



Faculty of Health and Social Sciences

Master by Research

Developing an evidence-based and UK-adapted Mediterranean style diet for healthy eating in
overweight/obesity

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Abstract

Introduction

In the UK, obesity and overweight contribute to multiple non-communicable diseases (NCDs), increased individual burden and financial burdens on the National Health Service. Excess weight is a modifiable risk factor for the population. The Mediterranean Diet (MedDiet) has a long history of reducing prevalence of NCDs and may offer a more-sustainable plant-based dietary pattern. Despite this, barriers and preconceptions about MedDiet continue to hinder adoption, adherence and concordance in the UK. This research investigated the potential to contribute to a UK version of MedDiet to improve these three considerations.

Methods

Split into two phases, this study combined quantitative and qualitative aspects. Phase 1 was a systematic review of 4478 records with 16 found to be eligible for review. Rigorous methodology was applied using PRISMA and Cochrane Risk of Bias tool v2. Phase 2 drew on the findings from the systematic review to inform the design for online focus groups. In a semi-structured format, eligible participants (n=9) responded to the guide questions and conversation flow to explore awareness, preconceptions and barriers to adoption of the MedDiet. Iterative analyses were performed with Reflexive Thematic Analysis to develop major themes from codes and sub-themes in a post-positivist epistemology.

Results

The systematic review revealed a paucity of MedDiet interventions in overweight and obese, yet otherwise healthy, individuals especially outside the Mediterranean Basin. Additionally, many of the dietary modifications increased the healthiness of the diet for specific purposes. Examples of this were visible in the PREDIMED studies, where supplementary extra virgin olive oil and/or nuts were widely deployed. Non-dietary factors were broadly absent in the eligible articles, with only one behavioural study deploying a psychological model. In the focus groups, factors such as palatability, cost, conviviality and quality of produce were dominant. Three major themes were iteratively identified using verbatim transcripts of online focus groups: Challenges in Adopting the Mediterranean Diet, Cultural and Social Dimensions of Diet, and Health and Nutritional Impacts. Common barriers such as cost were raised although more unusual concepts such as conviviality and communal eating featured almost as powerfully.

Conclusions

Specific designs such as the ketogenic MedDiet offer promise for weight loss with the associated costs of that preprepared solution. Dietary modifications to MedDiet should be considered which increase adoption, adherence and concordance while addressing well-known barriers. Such barriers include convenience, time and cost in challenges to adoption; cultural and social aspects such as conviviality; and the health and nutritional impacts from the MedDiet. This research suggests that a modified version of the MedDiet for the UK could be developed to adapt to these factors. Future research could assess the nutritional benefits of a plant-based, seasonal and affordable MedDiet as developed by several European countries.

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Developing an evidence-based and UK-adapted Mediterranean style diet for healthy eating in overweight/obesity

1 Background

1.1 Prevalence and classification of obesity and overweight

Global, and United Kingdom (UK), public health is strongly linked to levels of excess weight as identified by overweight and obesity. Defined in terms of body mass index (BMI), these terms describe excess adiposity, notably visceral. BMI, derived from Quetelet's Index, is a population-level indicator calculated by division of weight in kilograms by the square of height in metres. However, BMI has limitations in its applicability on an individual level. One reason for this is the assumption of a constant ratio of fat-free to fat mass, which has large individual variability (Khan et al. 2022). Furthermore, differentiation of adipose distribution is not possible with this measure. Similarly, age-related changes and ethnic variations in body composition may not accurately reflect health risks in lower BMI ranges. Adult BMI thresholds for overweight and obesity are applied according to Table 1, in accordance with the National Institute for Health and Care Excellence (NICE). Globally, the World Health Organization (2022) report near tripling of obesity between 1975 and 2016, with a combined total of 2.55 billion adults being overweight and obese. This global trend is highlighted by the Non-communicable Disease Risk Factor Collaboration using data up to 2015 (Abarca-Gómez et al. 2017). More recent data from the UK mirrors the global trend; 69% of men and 59% of women were overweight or obese according to the National Health Service (Moody 2019). In this same data, analysing by deprivation shows an increased prevalence. Obesity differences between the most and least deprived are +17.1% for men and +8.3% for women.

Table 1: Adult BMI for the UK adapted from NICE (2024)

BMI Range	Descriptor
Less than 18.5 kg/ m ²	Underweight
18.5 to <25 kg/ m ²	Healthy weight
25 to <30 kg/ m ²	Overweight
30 kg/ m ² or more	Obesity
40 kg/ m ² or more	Severe obesity

Abbreviations: BMI, body mass index; kg, kilogram; m, metre; NICE, National

1.2 Burden of disease

Given the severity of these conditions, it should come as no surprise the scale of burden of disease from overweight and obesity is extreme. Chong et al. (2023) analysed the Global Burden of Diseases, Injuries and Risk Factors (GBD) 2019, in conjunction with forecasting by Institute for Health Metrics and Evaluation, reporting obesity – and several of the associated comorbidities – among the highest age-adjusted death rates in young adults (rates per 100,000 population with uncertainty intervals (UI): 62.59 [39.92–89.13]).

This same study revealed obesity mortality rates rose by 1.07% while also having the highest age-standardised disability adjusted life years (DALY) 1932.54 [1276.61–2639.74]. Forecast from this study also project obesity as highest cause of death, with 102.8% (increase relative to 2019).

Similar analysis of the burden of T2DM attributable to excess body weight by Zhang et al. (2022) shows nearly triple the deaths (619,494.8) and DALYs (34,422,224.8) in 2019 compared to 1990. Recently, Ong et al. (2023) reported 52.2% (95% UI: 25.5–71.8) of global T2DM DALYs being attributable to elevated BMI.

Estimates for the financial burden of overweight and obesity are both large and uncertain. While headline data indicates the cost of obesity alone, in the UK to be £65 billion, this was based as a percentage of gross domestic product and using a lower value of quality-adjusted life year (QALY) than the NHS applies (Griffith 2023). Using updated data published by Frontier Economics, revised estimates of combined costs of overweight and obesity in the UK were £98 billion (Bell et al. 2023).

1.2.1 Reductionism in nutrient-based analysis

Dissecting diets, as performed in early nutrition research, did guide creation of recommended dietary values for specific nutrients, although potentially ignored the symbiotic nature of food absorption. Vitamin C and the interaction with scurvy was augmented by later knowledge of its immunomodulatory and antimicrobial effects (Levine et al. 1996; Baron 2009; Mousavi et al. 2019). Synergistic foods present recognisable benefits to health, beyond the nutrient value of individual components (Natarajan et al. 2019). To reduce or prevent orthorexic tendencies, using a dietary pattern approach presents a better opportunity than a nutrient-based method.

1.3 Paradigms to explain overweight/obesity

While multiple paradigms exist to explain factors and causes of overweight and obesity, a vast array of mediators and moderators are involved. Some examples include metabolic rate, hormonal imbalances, socioeconomic factors and genetics. In the Energy Balance Model (EBM) overeating – where energy intake exceeds energy expenditure – is believed to be the primary cause (Ludwig et al.

2022). In contrast to this, however, the alternate paradigm inverts causality. The Carbohydrate-Insulin Model (CIM) proposes that highly-processed carbohydrates drive hormonal responses, increasing adiposity, creating metabolic energy deficiency (Ludwig 2023). In both paradigms, however, the consistent excess adipose deposition contributes to weight gain, and in turn elevates risks of comorbidities (Figure 1); the detail on these will be discussed in section 1.4.

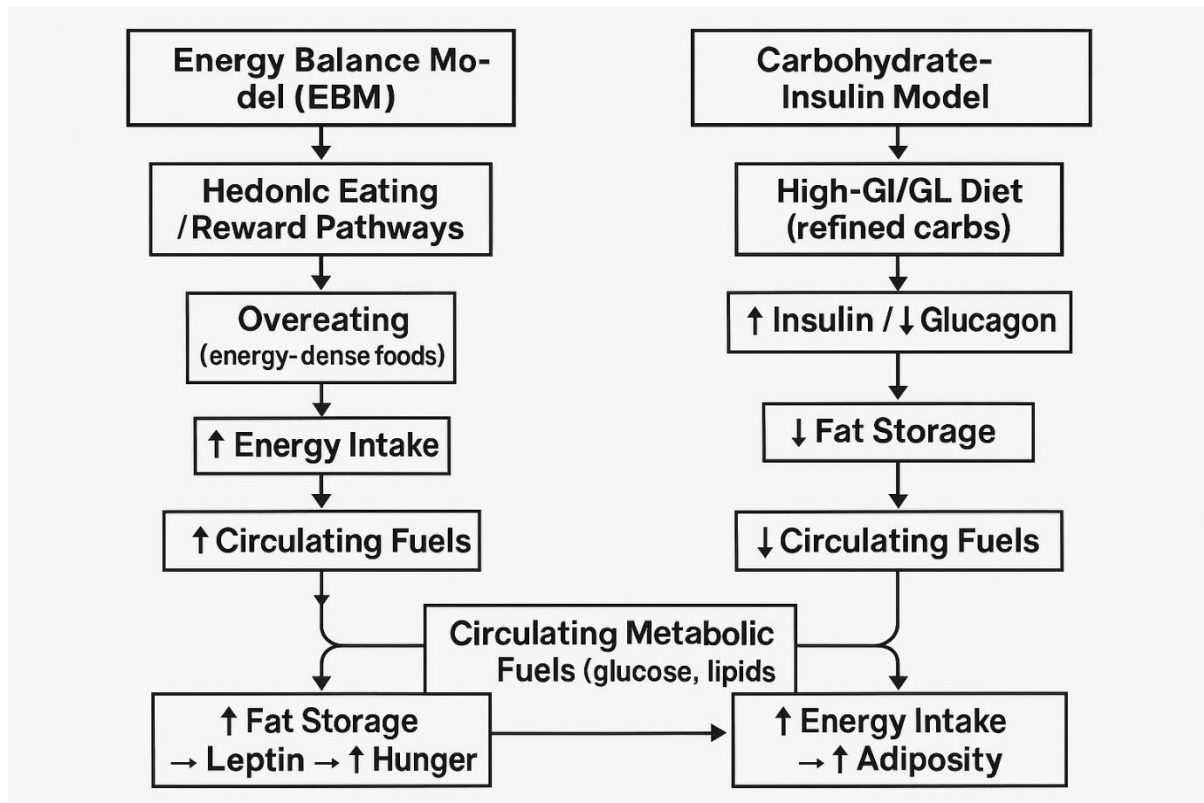


Figure 1 Summary of energy paradigms adapted from (Ludwig 2023)

1.4 Dietary patterns

In seeking to understand the relative merits of the two concepts described in section 1.1, the idea of dietary patterns can be introduced. The term “dietary pattern” is a reference to the summation of consumed drinks and food over time. This pattern should approximate the total intake of calorific and nutrient intakes, representing the nuances of the individual diet (Kant 2004). Understanding the overall diet composition highlights the role of diet in shaping health outcomes, incidence of disease, nutritional issues, quality of life, and mortality in individuals and populations. Whole foods have been evidenced to reduce NCD incidence whereas more highly-processed foods correlated to increased prevalence and weight gain (Migliozzi et al. 2015; Hajihashemi et al. 2021; Jakobsen et al. 2023).

1.4.1 Description of contrasting dietary patterns

One such dietary pattern is known as the Western Pattern Diet (WPD). Since the definition of WPD is one which continues to evolve, it is most easily described in contrast to another dietary pattern. In Table 2, the comparison between Western Pattern Diet and the Mediterranean Diet has been highlighted. The Western Pattern Diet in earlier literature describes key components of high intakes of food groups such as red and processed meats, refined carbohydrates, sugary drinks and sweets, and saturated and trans fats; in combination with low intakes of generally-recognised healthier food groups such as fruit and vegetables, whole grains, legumes, nuts and seeds, fish (including oily fish) and healthier fat sources such as extra-virgin Olive Oil (EVOO). Diametrically opposite to this Western Pattern Diet is the Mediterranean(-style) Diet which as portrayed in Table 2 inverts the relative content of the aforementioned food groups. While a highly-simplified summary, this highlights the dramatic differences between the two dietary patterns in nutrient density, nutritional value and well-established health outcomes linked to diet intake. It is worth noting that other diets such as the Nordic Diet do represent competitively healthy options to the MedDiet. However, since the MedDiet represents more than just a dietary pattern, incorporating concepts such as hydration, exercise and conviviality, this has been selected to underpin the design of this research.

