complete the training program based around circuit training consisting of resistance, and endurance-based exercises. Participating subjects will take part in a supervised exercise program divided into three non-consecutive days per week (totalling 72 workouts), lasting approximately 50 minute per session were attendance will be noted. All participants will complete a familiarisation session allowing them to learn correct exercise techniques and answer any questions participants may have. The circuit training will include a 5 min aerobic warm-up performed on either a bike or a treadmill, followed by 5 mins of dynamic stretching. The circuit will consist of bodyweight, resistance and endurance based exercises (push-ups, squats, lunges, back extensions, side bends, triceps dip, calves raises, bicep curls, chest press, shoulder press, sit-ups, rowing, cycling, treadmill and incline walking). Participants will complete resistance exercises using free-weights and elastic bands and endurance exercise will be completed using stationary machines. Any participants failing to attend 80% of sessions will be excluded.

After the 6 months intervention, all participants who have successfully completed both diet and training interventions will be asked to attend a post screening session where all baseline measurements will be repeated. A questionnaire will be completed by all asking subjects to score their levels of satiety and satisfaction when following their assigned diet. Baseline measurements will be compared with post intervention measurements to assess the effect of the intervention. Data analysis will be done using IBM SPSS Statistics. An ANOVA with post hoc analysis will be used to assess

differences between groups and variables will be adjusted for potential confounders which will be determined using multiple linear regressions. A p-value of ≤0. 05 will be deemed significant.

References

- Al-Goblan AS, Al-Alfi MA, Khan MZ (2014) Mechanism linking diabetes mellitus and obesity. *Diabetes, metabolic syndrome and obesity: targets and therapy* 7: 587-591
- Burke GL, Bertoni AG, Shea S, Tracy R, Watson KE, Blumenthal RS, Chung H & Carnethon MR (2008) The impact of obesity on cardiovascular disease risk factors and subclinical vascular disease: the Multi-Ethnic Study of Atherosclerosis. *Archives of internal medicine American Medical Association* 68: 928-35
- Chalvon-Demersay T, Azzout-Marniche D, Arfsten J, Egli L, Gaudichon C, Karagounis L & Tome D (2017) A Systematic Review of the Effects of Plant Compared with Animal Protein Sources on Features of Metabolic Syndrome. *Journal of Nutrition* 147: 281-292
- Farnsworth E, Luscombe N, Noakes M, Wittert G, Argyiou E & Clifton P (2003) Effect of a high-protein, energy-restricted diet on body composition, glycemic control, and lipid concentrations in overweight and obese hyperinsulinemic men and women. *American Journal of Clinical Nutrition* 78: 31-39
- Foster G, Wyatt H, Hill J, McGuckin B, Brill C, Mohammed B, Szapary P, Rader D, Edman J & Klein S (2003) A Randomized Trial of a Low-Carbohydrate Diet for Obesity. *New England Journal of Medicine* 348: 2082-2090

- Gilbert J, Bendsen NT, Tremblay A & Astrup A (2011) Effect of proteins from different sources on body composition. *Nutrition, Metabolism and Cardiovascular Diseases* 21: 16-31
- Kahleova H, Fleeman R, Hlozkova A, Holubkov R & Barnard ND (2018) A plant-based diet in overweight individuals in a 16-week randomized clinical trial: metabolic benefits of plant protein. *Nutrition & Diabetes* 8: 1-10
- Nickols-Richardson S, Coleman M, Volpe J & Hosig K (2005) Perceived Hunger Is Lower and Weight Loss Is Greater in Overweight Premenopausal Women Consuming a Low-Carbohydrate/High-Protein vs High-Carbohydrate/Low-Fat Diet. *Journal of the American Dietetic Association* 105: 1433-1437
- Samaha F, Iqbal N, Seshadri P, Chicano K, Daily D, McGrory J, Williams T, Williams M, Gracely E & Stern L (2003) A Low-Carbohydrate as Compared with a Low-Fat Diet in Severe Obesity *New England Journal of Medicine* 348: 2074-2081
- Swift DL, Johannsen NM, Lavie CJ, Earnest CP & Church TS (2013) The role of exercise and physical activity in weight loss and maintenance. *Progress in Cardiovascular Diseases* 56: 441-447
- Westerterp KR (2017) Doubly labelled water assessment of energy expenditure: principle, practice, and promise *European Journal of Applied Physiology* 117: 1277-1285
- Wiklund P (2016) The role of physical activity and exercise in obesity and weight management: Time for critical appraisal. *Journal of Sport and Health Science* 5: 151-154

- World Health Organisation (WHO) (2018) Obesity and overweight. [online] Available at: https://www. who. int/en/news-room/fact-sheets/detail/obesity-and-overweight(Accessed 9 December 2018)
- Vargas S, Romance R, Petro J, Bonilla D, Galancho I, Espinar S, Kreider & Benítez-Porres J (2018) Efficacy of ketogenic diet on body composition during resistance training in trained men: a randomized controlled trial. *Journal of the International Society of Sports Nutrition* 15: 1-9
- Yancy W, Olsen M, Guyton J, Bakst R & Westman E (2004) A Low-Carbohydrate, Ketogenic Diet versus a Low-Fat Diet to Treat Obesity and Hyperlipidemia. *Annals of Internal Medicine* 140: 769-777