Table 2: Relative content of two dietary patterns, Western Pattern Diet (WPD) and Mediterranean Diet (MedDiet)

Diet component	Western Pattern Diet	Mediterranean Diet
Red/processed meat	High	Low
Refined carbohydrates	High	Low
Sugary drinks/sweets	High	Low
Saturated/Trans fats	High	Low
Fruit/Vegetables	Low	High
Whole grains	Low	High
Legumes	Low	High
Nuts/seeds	Low	High
Fish	Low	High
Olive oil/healthy fats	Low	High

1.4.2 Historical and updated Mediterranean Diet

Early research on the Mediterranean diet notably in Greece and Italy explored these benefits as observed by longer life expectancy, lower cancer incidence and lower rates of coronary heart disease with proposed pyramid diet design (Willett et al. 1995; Simopoulos 2001). Newer research has

evolved the documented pyramid further. Additions include the physical activity and other social elements of the dietary pattern, above and beyond diet components. Figure 2 shows an updated version of the MD pyramid including non-dietary components (Bach-Faig et al. 2011)

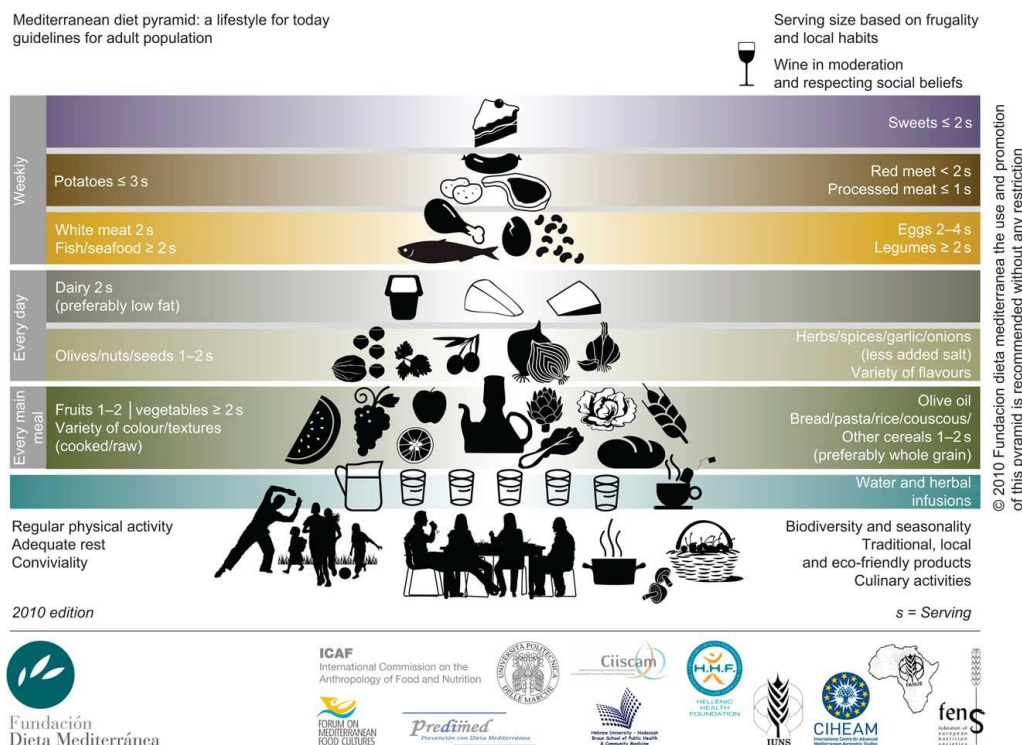


Figure 2 The proposed modern Mediterranean diet pyramid (Bach-Faig et al. 2011)

1.4.3 UK Trends

Within the UK, the rolling National Diet and Nutrition Survey offers a statistical insight into population level dietary quality. In the most recent analysis, dominant consumption trends included: reductions in sugar-sweetened drinks and free sugars, little change in saturated fat intake, and inconsistent changes in fibre (Public Health England 2020). This data would suggest that high prevalence of WPD continues to exist in England, supported by analysis of older NDNS data (Roberts et al. 2018). This represents a need for dietary pattern shift in the UK, promoting healthier and more-sustainable plant-based diet, similar to other European countries. Of particular note is the success of the derived Nordic diet which has been linked to reduced abdominal obesity and lower NCD incidence (Kanerva et al. 2012; Kahleová et al. 2019; Lankinen et al. 2019).

1.5 Link to non-communicable diseases

Overweight, and particularly obesity, have well-established links to multiple non-communicable diseases. A few of these are discussed although not necessarily exhaustive given the complexity of comorbidities of excess weight, with emphasis on visceral formation over subcutaneous. MedDiet has been shown to reduce incidence of multiple NCDs.

1.5.1 Cardiovascular Disease (CVD)

CVD is a general term for conditions linked to the cardiovascular systems in the body. Excess adiposity is a key factor in development of CVD, notably through dysregulation of lipolytic homeostasis. Modern foods and often entire dietary patterns can be high in saturated fat and cholesterol. These specifically are linked to increase of triglycerides in the blood.

Links between excess weight and elevated cardiac workload are long established (de Divitiis et al. 1981; Ybarra et al. 2012). One result of the excess cardiac workload is hypertrophy (enlargement), which if unchecked leads to weakening of the muscle (Kotsis et al. 2010; Abel and Doenst 2011). In cases of high visceral adiposity, venous compression may occur, further burdening the heart and contributing to the hypertrophy of heart muscle (Moreira-Gonçalves et al. 2015).

In turn, atherogenesis or plaque formation, in arteries increases (See et al. 2007). The resultant narrowing of arteries requires elevated blood pressure (hypertension) to maintain the supply of blood to all parts of the body. Should portions of the arterial plaque be dislodged and form clots, these may travel to organs with concomitant damage. Association of clots with arterial organ damage are strong for the brain, heart, kidneys, and eyes. Additionally, hormones and pro-inflammatory factors produced by excess adipose tissue can result in systemic inflammation and endothelial dysfunction; both are linked to increased blood pressure (Piquereau and Ventura-Clapier 2018).

Additional factors do moderate the risk of contracting CVD, such as ethnicity, alcohol consumption, gender (earlier disease development in men), and age. Nevertheless, adherence to MedDiet is linked to improvements in biochemical and physiological benefits reducing CVD risk (Trichopoulou et al. 2014; Tong et al. 2016b).

1.5.2 Metabolic dysregulation

Elevated levels of adiposity, especially visceral, can impair insulin sensitivity through inflammatory cytokines, with hyperglycaemia (high blood sugar levels) (Frayn 2001; Wiedemann et al. 2013). Chronic hyperglycaemia can also escalate atherosclerosis risk combined with the burden of cytokines (Luan et al. 2015; Jiang et al. 2020).

1.5.3 Further factors in atherosclerosis risk

Functions of the endothelium (inner lining of blood vessels) can be impaired by excess fat (Ghosh et al. 2017). This endothelial dysregulation can reduce regulation of blood flow, while also promoting clot formation and inflammation, and increasing levels of arterial stiffness (Romero-Corral et al. 2010; Bussel et al. 2011).

Free radicals, a by-product of oxygen metabolism, are highly reactive and unstable, able to react with any substance in the body. With elevated levels of free radicals produced by adipose tissue, low-grade inflammation is further promoted (Higashi 2022). Dysregulation of endothelial nitric oxide synthase activity is also associated with excess obesity (Toda and Okamura 2013).

Platelet formation is demonstrably higher in obesity, with greater risk of clot formation and potential arterial blockage (Santilli et al. 2011; Heffron et al. 2018). Further support for increased platelet reactivity is strong in obesity (Samocha-Bonet et al. 2008; Bordeaux et al. 2010).

1.5.4 Additional mechanisms

Dysregulation of sleep, notably obstructive sleep apnoea commonly causing intermittent oxygen deprivation, has well-documented links to obesity (Punjabi 2008; Gabryelska et al. 2018). Unadjusted analysis demonstrated association of obstructive sleep apnoea (hazard ratio (HR) 2.57, 95% confidence interval (CI) 1.39–4.72, $P = 0.003$) with adjusted HR remaining statistically significant (HR 2.06, 95% CI 1.10–3.86, $P = 0.024$) (Shah et al. 2009).

Dysbiosis of the gut microorganism flora has wide-ranging effects, although not fully understood, which appear to stem from modification to the production of short chain fatty acids (SCFA), and pro-inflammatory activity (Guarner and Malagelada 2003). Among other conditions, for example Type I diabetes mellitus, obesity demonstrates characteristic changes to the microbiota in the gut; an example being low ratio of *Firmicutes* to *Bacteroidetes*, with consequent metabolite production imbalance (Kasselman et al. 2018).

1.5.5 Type II diabetes mellitus (T2DM)

T2DM is recognised as a global health threat and chronic, with 2019 estimates being 463 million people worldwide, projected to reach 590 million diagnoses by 2035 (Zhang et al. 2022). Two main factors drive T2DM incidence. Firstly, insulin resistance, implying defective insulin signalling, promoting hyperglycaemia (Kahn 2003; Cerf 2013). Secondly β -cell dysfunction where the pancreas produces insufficient insulin, linking with ethnicity and genetics, are notable risk factors (Walker et al. 2012; Buczkowska 2014). Dysfunction of lipid pathways in T2DM, metabolic dysregulation, and chronic low-grade inflammation are well recognised in the disease's development (Jankowski et al. 2021; Galper et al. 2022). A combination of the two are primary pathogenic mechanisms in autoimmune individuals from genetic predisposition (Walker et al. 2012; Valitsky et al. 2017)

1.6 Diet and Lifestyle modification

Global support for dietary and lifestyle interventions was again recognised in the WHO's fifty-seventh World Health Assembly (WHO 2004). Since excess calorie consumption and lack of activity are

considerable factors in the aetiology of excess BMI, combination therapy (of diet and exercise) programs such as the randomised crossover trial by Redmon et al. (2005) (n=65) show efficacy with weight loss of 4.6 ± 1.2 kg ($P < 0.001$) and decreased HbA_{1c} by $0.5 \pm 0.3\%$ ($P = 0.08$).

1.6.1.1 Fruit and vegetable consumption

The term “5 a day” of fruit and vegetables is commonly used. Fortunately, both research and national guidelines do provide support for this adage usually in the form of ≥ 2 fruit and ≥ 3 vegetables daily. In low-to-medium income countries, cross-sectional national data revealed association between inadequate consumption of these and NCD risks e.g. diabetes odds ratio OR =1.45 (n=34129: mean/standard deviation (SD) age, 62.4 (16.0). Offringa et al. (2019) provide support with lower all-cause and cancer mortality, CVD, and stroke incidence more strongly associated with vegetable rather than fruit consumption; 10 included studies showed inverse and statistically significant association between mortality and vegetable intake. MD specifically includes fruit and vegetable consumption, this being a determining adherence factor and indicative of healthy diet and micronutrient intake levels (Donini et al. 2016)

1.6.1.2 Whole food approach and ultra-processed foods

A balanced whole food approach with lean proteins is strongly recommended in many countries' national guidelines with increasing emphasis on low saturated fat intake. This approach also dissuades consumption of processed foods including hyper- or ultra-processed foods (UPF). UPF as a term was coined in 2009 to describe foods depreciated in nutrient composition (Fardet and Rock 2019). Notably in a systematic narrative review by Elizabeth et al. (2020), 37 of the 43 reviewed studies contained at least one adverse health outcome; none revealed any positive health outcomes although it should be noted these studies were mostly observation, limiting the understanding of causality.

One randomised trial (n=20; mean $\pm$ SE age, 31.2 ± 1.6 ; BMI = 27 ± 1.5 kg/m²) indicated an *ad libitum* intake of UPF exceeded unprocessed diet by 508 ± 106 kcal/day; $p = .0001$ with weight gain of 0.9 ± 0.3 kg ($p = 0.009$) on the former and weight loss of 0.9 ± 0.3 kg ($p = 0.007$) on the latter (Hall et al. 2019).

Well-intentioned efforts to reduce the consumption of free sugars has created a dichotomy in the use of artificial sweeteners. On one hand, reduction in added sugar to foods – notably through the sugar tax in the UK – has reduced calorific value of many foods (Ginsberg 2017; Piekara 2022). Conversely, use of artificial sweeteners shows association with increased risk of cardiovascular diseases (1502 events, HR 1.09, 95% CI: 1.01 to 1.18, $P=.03$) (Charlotte et al. 2022). Assessing reverse

causality, some research observed that individuals with obesity or CVD may be more likely to switch to sweeteners, potentially creating a bias in these studies' samples (Swithers 2013).

This suggests control of UPF intake could moderate weight gain or promote weight loss, as well as reduce incidence risk of NCDs through reductions in sugar and salt consumption (Rauber et al. 2018).

1.6.1.3 Exercise and sedentary behaviour

Exercise recommendations in the UK for adults are similar to those in North America, and to the WHO guidelines on physical activity and sedentary behaviour (Bull et al. 2020). These include minimum amount of moderate-intensity cardiorespiratory exercise, flexibility, and resistance training (Garber et al. 2011; Piercy et al. 2018; Chtourou et al. 2020). Adaption of exercise to suit the individual can be seen in the randomised trial on military personnel investigating low-intensity blood flow restricted exercise while avoiding heavy resistance training (Ladlow et al. 2017; Ladlow et al. 2018).

Sedentary lifestyles and working habits are of increasing importance in recent years with mounting evidence of increased NCD risk (Colberg et al. 2016; Rezk-Allah and Takla 2019). Higher levels of sedentary behaviour increase risk of metabolic syndrome (MetS) by 73% (OR 1.73, 95% CI 1.55–1.94, $p < 0.0001$) (Edwardson et al. 2012). Widespread support can be found for sedentary behaviour and physical activity being independently associated with MetS incidence (Saleh and Janssen 2014; Chen et al. 2015; Ekblom et al. 2015; Xu et al. 2022). Uncertainties remain, however, surrounding sedentary volume and sex linkage (Lin et al. 2018) and even the type of sedentary behaviour itself (Picavet et al. 2016; Beale et al. 2020).

1.7 Dietary patterns and considerations

Nutrition as a science has evolved over the past centuries, from initial focus on specific nutrients, to whole-diet patterns and their impact on human health (Prowse et al. 2020). Dietary patterns including MD may have dramatic effect on microbiota populations, with positive species producing short-chain fatty acids benefitting the host, while proliferation of disadvantageous may increase risks of conditions such as depression and anxiety. With increasing awareness of the gut-brain axis, and relevance of the gut microbiota, *a posteriori* analysis of dietary pattern appears to better predict the microbiome; five in particular being significantly associated with beta diversity ($P \leq 0.0002$) (Cotillard et al. 2022). Use of *a priori* indices to assess diet are usually validated in the respective populations; yet the responsive nature of gut microbiota is perhaps more indicative of the diet efficacy than other measures confounded by various factors (Burggraf et al. 2018).

1.7.1 Metabolically healthy obese and dietary patterns

Metabolically healthy obese (MHO) describes individuals who appear to be metabolically healthy despite obesity. However, these individuals are more at risk of developing metabolic abnormalities (MA) at a rate of 0.49 (95% CI: 0.38 to 0.60); incident MA compared to metabolic healthy normal weight individuals demonstrated higher risk (pooled RR = 1.80, 95%CI: 1.53–2.11) (Lin et al. 2017). The concept of progression of MHO phenotypes to unhealthy obesity remains debated, arguing that healthy dietary patterns may prevent the migration to MA incidence (Vilela et al. 2021). Dietary patterns which favoured more plant-based foods correlated with improved mental health and biochemical markers even in metabolically unhealthy (Amerikanou et al. 2022).

1.8 Rationale

The incidence of NCDs in the UK has a dramatic impact on individuals and the broader health system as detailed in the previous sections. This associated burden of disease as a result of overweight and obesity, represents a pandemic challenge for the National Health Service. In this work, the combination of prior research systematically reviewed, combined with the up-to-date perceptions especially in the context of known barriers, can show potential to assist the UK in developing and UK version of MedDiet. This could be very helpful in addressing the obesity pandemic in the UK specifically. Further, an acceptable, affordable, tailored MedDiet could deliver significant population benefit through easier adoption, adherence and concordance. Consideration for geographic crop types, being culturally-sensitive especially about alcohol recommendations, and making environmentally-friendly adaptations such as seasonality could be vital to a UK adapted MedDiet.

2 Aims and objectives

2.1 Aims

This research has been divided into two phases. The first phase, a systematic review, sought to assess prior adaptations to MedDiet. A systematic review investigated the design of modified or adapted MedDiet to evaluate both food-based and non-dietary changes previously undertaken. The second phase sought to investigate the perceived barriers and facilitators to adopting the MD using online focus groups. This public consultation deployed similar inclusion and exclusion criteria to the systematic review.

2.2 Objectives

The first objective was to systematically review experimental and quasi-experimental adaptations or modifications to MD tailored for specific countries, for obese and overweight adults.

The second objective was to investigate perceptions and opinions of MD in overweight and obese adults who were not habitually consuming MD. Understanding opinions and preconceptions about MD in obese and overweight people is essential to reduce non-adherence and to lower the dramatic long-term health risks associated with these conditions.

2.3 Rationale

Understanding opinions and preconceptions about MD in obese and overweight is essential to reduce non-adherence and to lower the dramatic long-term health risks associated with these conditions. Further, the incidence of non-communicable disease has an impact on both the individual and larger society through the associated burden of disease, especially for the National Health Service. The combination of prior research systematically reviewed and up-to-date perceptions especially in the context of known barriers showed potential to assist in developing a UK version of MD which could be essential to addressing the obesity pandemic. In addition, an acceptable, affordable, tailored MD could deliver a significant benefit to the population's welfare through easier adoption, adherence and concordance. Consideration for culturally-sensitivity especially about alcohol recommendations, and making environmentally-friendly adaptations such as seasonality could be vital to a UK MD.

3 Chapter 3 A systematic review of dietary modifications to Mediterranean-style diets

3.1 Introduction

Rising prevalence of weight gain is multifactorial in the highly obesogenic modern environment with ready access to low quality, highly processed food, and diets (Crino et al. 2015; Popkin and Ng 2022). Unhealthy eating patterns and associated excessive weight gain can have an impact on appetite dysregulation; in obese young adult females, meal-skipping (breakfast) and hyperphagia (hedonic excess food intake beyond energy needs) were common for 3-4 days per week and 61.11% incidence respectively (Goldstone et al. 2012; Gowe et al. 2016).

Additionally, leptin resistance is well documented as associated with excessive energy and fat consumption in obesity (Lederer et al. 2022). Similarly, elevated hunger signalling, alongside reduced control over food liking and food wanting, appears to be exacerbated in obese individuals with low quality diets and eating practices (Finlayson and Dalton 2012).

Mediterranean style diets (MD) have the strongest evidence for positive health outcomes compared to the more prevalent WPD in the UK. MD eating patterns typically promotes fruits, vegetables, legumes, and healthy fats. In contrast, processed foods, added sugars and refined grains are not recommended (Bach-Faig et al. 2011). The MD promotes appetite control through high fibre content and low energy density as shown in the Prevención con Dieta Mediterránea (PREDIMED) study (Estruch et al. 2018; Tosti et al. 2018). Lotfi et al. (2022) report a 9% risk reduction of overweight and obesity in adult MD adherence for adults (RR: 0.91; 95% CI: 0.88, 0.94; I² = 44.7%; PQ-test = 0.031). In the EPIC study, MedDiet was also shown to reduce negative health outcomes for older adults (Trichopoulou et al. 2003).

It appears that MedDiet might exhibit protective properties in obesity through improving metabolic and hormonal profile involved in regulation of appetite and food intake. Studies exploring adherence to MedDiet in the UK have shown promising results though there is paucity of diet studies in otherwise-healthy overweight and obese people. It is considered imperative to explore views and perceptions and awareness of obese people about med style eating, and what kind of modification they would consider useful for adherence and adoption in the UK.

Despite this research focussing on the modifications to MedDiet and how effective these proved, the assessment of adherence was outside the explicit focus. Adherence scoring is highly heterogeneous in literature. Additionally, the diverse nature of MedDiet implementation may not benefit from summary in a single figure, especially where nuanced adjustment is considered.

3.1.1 Previous systematic reviews

Although multiple systematic reviews in this area have been published, none were found to investigate the dietary modification to MD. Instead, most appear focussed on outcomes for specific health goals. Starting with children Papamichael et al. (2017) reviewed MD and asthma, while Craig et al. (2017) also included adolescents and adults in a review on musculoskeletal health and MD. Multiple reviews included specific health outcomes and MD in adults: Coughlin et al. (2018) on breast cancer; Godos et al. (2017) and Papadaki et al. (2020) on metabolic syndrome; Martínez-González et al. (2019), Sleiman et al. (2015) and Rees et al. (2012) on cardiovascular health; Soltani et al. (2019) on all-cause mortality; Schwingshackl et al. (2018) on Type II Diabetes; Piera-Jordan (2024) on seminal quality; Ros (2021) on cognitive decline. Three umbrella reviews on MD and health outcomes: Seifu et al. (2021) on obesity outcomes; Neuenschwander et al. (2019) on Type II Diabetes; Dinu et al. (2018) on cardiovascular health (Table 3).

Table 3 Summary of previous reviews

Author	Year	Population	Health outcome	Type of review
Papamichael et al.	2017	Children	Asthma	Systematic
Craig et al.	2017	Adolescents & adults	Musculoskeletal health	Systematic
Coughlin et al.	2018	Adults	Breast cancer	Systematic
Godos et al.	2017	Adults	Metabolic syndrome	Systematic
Papadaki et al.	2020	Adults	Metabolic syndrome	Systematic
Martínez-González et al.	2019	Adults	Cardiovascular health	Systematic
Sleiman et al.	2015	Adults	Cardiovascular health	Systematic
Rees et al.	2012	Adults	Cardiovascular health	Systematic
Soltani et al.	2019	Adults	All-Cause mortality	Systematic
Schwingshackl et al.	2018	Adults	Type II diabetes	Systematic

Piera-Jordan	2024	Adults (men)	Seminal quality	Systematic
Ros	2021	Adults	Cognitive decline	Systematic
Seifu et al.	2021	General Population	Obesity	Umbrella
Neuenschwander et al.	2019	General Population	Type II diabetes	Umbrella
Dinu et al.	2018	General Population	Cardiovascular health	Umbrella

3.1.2 Adaption of MD to countries outside the Mediterranean Basin

Martínez-González et al. (2017) reported on CVD as well as discussing the necessity of elements in MD, with some focus on US perceptions of the dietary pattern itself. In 2018, the Papadaki et al. (2018) validated the 14-point Mediterranean Diet Adherence Screener (MEDAS) from the *PREvencion con Dieta MEDiterranea* (PREDIMED) in UK adults at high cardiovascular risk. Jacka et al. (2017) deployed a ModiMedDiet in Australia notably with higher red meat and allowing 2 red or white wine drinks, with any further alcohol being “extras”. Similarly in Australia, an RCT by Wade et al. (2018) compared a MedDairy and low-fat diet, the former being supplemented with additional dairy foods. A broad range of MD variants were systematically reviewed for effect on high-risk of coronary heart disease by (Mayr et al. 2018) with much heterogeneity in diet composition.

3.2 Aims and objectives

The primary aim of this study is to conduct a systematic literature review to investigate adaptations to the MedDiet and food components of the MD in previous studies.

3.2.1 Aim

To identify and critically appraise both quasi-experimental and randomised control trials of MD in healthy yet overweight or obese populations.

3.2.2 Objectives

Identify geographical, cultural, and adherence-based modifications to the core MedDiet energy distribution, macronutrients, and micronutrients.

3.2.3 Review Questions

How have adaptations, modifications, and tailoring affected adherence to the MedDiet across countries and cultures?

3.3 Methods

3.3.1 Systematic search strategy

A comprehensive search strategy was devised and prospectively registered on the International Prospective Register of Systematic Reviews (PROSPERO) on 16 March 2023 with reference CRD42023408278. The study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

3.3.2 Systematic search criteria

Since quasi-experimental studies were to be included, no comparator was selected, and a population/exposure/outcome framework (PEO) was developed to assist in creating search syntax. Broadly this complies with the guidance on PEO frameworks by (Morgan et al. 2018). The PEO criteria are shown in Table 4.

Table 4: PEO criteria to guide search syntax

PEO criterion	Detail
Population	Studies on children (<18) to be excluded. Elderly (>65yrs), medical condition studies included.
Exposure	The studies must include at least one arm with Mediterranean Diet or a variation thereof.
Outcomes	Adherence must be a factor in the study, even if not a primary outcome. A default MedDiet is acceptable if the scoring system has been adapted or modified to include variations in the default.

3.3.3 Systematic search syntax

The search syntax was created to summarise these requirements while optimising success in sourcing relevant peer-reviewed literature. A federated search was used to search multiple databases including MEDLINE Complete, Academic Search Ultimate, CINAHL, Environment Complete, APA Psycinfo, and SPORTDiscuss with Full Text. A more comprehensive list of the databases is shown in Appendix I.

One expander criterion was used, this being “apply equivalent subjects”, while limiters included full-text availability in English, published dates between inception and 31 December 2023.

A nested search syntax was refined, using “AND” between the PEO criteria together with “OR” within each search string. Wildcards were used to expand upon single variations of relevant words where multiple alternatives possibly existed within the literature. The population string included the terms “adult*”, “age*”, “elderly”, “older*”, “mature”. Similarly wildcard terms for MedDiet were used: “Mediterranean Diet”, “Mediterranean-style diet”, “meddiet”, “MD”. Exposure terms included the variations of modification, tailoring, personal or adjusted: “modif*”, “adapt*”, “personal*”, “adjust*”. Since factors related to adherence were of primary interest, outcome search terms included the following: “adherence”, “compliance”, “nonadherence”, “noncompliance”.

3.3.4 *A priori* inclusion and exclusion criteria

Given the diversity of MedDiet and focus on adherence rather than experimental outcomes, the criteria were tailored accordingly. Of primary importance to inclusion was experimental and quasi-experimental design; randomised controlled trials, single-arm trials and cross-sectional studies were included. The PEO requirements were applied as the *de facto* inclusion and exclusion criteria.

Table 5 Detailed inclusion and exclusion criteria as published on PROSPERO

Domain	Inclusion Criteria	Exclusion Criteria
Population	Adults aged 18–65 years, male and female, any ethnicity or socio-economic background	Children, adolescents under 18, or older adults over 65 unless stratified and data for 18–65 clearly extractable
Intervention	Modified or adapted Mediterranean-style diets (e.g. substitutions, cultural/geographic tailoring, adjusted scoring systems)	Interventions using only a single Mediterranean component (e.g. olive oil only, fruits only)
Comparator	Any or none. No restrictions on comparator groups (can include usual diet, standard Med diet, or other interventions)	Not applicable
Study Design	Quantitative studies: RCTs and quasi-experimental studies	Observational studies, qualitative research, reviews, protocols, editorials, case studies
Setting / Context	Any geographical location	None explicitly excluded based on geography
Language	English	Non-English studies

Date Range	All years (no date restriction)	None (except non-English publications)
Outcomes	Defined characteristics of modified Mediterranean diets	Studies with no adherence score reported or no clear definition of diet modification
	Change in Mediterranean diet adherence score (baseline to follow-up)	
Measurement	Quantitative dietary data collection via questionnaires, food frequency surveys, or observation	Studies without primary dietary assessment methods

In this research, it was anticipated that the absence of data was equally as important to the design concept. This decision allowed the consideration of journals which highlighted facets of MedDiet implementation, adherence or application. Table 5 details this logic

3.3.5 Data extraction and coding

One researcher (LC) assessed potentially relevant articles for eligibility through selection. The participation of reviewers increased the reliability of the decision process. The extraction of data was done independently by one review author (LC) with independent sample review (set at 30% percent) by two reviewers (FT and PF). Any disagreements between reviewers were planned to be identified, noted, and resolved either by consensus among researchers or by arbitration by an additional independent researcher (CC) where necessary. Papers which fulfil the inclusion and exclusion criteria outlined for this review were included for data extraction and coding stages of the review. The following information was extracted from eligible studies: last name of the first author, year of publication, location, study design (experimental or quasi-experimental study), number of subjects, sex, period of enrolment and follow-up, age, and outcomes.

3.3.6 Risk of bias (quality) assessment

One review author (LC) independently assessed the risk of bias in included studies at the beginning of data extraction and before data synthesis commenced. A reviewing author (PF) evaluated a percentage sample (approximately 30%) of the studies. Any disagreement was planned to be resolved through discussion; subsequent discrepancies were to be referred to an independent researcher (FT/CC). The Cochrane Risk of Bias 2 tool for experimental/quasi-experimental studies was

used to assess quality and risk of bias (Sterne et al. 2019). Observational and qualitative studies did not meet inclusion criteria as defined in the protocol.

3.4 Results

This systematic review identified 16 studies meeting the inclusion and exclusion criteria. As shown in Figure 3 the initial search produced 4478 records for screening after automated deduplication by the federated search engine. After import into EndNote version X9 (The EndNote Team 2013). Using the automated deduplication from EndNote, a further 834 records were deduplicated. During screening 224 additional duplicates were discovered. Filtering the remaining records, first by title, then abstract, produced 32 journals to be sought for retrieval. Full-text articles were available for all except 1 journal. Ensuing screening resulted in 16 eligible studies for this review.

3.4.1 PRISMA flowchart

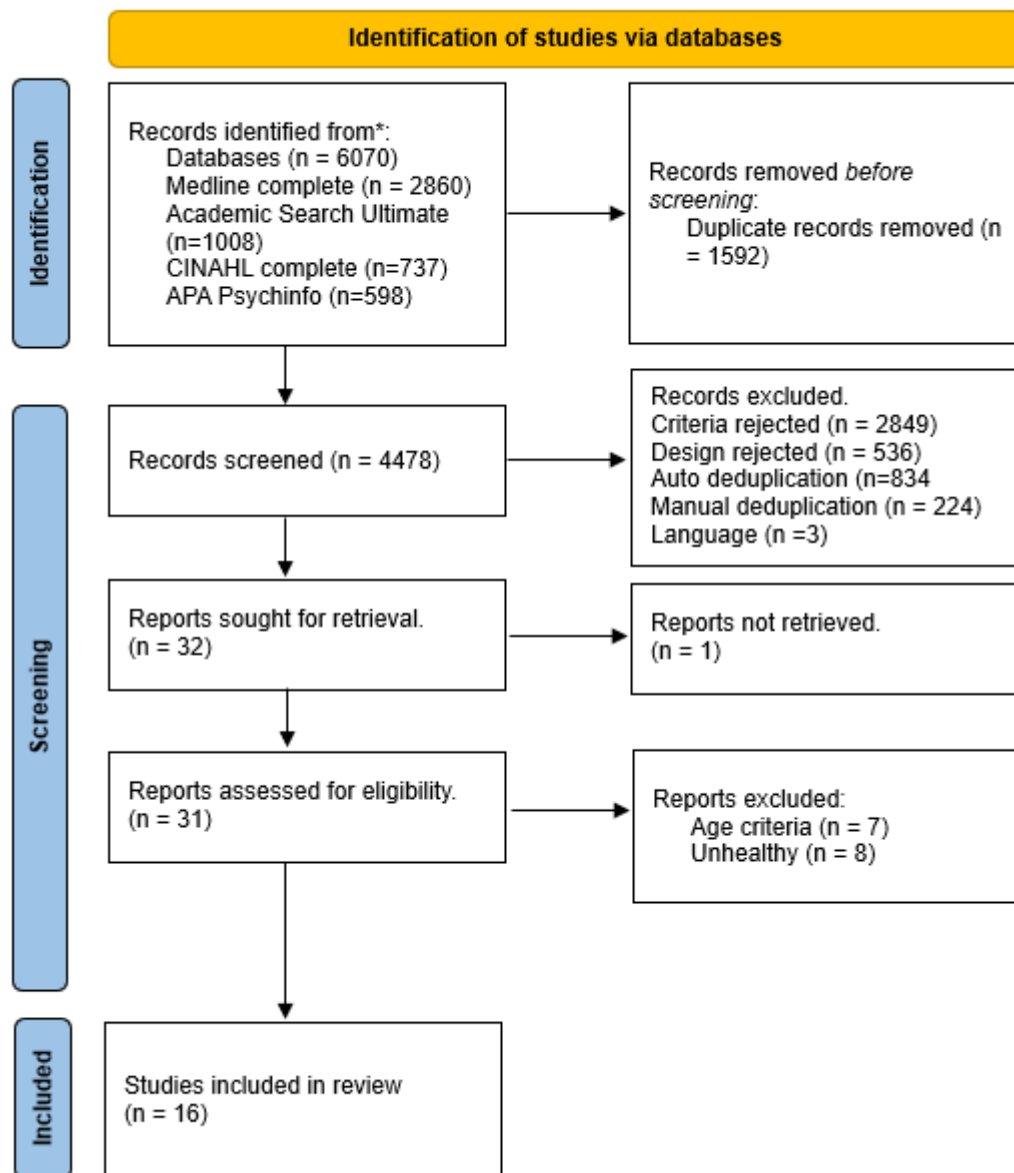


Figure 3 Flowchart of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Page et al. 2021)

3.4.2 Data Extraction

The primary researcher (LC) performed the data extraction and coding stage, using an extraction form previously reviewed by FT. The following endpoints were identified as most relevant: first author, year of publication, location, outcomes, number of participants, age, duration, follow-up period, diet description, adherence scoring method, adherence scores, adaptations made. A proportion of the extracted data (30%) was checked for accuracy by second reviewer (FT).

3.4.3 Risk of bias analysis

Assessing risk of bias is considered an essential step in systematic reviews and rigorous research to ensure validity and reliability. To this end, the Cochrane Risk of Bias v2 tool was used to assess each included study, reporting on multiple domains, to produce an overall risk of bias (Sterne et al. 2019). The individual domains may be summarised as follows:

- Domain 1: Risk of bias from the randomisation process
- Domain 2: Risk of bias due to deviations from the intended interventions
- Domain 3: Risk of bias due to missing outcome data
- Domain 4: Risk of bias in the measurement of the outcome
- Domain 5: Risk of bias in the selection of the reported result

These domains are combined within the tool to produce an overall risk of bias (Figure 4).

One researcher (LC) independently performed the risk of bias analysis for all included studies, followed by supervisor assessment (PF) of the results for accuracy.

Citation/Domain	D1	D2	D3	D4	D5	Overall
Assaf-Balut et al., 2017	+	+	+	+	+	+
García-Layana et al., 2017	+	+	+	+	+	+
Gepner et al., 2018	+	+	+	+	+	+
Hassapidou et al., 2020	+	!	+	+	+	!
Hermesdorff et al., 2009	!	!	+	!	+	!
Hernández et al., 2017	+	+	+	+	+	+
Hernández et al., 2017	+	+	+	+	+	+
Hernández et al., 2021	+	+	+	+	+	+
Meslier et al., 2020	+	+	+	+	+	+
Paoli et al., 2011	-	-	-	!	+	-
Salas-Salvadó et al., 2011	+	+	+	+	+	+
Sánchez-Villegas et al., 2011	+	+	+	+	+	+
Seconda et al., 2017	+	+	+	+	+	+
Simos et al., 2019	+	+	+	!	+	!
Tagliamonte et al., 2021	+	+	+	+	+	+
Zulet et al. 2011	+	+	+	+	+	+

Abbreviations: D1, domain 1 – risk of bias from the randomisation process; D2, domain 2 – risk of bias due to deviations from the intended interventions; D3, domain 3 – risk of bias due to missing outcome data; D4, domain 4 – risk of bias in the measurement of the outcome; D5, domain 5 – risk of bias in the selection of the reported result. Colour-based scoring of the risk of bias: green, low risk; yellow, some concerns; red, high risk.

Figure 4: Risk of Bias assessment using the Cochrane Risk of Bias V2 (Sterne et al 2019).

3.4.4 Study characteristics

Table 6: General study characteristics and summary anthropometric detail

Study citation	Outcomes	Participants	Recruited participants	Final participants	Age, Weight, BMI
Assaf-Balut et al., 2017 (Spain)	Effect of MD in prevention of GDM	Normoglycemic pregnant women n=1000	n=1000 (500/500 CG/IG)	n=874 (440/434 CG/IG)	Age CG 32.7 ± 5.3 , IG 33.2 ± 5.0 ; Weight pre-pregnancy CG 61.7 ± 11.6 , IG 60.4 ± 10.4 ; Baseline BMI CG 24.1 ± 4.1 , IG 23.7 ± 3.8
Bendinelli et al., 2022 (Italy)	Effect of dietary habits and physical activity on body composition	Postmenopausal women	n=403 (f=403)	n=388 (f=388)	Age follow-up 70.3 ± 6.1 ; Weight 66.1 ± 11.9 ; BMI 26.8 ± 4.8 59.3% overweight/obese
García-Layana et al., 2017 (Multicenter)	Effect on incidence of cataract surgery	Overweight/obese adults with T2D or ≥ 3 CVD risk factors	IG1 n=1998 (f=1120/56.1%), IG2 n=1914 (f= 985/ 51.5%), CG n=1890 (f=1099/ 58.2%)	N/A	Age 55-80, IG1 66.1 ± 6.1 , IG2 65.8 ± 5.9 , CG 66.3 ± 6.2 (m 55-80, f 60-80); BMI IG 30.0 ± 3.7 , IG2 30.0 ± 3.8 , CG 30.3 ± 4.1
Gepner et al., 2018 (Israel)	Effect of lifestyle intervention on adipose deposits (redistribution)	Adult, older adult, with high WC	278, IG m=89.9% CG m=87.7%	239 (86%)	age mean 48 (28.8-69.4), 89% male, IG 47.4 ± 9.3 , CG 48.4 ± 9.2 : BMI IG 30.9 ± 4.0 , CG 30.8 ± 3.7

Abbreviations: BMI, body mass index; CG, control group; CVD, cardiovascular disease; f, female; HDL, high-density lipoprotein; IG, intervention group; LDL, low-density lipoprotein; m, male; MD, Med Diet; T2D, Type II Diabetes; WBC, white blood cell; WC, waist circumference

Hassapidou et al., 2020 (Greece)	Effect of MD on weight loss in a municipality setting	Overweight/obese adults	IG n=3508, CG n=2802	IG n=1816 (51.8%) m=19.9%, CG n=2210 (78.9%) m=36.4%	Age IG 53.9±13.4 CG 54.3±16.4; Weight IG 83.0 ± 16.9 (change -4.2 ± 4.9), CG 84.7 ± 16.8 (change 0.2 ± 3.4) [6months, change vs base]; BMI IG 30.7 ± 5.8 (change -1.6 ± 1.9), CG 30.1 ± 5.4 (change 0.1 ± 1.3) [6months change vs base]
Hermsdorff et al., 2009 (Spain)	Effect of hypocaloric MD on inflammatory markers	Obese adults	n=41, m=17, f=24	N/A	Age 37±7; BMI 32.3±3.9; Change -5.3 ± 2.4 n=20 lower loss, -10.0 ± 1.5 n=21 higher loss; BMI 32.2 ± 3.9 base to 30.3 ± 3.7 end
Hernández et al., 2017 (Multicenter)	Effect of traditional MD on HDL	Obese adults	IG1 n=100 m=56%, IG2 n=100 m=47%, CG n=96 m=50%	N/A	Age, means IG1 66.3 ± 5.78, IG2 66.4 ± 6.93, CG 65.0 ± 6.49; BMI IG1 30.1 ± 3.85, IG2 29.0 ± 3.76, CG 29.9 ± 3.87
Hernández et al., 2017 (Multicenter)	Effect of MD on LDL atherogenicity in high CVD risk	Obese adults	IG1 n=71 m=45.1%, IG2 n=68 m=61.8%, CG n=71 m=47.9%	N/A	Age IG1 66.5 ± 6.34 IG2 65.1 ± 6.85 CG 64.7 ± 6.58; BMI IG1 30.2 ± 3.96, IG2 29.2 ± 3.92, CG 29.7 ± 3.98
Hernández et al., 2021 (Multicenter)	Effect of MD on WBC count	Overweight/obese adults	n=4192 f=2416/57.6%, IG1 n=1439 66.8 ± 6.08 f=854/59.3%, IG2 n=1328 f=719/54.1%, CG n=1425 f=843/59.2%	N/A	Age, All 67.1 ± 6.14, IG1 66.8 ± 6.08, IG2 66.9 ± 6.04, CG 67.5 ± 6.28; BMI IG1 25-29.9 n=642/48.5%, ≥30 n=698/46.7%, IG2 25-29.9 n=604/45.5%, ≥30 n=620/46.7%

Abbreviations: BMI, body mass index; CG, control group; CVD, cardiovascular disease; f, female; HDL, high-density lipoprotein; IG, intervention group; LDL, low-density lipoprotein; m, male; MD, Med Diet; T2D, Type II Diabetes; WBC, white blood cell; WC, waist circumference

Meslier et al., 2020 (Italy)	Effects of an isocaloric MD intervention on metabolic health, gut microbiome and systemic metabolome in subjects with lifestyle risk factors for metabolic disease	Overweight/obese adults	n=82, IG n=43 f=22 m=21, CG n=39 f=21 m=18	n=62 IG=30 CG=32	Age 43±12 IG f=41 (19-64) m=45 (29-65), CG f=38 (21-56) m=43 (18-58); BMI 31.1±4.5, baseline IG 30.9 ± 3.8 CG 31.2 ± 5.3, 8wk IG 30.5 ± 3.6 CG 30.9 ± 5.5; Weight IG 87.1 ± 12.4, CG 87.9 ± 16
Paoli et al., 2011 (Italy)	Effect of ketogenic MD with phytoextracts on weight/CVD risk factors/body composition and compliance	Overweight/obese adults	n=106 m=19 f=87	n=87	Age 18-65, mean 48.49 ± 10.3; Weight, baseline 86.2 ± 16.4, final 79.4 ± 15.3, p<.0001; BMI, baseline 31.5 ± 5.1, final 29. ± 4.8, p<.0001
Salas-Salvadó et al., 2011 (Spain)	Effect of MD on diabetes incidence in non-diabetics	Overweight/obese adults	All n=418 m=125, IG1 n=139 m=40, IG2 n=145 m=47, CG n=134, m=38	N/A	Age 55-80 IG1 67.4 ± 6.1; IG2 66.6 ± 5.8; CG 67.8 ± 6.1; BMI IG1 29.7 ± 3.3, IG2 29.6 ± 3.1, CG 30.0 ± 3.3
Sánchez-Villegas et al., 2011 (Spain)	Effect of diet intervention on plasma brain-derived neurotropic factor conc.	Overweight/obese adults	All n=243, IG1 n=91 f=53.8%, IG2 n=75 f=48.0%, CG n=77 f=51.9%	N/A	Age 55-80 IG1 68.1 ± 6.1, IG2 67.4 ± 5.7, CG 68.0 ± 6.1; BMI IG1 29.7 ± 3.6, IG2 29.1 ± 2.7, CG 28.5 ± 3.4

Abbreviations: BMI, body mass index; CG, control group; CVD, cardiovascular disease; f, female; HDL, high-density lipoprotein; IG, intervention group; LDL, low-density lipoprotein; m, male; MD, Med Diet; T2D, Type II Diabetes; WBC, white blood cell; WC, waist circumference

Seconda et al., 2017 (France)	Describe/compare 4 groups of organic/non-organic MD adherence	Adults	n=22866 f=16775 m=6091, CG1 n=14266(62%), IG1 n=3498(15%), CG2 n=2532(11%), IG2 n=2570(12%)	N/A	Mean age(range) CG1 52.9 (52.7–53.2) IG1 57.0 (56.6–57.5) CG2 53.8 (53.2–54.3) IG2 54.6 (54.1–55.2); BMI (95% CI) CG1 24.89 (24.81–24.96), IG1 24.11 (23.96–24.26), CG2 24.09 (23.92–24.27, IG2 22.90 (22.72–23.08)
Simos et al., 2019 (Greece)	Effect of 'Pythagorean Self-Awareness Intervention'	Overweight/obese adults	n=62	All n= 49, IG n=28 f=23 (82.1%), CG n=21 f=16 (76.2%)	Age IG 54.7 ± 11.9, CG 51.8 ± 11.9; Weight, baseline IG 85.5 ± 12.6 CG 85.6 ± 12.2, Final (mean change) IG 81.5 ± 12 (–4.0 ± 2.3) CG 84.1 ± 11.7 (–1.5 ± 1.4); BMI, baseline IG 31.3 ± 4.1 CG 31.2 ± 4.0, Final (mean change) IG 29.9 ± 3.9 (–1.47 ± 0.80) CG 30.6 ± 3.8 (–0.53 ± 0.53)
Tagliamonte et al., 2021 (Italy)	Effect of MD on endocannabinoids, N-acylethanolamines with risk factors for metabolic factors	Overweight/obese adults	n=82, IG n=43 f=22 m=21, CG n=39 f=21 m=18	n=62 IG=30 CG=32	Age 43 ± 1.4, IG f=41 (19-64) m=45 (29-65), CG f=38 (21-56) m=43 (18-58); Weight, IG 87.1 ± 12.4, CG 87.9 ± 16; BMI all 31.1 ± 0.5, baseline IG 30.9 ± 3.8 CG 31.2 ± 5.3, 8wk IG 30.5 ± 3.6 CG 30.9 ± 5.5
Zulet et al., 2011 (Spain)	Reduce body weight and to manage the oxidative and inflammatory impaired status	Overweight/obese adults	N/D	N/D	Age 35-65

Abbreviations: BMI, body mass index; CG, control group; CVD, cardiovascular disease; f, female; HDL, high-density lipoprotein; IG, intervention group; LDL, low-density lipoprotein; m, male; MD, Med Diet; T2D, Type II Diabetes; WBC, white blood cell; WC, waist circumference

3.4.5 Dietary characteristics

Study citation	Brief description	Stated dietary modifications	Adherence scoring system	Adherence group 1	Adherence group 2	Duration [follow-up]
Assaf-Balut et al., 2017 (Spain)	Modified MD	Min 40ml EVOO + 25-30g pistachios	MEDAS (max 14)	6.66 ± 1.77 $p < .0001$	7.81 ± 1.89 $p < .0001$	12 [6]
Bendinelli et al., 2022 (Italy)	Greek, Italian Modified Diet and DASH	See EPIC Florence cohort data	MDS, IMI, DASH score	IMD 0–2 (65) 3–4 (151) 5–9 (146)	GMD 0–3 (112) 4–5 (147) 6–8 (103)	N/A
García-Layana et al., 2017 (Multicenter)	Modified MD	MD+EVOO, MD+nuts (PREDIMED); IG1 +EVOO; IG2 +nuts (30 g/day; 15 g walnuts, 7.5 g hazelnuts, and 7.5 g almonds); CG low-fat diet	MD Adherence score II	Baseline 8.7 ± 2.0	Baseline 8.8 ± 2.0	12 [60]
Gepner et al., 2018 (Israel)	Low carb MD	MD low carb + 28g walnuts daily, PA factor gym. 0-2months <40 g/day increase to ≤70 g/day. MED/LC diet was rich in vegetables and legumes and low in red meat, with poultry and fish replacing beef and lamb.	127-point FFQ	N/D (dietary intake)	N/D (dietary intake)	6 [12]
Hassapidou et al., 2020 (Greece)	Personalised, slightly hypocaloric Med-type diet	1200–1600 kcals based on individual needs with 50% to 55% of energy intake as carbohydrates, 30% to 35% as fat, and 15% as protein. Adjusted every 2 weeks.	MD Score (0-55) 10.1016/j.ypmed.2006.12.009	34.8 ± 2.9 (change 0.7 ± 2.5) [6months change vs base]	33.0 ± 3.2 (change 0.0 ± 1.8) [6months change vs base]	6
Hermisdorff et al., 2009 (Spain)	Hypocaloric MD	Energy 1529 ± 247 IG. Provide about 30, 53, and 17% of the total energy intake from lipids, carbohydrates, and proteins, respectively.	MD Score	2.9 ± 1.3 base to 6.5 ± 0.5 end	N/A	2

Abbreviations: CG, control group; CI, confidence interval; DASH, Dietary Approaches to Stop Hypertension; DQI, diet quality index; EPIC, European Prospective Investigation into Cancer and Nutrition; EVOO, extra virgin olive oil; FFQ, food frequency questionnaire; G1, group 1; GMD, ; IG, intervention group; IMD Italian Mediterranean Diet; IMI, Italian Mediterranean Index; MEDAS, Mediterranean Diet Adherence Screener; N/D, no data; PREDIMED, Prevención con Dieta Mediterránea

Hernández et al., 2017 (Multicenter)	Modified MD	IG1 MD + EVOO, IG2 +30g mixed nuts PREDIMED	MEDAS (max 14) 10.3945/jn.110.135566	Diff 1.53 ± 1.82 p<.001	Difference 1.24 ± 1.91 p<.001	12
Hernández et al., 2017 (Multicenter)	Modified MD	IG1 MD + EVOO, IG2 +30g mixed nuts PREDIMED	N/D	N/D	N/D	12
Hernández et al., 2021 (Multicenter)	Modified MD	IG1 MD + EVOO, IG2 +30g mixed nuts PREDIMED	MEDAS (max 14) 10.3945/jn.110.135566	IG1 8.76 ± 1.99 (All 8.62 ± 1.96, CG 8.40 ± 1.91, non-PREDI 8.75 ± 1.81)	IG2 8.70 ± 1.96 ± 1.99 (All 8.62 ± 1.96, CG 8.40 ± 1.91, non-PREDI 8.75 ± 1.81)	12
Meslier et al., 2020 (Italy)	Energy restricted MD	Iso-caloric: inclusion fruit/vegetables (min 5 portions, ~500 g/d) nuts (30 g/d), calorie-adjusted replacement of refined cereal products with wholegrain products (min 2 portions, ~200 g/d between wholegrain pasta, bread, breakfast cereal); replacement of meat, eggs, dairy products with fish and legumes (min 2 portions, ~300 g/week of fish, 3 portions, ~300 g/week legumes); replacement of butter/margarine with EVOO	IMI	Baseline IG 6.2 ± 2.8, 8wk IG 8.7 ± 2.8	Baseline CG 5.3 ± 2.2, 8wk CG 4.4 ± 1.5	2

Abbreviations: CG, control group; CI, confidence interval; DASH, Dietary Approaches to Stop Hypertension; DQI, diet quality index; EPIC, European Prospective Investigation into Cancer and Nutrition; EVOO, extra virgin olive oil; FFQ, food frequency questionnaire; G1, group 1; GMD, ; IG, intervention group; IMD Italian Mediterranean Diet; IMI, Italian Mediterranean Index; MEDAS, Mediterranean Diet Adherence Screener; N/D, no data; PREDIMED, Prevención con Dieta Mediterránea

Paoli et al., 2011 (Italy)	KEMEPHY (ketogenic Mediterranean with phytoextracts, low carb/high protein)	Cooked/raw green veg (200 g/meal), meat, fish and eggs (2 times/d), olive oil 40 g/d. Integration with a dish (i.e. porzione alimentare tisanoreica = tisanoreica nutritional portion) composed of high-quality proteins (equivalent to 18 grams) and virtually zero carbohydrate provided for maximum of four per day. During the last three weeks complex carbohydrates were introduced (50-80 g/d), cheese (60 g/d), reduced to two. Distribution of nutrients (proteins, carbohydrates and fats) % of was 36%, 12% and 52%, respectively (weeks 1 to 3) and 31%, 25% and 44% (weeks 4 to 6). Phytoextracts: mint, black radish, burdock, Serenoa Repens (saw palmetto), white bean, equisetum, dandelion (Taraxacum officinale), ginseng, Miura Puama, Guaranà. Morning multivitamin	N/A	Adjusted compliance 93.4%	N/A	1.5
Salas-Salvadó et al., 2011 (Spain)	Modified MD	IG1 MD + EVOO, IG2 +30g mixed nuts PREDIMED	MEDAS (14-point questionnaire)	IG1 8.4 ± 1.9, CG 7.9 ± 1.9	IG2 8.4 ± 1.9, CG 7.9 ± 1.9	12 [48]
Sánchez-Villegas et al., 2011 (Spain)	Modified MD	IG1 MD + EVOO, IG2 +30g mixed nuts (15 g walnuts and 15 g almonds) PREDIMED. No energy restrictions.	N/D	N/D	N/D	36

Abbreviations: CG, control group; CI, confidence interval; DASH, Dietary Approaches to Stop Hypertension; DQI, diet quality index; EPIC, European Prospective Investigation into Cancer and Nutrition; EVOO, extra virgin olive oil; FFQ, food frequency questionnaire; G1, group 1; GMD, ; IG, intervention group; IMD Italian Mediterranean Diet; IMI, Italian Mediterranean Index; MEDAS, Mediterranean Diet Adherence Screener; N/D, no data; PREDIMED, Prevención con Dieta Mediterránea

Seconda et al., 2017 (France)	MD	N/D	DQI, adherence score of MD 10.1017/S1368980013003169; Dietary diversity score	IG1 11.81 (95% CI 11.75–11.86), CG1 7.55 (95% CI = 7.52–7.57), CG2 8.39 (95% CI = 8.33–8.46)	IG2 12.31 (95% CI 12.25–12.38), CG1 7.55 (95% CI = 7.52–7.57), CG2 8.39 (95% CI = 8.33–8.46)	60
Simos et al., 2019 (Greece)	Personalised, low-calorie Med-type diet (Harris-Benedict equation)	Pythagorean self-awareness intervention technique twice a day in a quiet place (112 home sessions). three cognitive processes. First, he/she recalled every daily event in the exact time sequence that it happened. To facilitate recall, events were categorized in diet, physical exercise, sleep, and interpersonal contacts. Next each selected experience was critically appraised using three questions: 'Is what I have done wrong? Is what I have done right? and What have I omitted that I ought to have done?'. N/D on specified diet	Dutch Eating Behaviour Questionnaire	N/D	N/D	2
Tagliamonte et al., 2021 (Italy)	Energy restricted MD	Isocaloric: inclusion fruit/vegetables (min 5 portions, ~500 g/d) nuts (30 g/d), calorie-adjusted replacement of refined cereal products with wholegrain products (min 2 portions, ~200 g/d between wholegrain pasta, bread, breakfast cereal); replacement of meat, eggs, dairy products with fish and legumes (min 2 portions, ~300 g/week of fish, 3 portions, ~300 g/week legumes); replacement of butter/margarine with EVOO	Italian Med Index	Baseline IG 6.2 ± 2.8, 8weeks IG 8.7 ± 2.8	Baseline CG 5.3 ± 2.2, 8weeks CG 4.4 ± 1.5	2

Abbreviations: CG, control group; CI, confidence interval; DASH, Dietary Approaches to Stop Hypertension; DQI, diet quality index; EPIC, European Prospective Investigation into Cancer and Nutrition; EVOO, extra virgin olive oil; FFQ, food frequency questionnaire; G1, group 1; GMD, ; IG, intervention group; IMD Italian Mediterranean Diet; IMI, Italian Mediterranean Index; MEDAS, Mediterranean Diet Adherence Screener; N/D, no data; PREDIMED, Prevención con Dieta Mediterránea

Zulet et al., 2011 (Spain)	Hypocaloric MD compared to American Heart Association Diet	30% energy restriction diet, with a macronutrient distribution (carb/fat/protein) of 40/30/30, high meal frequency (7 / day), low glycaemic index/load and high antioxidant capacity as well as a high adherence to the MD.	N/D	N/D	N/D	2 [4]
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Abbreviations: CG, control group; CI, confidence interval; DASH, Dietary Approaches to Stop Hypertension; DQI, diet quality index; EPIC, European Prospective Investigation into Cancer and Nutrition; EVOO, extra virgin olive oil; FFQ, food frequency questionnaire; G1, group 1; GMD, ; IG, intervention group; IMD Italian Mediterranean Diet; IMI, Italian Mediterranean Index; MEDAS, Mediterranean Diet Adherence Screener; N/D, no data; PREDIMED, Prevención con Dieta Mediterránea

3.5 Discussion

This systematic review revealed modifications to the MedDiet, often by additional supplementation of specific food groups such as EVOO and nuts. Additionally, modifications to the scoring system were used to reflect more flexible interpretations of the MedDiet pyramid according to the local preferences.

This review primarily focussed on the adaptations to the dietary pattern of MedDiet. Although many studies measured adherence, the scoring methods used were varied and relatively heterogeneous. The most common tool used was the MEDAS (14-point) score, notably in PREDIMED trials. The variety in scoring methods and the inherent variation in the actual values is more deserving of a meta-analytical approach to use this data in constructive ways. An example of this is a MEDAS score of 9 or higher are typically viewed as high adherence. Meanwhile, country-specific measures such as the Italian Mediterranean Index used continuous ranges or even grouped scores.

With a large geographical spread in the studies, including Mediterranean populations with an already-high adherence, some baseline adherence was high. This partially obscured the extent of change post-intervention. In Mediterranean countries, and particularly in the PREDIMED studies, a more traditional modification pattern was observed. Additional EVOO would be more acceptable to these populations, for example, than in a Nordic country or even the UK. Another key modification centred around the concept of calories and/or macronutrient ratios. Zulet et al. (2011) combined both energy paradigms by a 30% energy reduction and low-GI foods in a specific ratio. The dramatic strategy by Paoli et al. (2011) to begin with pre-formulated meal substitutes, only including complex carbohydrates in the later stage of the trial. This strategy was also combined with phytoextracts and nutrient ratios. Both strategies diverted from recommended UK ratios approximated to 50% carbohydrates, 35% fat, and 15% protein (Public Health England 2016).

Several of the studies such as Hernáez et al. (2017) and Hermsdorf et al. (2009) appraised the diet modification using clinical markers. Varying from cholesterol to simple weight loss, quantitative data of this nature could be better as part of a more comprehensive ABCDE nutritional assessment (Ahmad 2019). Furthermore, this would allow capturing more specifics of the MedDiet as a lifestyle pattern rather than a more-reductionist single component (mostly diet modification). This argument can be extended to the use of scoring systems. As a proxy for dietary assessment, the scores do benefit from validation. A unified reporting standard for MedDiet could balance the contrast between traditional and personalised versions. Additionally, it would allow for more comparability between studies and perhaps more generalisability.

Compared to the high-prevalence WPD largely dominant in developed countries, and spreading to developing countries, even modified adherence to MD does reflect a significant change in the key areas as discussed below:

3.5.1 Fatty acid profile and implied inflammatory profiles

Within the WPD, ratios of omega-3 to omega-6 fatty acids have been recorded between 1:10 and 1:25 (Simopoulos 2011). Given the ideal ratio is 1:4 or lower (evolutionary diets may have been as low as 1:1), this imbalance in WPD represents a deficit in anti-inflammatory activity combined with excessive pro-inflammatory activity (Fabiani et al. 2021).

Saturated fat guidelines in the UK for healthy adults are established in public health for adults through the Scientific Advisory Committee on Nutrition (SACN). This committee rigorously analyses clinical studies and relevant research to provide evidence-based recommendations. Recommended intakes of saturated fats are widely exceeded in WPD especially through the consumption of ultra-processed foods, excessive red meat consumption, excessive dairy and sweet products, and use of fats or even oils with high levels of saturates (Jiménez-López et al. 2020). In contrast, the use of EVOO promotes reduced consumption of saturates, increased levels of PUFA and MUFA especially omega-3, and multiple polyphenols (Vrdoljak et al. 2022). This combination of bioactive polyphenols and favourable fatty acid profile has been shown to be beneficial in multiple diseases and conditions (Lozano-Castellón et al. 2020; Marrano et al. 2021; Alkhalifa et al. 2024). In MD, specifically reduced intake of red meat, increased consumption of plant-based products, and the use of beneficial oil combine to produce a more favourable saturated to unsaturated fatty acid ratio. Extra virgin rapeseed oil (EVRO) presents lower saturated fat content compared to EVOO while being a more cost-effective UK product. This presents an opportunity to reduce cost, palatability objections, and familiarity with the MedDiet.

3.5.2 Protein consumption

The current Recommended Nutrient Intake is calculated by 0.75g of protein per kilogram of bodyweight (British Nutrition Foundation 2021). Requirements for protein are usually dependent on multiple factors although may be higher due to multiple factors; a) physical activity – an increased amount of insulinogenic protein is recommended for highly-active individuals, athletes, and those regularly engaged in sport (b) age – Younger adults may grow until their early-20s, requiring but likely not exceeding the higher levels of SACN protein recommended intake (c) pregnancy and lactation require additional 6g and 11g (8g for lactation at 6+ months) respectively per day (Alexandrov et al. 2018; Dorrington et al. 2020; British Nutrition Foundation 2021). Older adults especially those at risk of sarcopenia benefit from quality over quantity, with high-leucine proteins delivering anabolic

benefits against the effect of age (Dorrington et al. 2020). Although much of the UK population over-consumes protein, consistent and adequate protein intake encourages lean muscle mass retention and moderate mass gain when combined with both aerobic and resistance exercise as recommended in MD and public health. While these examples highlight that specific groups may have varying needs for protein intake, excessive protein intake is routinely recognised in the UK, suggesting this mixed-source protein MedDiet could address that issue.

3.5.3 Fish and seafood

Oily fish such as salmon, mackerel, sardines, and tuna (steaks) contribute to fatty acid, notably, omega-3, intake at the frequency recommended in MedDiet. As a quality protein source, these are low in saturated fat, while also providing micronutrients such as vitamin D. Sadly, larger oily fish, especially predatorial species are at risk of concentrating heavy metals such as mercury and, excess consumption of which can have serious long-term health effects (Blanchfield et al. 2022). Food governance in the UK remains strong, with robust levels of traceability, in turn promoting acceptable levels of risk from these compounds at a weekly consumption of two to three portions (Díaz-Méndez and Lozano-Cabedo 2020). Alternative sources of omega-3 in the MedDiet present an opportunity to augment intakes without necessarily directly increasing fish intake. Nevertheless, the benefits of omega-3 are sufficient to recommend non-fish sources such as microalgae in cases of inadequacy.

3.5.4 Dairy products

Minimally-processed dairy products are a healthy source of protein and calcium. The latter is important to promote healthy bone structure, keeping osteoclast breakdown of bone in line the building activity from osteoblasts (Polzonetti et al. 2020). Specific populations such as pregnant, breast-feeding, and older adults of both sexes require optimal calcium intakes. Lack of calcium for example, combined with inadequate vitamin D, may result in earlier onset of frailty from osteoporosis (Cai et al. 2022; Kuribanjiang et al. 2024). Frailty in older age will present risk of falls, injury, and increased burden on carers or health services. Further, such frailty has potential to reduce desire to engage in even mild to moderate exercise (Morante et al. 2019). Broad research shows the benefit of physical activity to promote retention of bone mass and mobility in general in adults.

3.5.5 Fibre

Highly-processed foods generally lack fibre, reflected in inadequate consumption in the UK. NDNS data shows the average UK adult has approximately half of the recommended fibre intake. This modifies

the
microbiota
in an

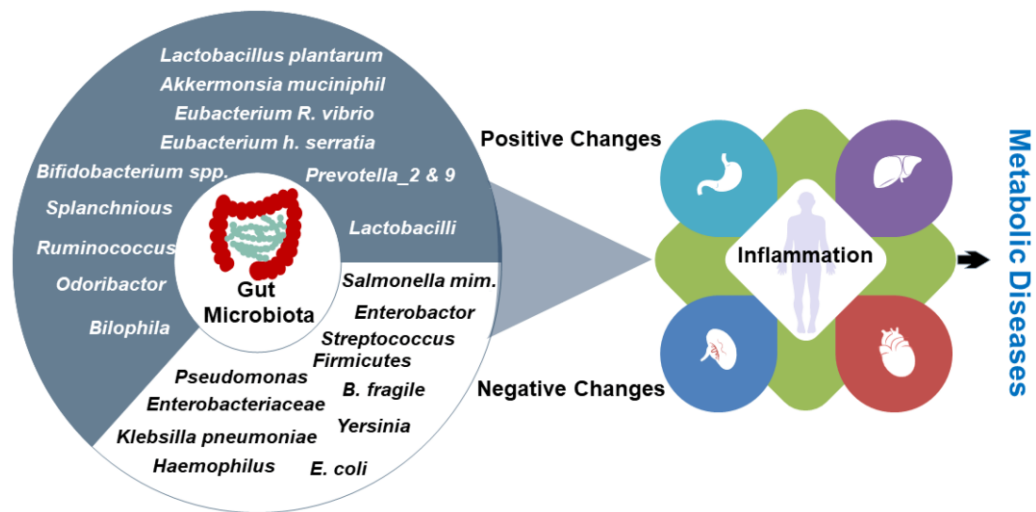


Figure 5: Microbiota effects on development of metabolic diseases adapted from Zeb et al. (2023)

unfavourable way, reducing proliferation of positive species, further allowing pro-inflammatory-producing species to flourish. Figure 5 shows a simplified breakdown of the relevant microbiota.

The MedDiet emphasises higher levels of high-fibre foods such as whole-grains, fruit, and vegetables. With high levels of prebiotic content, such foods can – especially in combination with a hypocaloric diet – confer benefits from changes in the gut-brain axis through beneficial SCFA fermentation. Additionally, the reduction in proinflammatory cytokines reduces low-grade inflammatory effects known to be present in overweight and obesity (Maneerat et al. 2013).

3.5.6 Sweeteners and ‘free sugars’

Excess sugar intakes are strongly linked to excess adiposity. Within the UK, the introduction of a sugar tax has produced some encouraging reductions in added sugar content in processed foods. Research has shown that the prior consumption of free sugars by the UK was a significant factor in visceral adiposity.

The benefits of recent food reformulation to sweeteners, however, are still to be proven in long-term health outcomes. Many sweeteners – in fact the majority other than erythritol and stevia – appear to have a more conflicted relationship with insulin resistance especially in the presence of other carbohydrates (Gibbons et al. 2024). Some research indicates little to no effect in healthy adults of sweeteners on insulin sensitivity using fasted and post-prandial monitoring (Ahmad et al. 2019). Other findings are inconsistent with this, showing concerning association between artificial

sweeteners in areas such as risks of atherosclerosis, cardiovascular diseases, and metabolic syndrome (More et al. 2021; Charlotte et al. 2022; Singh et al. 2023).

Given the wide variety and chemical constitutions of sweeteners, the effects of any may not reflect that of the entire group. Quantity and type of sweetener consumption is therefore of key importance and should be, where possible, moderated (Silva et al. 2023).

3.5.7 Processed foods

Researchers, professionals, and consumers generally recognise that consumption of high-fat, highly-sweetened, processed foods is not associated with a healthy dietary pattern. Yet the definition of highly- or ultra-processed foods (UPF) was disputed for many years. More recently the NOVA classification system included this and literature has increasingly recommended replacement of UPF with nutrient-dense, minimally-processed foods (Monteiro et al. 2019).

UPF consumption contributes to obesity in particular through excess energy provision and low satiety and satiation profiles of the foods; Patra et al. (2022) in particular linked growth in food energy UPF purchases with obesity prevalence (male 4.5% to 11%, female 5% to 10%). In the UK specifically, NDNS data between 2008 and 2014 shows up to 56.8% of calories contributed by UPF compared to 30.1% from unprocessed or minimally processed foods (Rauber et al. 2018).

Additionally, consumption of UPF represents a low level of control over the salt (notably sodium) and free sugar content of the foods.

For specific populations, such as pregnant and breast-feeding, UPF consumption has associations with reduced overall diet quality, adverse pregnancy and infant outcomes, and risk of obesity; Nansel et al. (2022) report doubling of added sugar consumption from UPF in both pregnancy and postpartum, between quartiles for UPF as percentages of energy intake (lowest quartile n=65 6.5% (5.5, 7.6) compared to highest quartile n=104 13.4% (12.3, 14.6)).

Marrón-Ponce et al. (2022) similarly link consumption of UPF in Mexico with reduced diet diversity and a linear negative association with micronutrient intakes, notably vitamin B12, magnesium, niacin, folate, calcium, and zinc.

3.5.8 Ketogenic MedDiet

The study by Paoli et al. (2011) is something of an outlier within this review, deploying a ketogenic version of the MedDiet. Any diet considered ketogenic is, by nature exclusionary of carbohydrates and this would contradict public health guidance in the UK, especially for nutritionists. This same study also used a range of herbal extracts including white kidney bean extract which shall be discussed separately.

A recent review by (Devranis et al. 2023) highlighted the insufficiency of research into the ketogenic MedDiet and the complexities surrounding the combined monitoring of ketone bodies (low levels of ketosis to be achieved) and the MedDiet adherence (using a validated scoring system).

Low-carbohydrate ketogenic MedDiet does appear to confer more-rapid reductions in weight and BMI compared to a low-calorie MedDiet, while similarly reducing metabolic markers for NCDs such as cardiovascular disease and T2DM (Ivan et al. 2022).

3.5.9 White kidney bean extract (WCBE)

Extracted from *Phaseolus vulgaris*, this extract is purported to inhibit the production of α -amylase, one of two enzymes responsible for carbohydrate absorption. Feng et al. (2022) identified a novel extraction method for WCBE using ultra-high-pressure treatment to reduce the heat-induced destruction of inhibitory activity seen in standard extraction. Using a 1.5g dose of WCBE, this study was able to demonstrate improvements in HbA1c compared to a control group after 2 months ($0.660 \pm 0.468\%$ vs. $0.222 \pm 0.763\%$, $p < 0.05$) and 4 months ($0.721 \pm 0.742\%$ vs. $1.059 \times 10^{-8} \pm 0.942\%$, $p < 0.05$). Additionally, improvements to gut microbiota were observed with elevated *Lactobacillus*, *Bifidobacterium*, *Romboutsia*, and *Faecalitalea*; reductions in concentrations of *Fusobacterium*, *Roseburia*, *Citrobacter*, *Klebsiella* and *Enterobacteriaceae* were also measured. In contrast, perhaps due to lack of the specific treatment used in the above example or possibly the short study duration (7 days), Houghton et al. (2023) observed a lack of α -amylase inhibition during an in-vitro study.

3.6 Conclusions

MedDiet has an almost unparalleled research history and demonstrable benefits to the overweight and obese population. In the studies reviewed, the risk of bias was generally acceptable and therefore promotes the relevance of these findings. Nevertheless, variations such as the ketogenic MedDiet, remain relatively unproven. This review highlighted the importance of EVOO in the MedDiet, with the vast majority specifying this as primary source of fats and an additional supplementation. The benefits of nuts appear more specific to the particular goal and demographic, pistachios for example being beneficial for reducing gestational maternal diabetes. Disadvantages of the WPD, and UPF as a considerable calorie-contributor of that diet, are considerable. Large-scale reduction of UPF therefore demonstrates the most urgent change which a UK MedDiet could facilitate.

Several key concepts around the conviviality of the MedDiet i.e. eating with others, eating unhurried, relaxation in physical activity and reducing stress, do seem difficult to include in quantitative studies as seen by the notable absence in this review. As such a qualitative study is warranted to reveal more experiential factors related to MedDiet, its barriers and facilitators.

One major finding from this systematic review is that the adaptations to the MedDiet appear to be more linked to augmenting its healthiness and thus increasing complexity. In many of the reviewed studies, the specificity of changes were valid for the outcome yet not necessarily linked to creating a more viable diet for the general population.

This research has several strengths, from the systematic process itself to the use of validated tools such as the risk of bias assessment. These processes increase reliability and validity through demonstrated transparency. The lack of discovered studies specifically outside the Mediterranean Basin does however present a potential limitation in the searching process. Future iterations of this systematic research could specifically consider adapting to reveal not only studies from additional countries but also seek to include adaptations to the scoring systems used to assess MedDiet adherence.

4 Chapter 4 Opinions and perceptions of MedDiet in overweight and obese

4.1 Introduction

Definitions of healthy eating are constantly changing with ongoing knowledge development. Specifically, the effects of nutrients, whole foods and dietary patterns have been shown to reduce prevalence of non-communicable disease.

Modern healthy dietary patterns are supported by substantive positive evidence while the negative effects of the Western Pattern Diet (WPD) are also widely recognised. The WPD is characterised by high intakes of saturated fat and processed foods, paired with low intakes of beneficial fats, fibre, and fruits and vegetables. Many of the healthy dietary patterns, such as Dietary Approaches to Stop Hypertension and Nordic diet, provide benefits to long term health outcomes. Yet, the largest body of support is for the Mediterranean diet (MedDiet), which has been shown to benefit physical and mental health.

However, adoption varies by region with specific countries with some Mediterranean countries falling in adherence (Greene et al. 2021). Measurement of the adherence is through a variety of validated scores which may not be directly comparable. Of relevance to this study, is the inconsistencies in both definition and assessment criteria (Hutchins-Wiese et al. 2022).

Cultural limitations have led to modifications to the basic MedDiet such as removal of alcohol or tolerance of sweets and red meat portions. With a high reliance on extra virgin olive oil, seafood and fish, there is a possibly unjustified assumption of higher weekly diet cost associated with MedDiet (Saulle et al. 2014). Nevertheless ongoing global food supply disruption and the UK cost of living crisis could well exacerbate the known barriers to adoption, adherence, and maintenance of the MedDiet (Van Der Velde et al. 2019). Similarly, the level of education, flexibility in diet pattern, and support may predict likelihood of adoption (Tsofliou et al. 2022).

In this context, focus group participants were sought to assess the perception of the MedDiet and acceptability of the modifications.

The primary aim of this study is to understand barriers, facilitators, and support concepts to promote the adherence to an affordable, bespoke Mediterranean-style diet adapted to the UK.

4.2 Philosophy and assumptions

In this qualitative phase, some philosophical assumptions were made according to the researcher's perspectives. First, ontologically this chapter aligns with a relativism approach. This assumed that

reality has multiple forms and is socially constructed. In this context, this followed the participants' perception and interpretation of MedDiet being different. Such participant beliefs derived from unique personal, social and cultural experiences. By exploring the subjective meaning which had been associated with MedDiet, this approach did not seek to establish objective and generalisable truth. Second, epistemologically the processes of semi-structured focus groups, reflexivity, and iterative analysis demonstrated interpretivism. Reflexive thematic analysis aligns with this philosophy to inform how people make sense of dietary practice, specifically around the MedDiet pyramid. Similarly, the concept of saturation was not embraced, aligning with Braun and Clarke (2021).

The researcher was viewed as an active participant and acknowledged this in detail in the reflexive summary. The concept of subjective engagement by the researcher was used identifying themes. This research does not claim neutrality, instead relying on trustworthiness and rigour throughout the reflexive thematic analysis. The goal of this philosophy was to avoid seeking linear causality to participant behaviour. Instead, the intention was to deepen understanding in motivation, perception, and challenges.

4.3 Methods

A qualitative design was proposed, using semi-structured focus groups to permit broad sharing of ideas.

As a qualitative tool, focus groups (FG) have certain strengths and weaknesses. Firstly, FG promote participants to interact dynamically. This process allows them to explore and extend each other's contribution. In turn, this can reveal richer data on shared beliefs or social influences (Kitzinger 1995). In this context, the contribution of social and cultural beliefs was considered important to the perception of MedDiet. Secondly, FG were a cost- and time-efficient option, allowing multiple viewpoints to be collected rapidly (Krueger 2014). Despite these and the many other advantages of FG, some limitations exist. Careful moderation is important in effective FG, especially in managing potential dominance or suppression of minority viewpoints (Tümen Akyıldız and Ahmed 2021). Another possible limitation is group conformity. One-on-one interviews could reduce these risks as an alternative but may not have delivered the aim of exploring the communal, social, and cultural perceptions sought.

A semi-structured format permitted greater exchange of ideas while keeping to an appropriate duration of approximately 35 to 45 minutes. This was selected with participant burden in mind while retaining relevance towards free expression.

Participants were selected based on proposed inclusion and exclusion criteria for a future quantitative trial of the UK MedDiet as shown in Table 1 below. Assessment of habitual diet will use an online eligibility questionnaire. This will include the validated 14-item PREvencion con Dieta MEDiterranea (PREDIMED) score (MEDAS) (Martínez-González et al. 2012; Papadaki et al. 2018).

Table 7: Inclusion and exclusion criteria for focus group participants

Inclusion criteria	Exclusion criteria
BMI between 25kgm ⁻² and 39.9kgm ⁻² *	Pregnant
Age between 18 and 50 years	Diagnosed eating disorders
Able to travel to Bournemouth University**	Diagnosed neurological conditions
Literate and numerate	Ongoing/beginning treatment for CHD/CVD
Internet, email, and telephone access	Diagnosed sleep disorders
Habitual diet not matching	Diagnosed sensory conditions
Mediterranean/prudent	Night-shift workers
	Tested positive for COVID-19 in the last 30 days
	Presence of food allergies/intolerances
	Following exclusionary diet (e.g. vegan)

*Values for overweight and obese drawn from National Health Service (NHS 2019).

**This would be required only for in-person focus groups.

The concept of saturation has not been deployed in this reflexive thematic analysis since it is based in grounded theory. Although a set of guide questions shown in Table 8 were used, the facilitator (LC) used discretion to allow deviation in discovery of topics and themes key to the research intent.

4.3.1 Recruitment

Eligible participants from the Dorset area were recruited using opportunity and snowball methods.

- i) A poster was prepared as shown in Appendix II. This was displayed on the Talbot campus of Bournemouth University on the public research notice board. This location enjoys relatively high footfall due to its proximity large social areas.
- ii) Awareness of this research was high among my social and academic circle. This promoted several opportunistic recruits.
- iii) Confirmation of eligibility was performed using an online questionnaire together with the Participant Information Sheet, and the Participant Consent Form. Recruitment was undertaken after ethical approval from Bournemouth University Ethics Panel under ID 51436.

- iv) Participant BMI and MEDAS scores were calculated by LC to ensure alignment with criteria. This allowed confirmation of informed consent.
- v) After confirmation of eligibility, LC contacted the participants to confirm availability for FG participation. During this process, LC also mentioned looking for more interested individuals (snowball).
- vi) Snowball respondents and opportunistic contacts from the Dorset area were directed to the online survey for eligibility assessment.
- vii) Two FG dates were selected from respondent availability to optimise attendance. This final step concluded the recruitment process.
- viii) No incentivisation was provided at any time.

4.3.2 Reflection on sampling and criteria

This research was guided by inclusion and exclusion criteria, intended to reflect a future quantitative or mixed-method trial. As such, these were designed to ensure participants were in the target population. Although this provided support for such planning, this potentially added an extra layer of specificity and therefore some limitations in recruitment. Purposive (also referred to as purposeful) sampling could have offered an alternative. Palinkas et al. (2015) described this non-random identification and selection of individuals with knowledge of the subject and willingness to share. In this study, the inclusion and exclusion criteria were highly detailed. A more pragmatic approach using broader criterion sampling could have achieved the research aim while still ensuring qualitative rigour.

Table 8: An adapted set of guide questions derived from (Kretowicz et al. 2018)

Guide Questions
Tell me what you already know about the Mediterranean diet.
How do you think the known benefits would affect you and people like you?
What are your thoughts on the adaptations to the Mediterranean diet?
How do you feel about the food in this Mediterranean diet in comparison to your usual diet?
What are your current motivations for following a healthy lifestyle?
What are your thoughts about preparing the food in this diet?
Tell me what you think about the cost of this diet.
Tell me about how you normally find and access information on diet and lifestyle.
Tell me about features of healthy eating resources that you find particularly helpful or unhelpful.

This schedule was adapted with guidance from FT (one of the authors of the source). This built on previous qualitative published peer-reviewed work by leading MedDiet researchers. A pilot session with moderator training was undertaken with FT and CC. As a dedicated qualitative researcher, CC advised the guide questions could and should be used flexibly to guide the FG but not dictate it. It was therefore agreed that partial use of the schedule was acceptable. LC undertook further one-on-one practice with two peers to practice delivery and build confidence.

This preparation included several lessons, notably that of preparation for the facilitation was essential. Managing dominant voices can present challenges and suppress minority voices. With this knowledge both from literature, facilitation training and previous experience, LC was able to ensure every person had a chance to speak and be heard. LC also learned that balancing timing and group dynamics was a skill, each FG presenting different lengths of response to the same questions. When participants did share personal stories, it was essential to be sensitive and empathetic. This required some control of the pace to allow time to process the shared information. The biggest lesson related to allowing spontaneous contribution and topics. Through this process, participants revealed unexpected and rich content. One participant was extremely quiet during the FG despite warm-up, and this potentially could have been the FG format or lack of familiarity with MedDiet.

Steps for FG process

- i) Warm-up: LC joined the online Teams video call with camera enabled. During this stage, while participants joined (usually before start time), LC engaged participants in casual discussion about how they were, their day and other such light topics.
- ii) Introduction: During this phase, LC introduced himself, confirmed the purpose of the FG. This housekeeping stage also included a polite request to respect each other's opinions, views and experiences.
- iii) The next step was to confirm everybody was happy to proceed and check participants against the invited group.
- iv) The first guide question was then asked and participants encouraged to share their knowledge. This was in line with Bournemouth University KWL trained facilitation technique. This covers what participants already Know, What they want to know, and then reiterate what was Learned.
- v) After the participants had broken the ice with each other debating this topic, LC provided the updated MedDiet pyramid as shown in Figure 2. After explaining the concepts it described, LC also answered any questions.

- vi) In both FG, this prompted a healthy discussion around the MedDiet and ensured a consistent awareness of the MedDiet beyond the dietary component.
- vii) Various guide questions were asked, differing between FG, although the full list was not required in either.
- viii) At the end of the planned timeframe for the FG (up to 45 minutes), LC allowed the conversation to come to a natural conclusion.
- ix) The final stage was to remind everyone of their right to withdraw and how to request a copy of the study in the future. LC then thanked the participants for their time and being willing to share.
- x) Recordings were promptly secured and anonymised as rapidly as possible, ensuring ethical handling of data.

Considerations for FG

- i) Before FG: Prior to each FG, LC ensured participants had provided informed consent in line with ethical considerations.
- ii) LC also carefully considered participant comfort and logistical setup.
- iii) During warm-up: Mutual respect was emphasised in this stage. LC encouraged all opinions, views and experiences related to the subject and validated all questions were welcome. Establishing these ground rules created an open, sharing, and psychologically safe environment for participants.
- iv) LC maintained reflexivity throughout the FG, observing any power dynamic and emotional cues.
- v) LC encouraged participants to share final thoughts and again reminded of the right to withdraw again at any time prior to anonymisation.

4.3.3 Coding and Analysis

Participants' views were assessed using thematic analysis (Braun and Clarke 2006). Focus groups and data processing occurred in parallel to promote assessment of themes. Saturation is recognised when emerging themes are no longer novel. One researcher (LC) reviewed the transcriptions with a second researcher (FT) independently assessing a sample for reliability (O'Connor and Joffe 2020).

The audio recording was uploaded to an online transcription service (Otter.ai 2025). After manually and iteratively correcting the verbatim transcripts, the original recordings were deleted. This was in line with recommendations by Halcomb and Davidson (2006) who noted even professional transcripts can contain substantial errors. This process involved checking the audio recordings in

sequence and thoroughly. Further anonymisation ensured the removal of identifiable information, including any mention of participant names.

Subsequently, the transcriptions were repeatedly read to develop familiarity with the content and to prepare for the iterative coding. This aligns with the six steps in reflexive thematic analysis (Braun and Clarke 2006, 2012, 2019). After familiarisation, initial codes were generated which were relevant to the research question (step 2). This involved systematically identifying and labelling specific parts of both transcripts. LC next started the construction of themes from these codes (step 3), seeking to find patterns. Detailed revision of codes and themes was performed (step 4) to confirm accuracy to the information and narrative of the transcriptions. In step 5 of the RTA, the themes were confirmed to connect to the research aims and suitably named. This thesis represents step 6 as the write-up for the research. Reflexivity was maintained throughout this process to acknowledge the active participation of the researcher in theme development.

4.3.4 Ethical considerations

Participants were provided with full information prior to the focus groups with signed participant involvement forms to confirm consent. The sessions were facilitated according to the list of guide questions and managed according to the methodology recommended by Sim and Waterfield (2019). Participants were encouraged to contribute while respecting the right to decline to comment. The right to withdraw from the group and from subsequent use of quotations were guaranteed and reiterated prior to each focus group. Coded and themed data from the transcripts will not be withdrawn. Transcripts and recordings were deleted upon completion of anonymising process.

4.4 Reflexive narrative

4.4.1 Background of researcher

After a long career in IT starting at 21 and lasting about 20 years, I decided to try to address the widely familiar ‘middle-age spread’ and general lack of fitness. This led me to try to unpick the mix of information, disinformation, anecdotes, and endless sales pitches relating to nutrition and exercise. This started off with an at-home exercise program called Insanity™ which was high intensity interval training with an associated diet plan (ST 2025). Following this plan did give rewards in aerobic fitness and reduced bodyfat but not necessarily the physique sought. After completing this program three times (and literally earning the t-shirt!) it still appeared that disinformation was rife.

This led to a great interest in solving my nutrition concerns to achieve a natural physique. Estimates of nutrition contribution seemed to agree to be around eighty percent of the end result. As such I started reading more on PubMed and subscribing to leading personal trainers. After 3 years including

several of training 3 hours a day 6 times a week in the gym, I was able to balance nutrition to create 'cut' and 'bulk' cycles. This facilitated a good ratio of strength to bodyweight for such a late bloomer. At under sixty-eight kilos in weight and a 7-point Jackson-Pollock calliper measurement of six percent bodyfat, I had a three RM of one hundred and forty kilograms on overhead deadlift without any aids.

4.4.2 Impact of background

This detailed reflection is intended to demonstrate several points. One, that despite years of learning about nutrition, I was still so uncertain that I returned to college to get an Access to Higher Education and then join Bournemouth University for my Association for Nutrition accredited undergraduate degree (BSc Nutrition). I achieved first-class honours in this degree and set out learning about research and extending my nutrition knowledge through this Master's by Research. Two, that even years into studying nutrition, I am still aware of how vast this specialisation is and the difficulty in generalisation. Three, that despite over fifty years of public health nutrition in the UK, obesity is still at record levels with equally high NCD risk. The COVID pandemic demonstrated yet again the importance of nutrition in health outcomes. Four, that while energy paradigms such as the Energy Balance Model broadly seemed to work in specific 'normal' ranges, there were substantial plateaus both in weight loss and gain. At this time, these appeared to revolve around some homeostatic norms for my own physique and I observed similar occurrences (anecdotally) over the years in others.

4.4.3 Reflection on possible biases

This therefore gives me a slightly orthorexic approach to nutrition and exercise. In turn this naturally led me personally to prefer precise and strict calorie counting for example. Despite this, and perhaps through maturity in my nutrition journey, I realised such dietary patterns are not transferable nor desirable in populations in general. As such, my interest in both energy paradigms and lived experience in MedDiet started to develop. This diet seemingly had transferability, excellent results in correlations, and a vast amount of research. Despite this it did not appear to be very widespread in the UK.

During my life I have often had times where the cost of food and indeed many things were prohibitively high. Recent years of being a student, combined with the cost-of-living crisis ongoing in the UK have created a concern over the rising cost of food. The most recent data from Kantar confirms ongoing food inflation (McKevitt 2025). This is a possible personal bias towards the financial pressures especially on healthier food. This has meant, however, that generally I have developed and relied on my own cooking skills. In turn, this is a possible bias around food knowledge and skill. It can be easy to assume that this is a common skill. Adams et al. (2015) confirmed this was not the case

from their study. This also combines with recent publications on food insecurity, the role of food banks, and the connection to rising living costs in the UK (Loopstra and Lambie-Mumford 2023).

4.4.4 Researcher philosophy

Throughout this Master's I have sought to improve my philosophy knowledge. While this does represent only early competence at qualitative research, I feel it has enabled me to consider my ontology and epistemology in much more depth than at undergraduate level. Hopefully, this has reduced any tendency to mix positivist or even post-positivist concepts with relativism. As a new area of knowledge however, I did not find even the terminology and complexity of qualitative research intrinsically easy. An example of this is described earlier in purposive sampling. This might appear simple on the face of it but with multiple designs and therefore philosophical implications, I remain aware there is a lot more to learn around these topics. As such therefore, I encourage the reader to appreciate this as a possible source of bias.

4.4.5 Design considerations

The design of this study, together with the aims and objectives, should be less liable to bias. This is due to the careful supervision of experts in Nutrition and MedDiet. This also remains accurate for the interview script adapted as previously described. Nevertheless, this study recognised the role of the researcher as active and co-creational together with the participants. In this vein, the subjectivity involved in facilitating FG, coding and creating themes, in describing this research and even indirectly through unconscious bias is a factor to carefully consider. In this study, the prioritisation of accessibility and cultural adaptation of MedDiet was particularly important. While adherence to the diet was of interest, it should remain a secondary concern to understanding these lived experiences. In creating this qualitative research, interesting and perhaps novel concepts have been demonstrated. In turn this could pave the way for future research to pursue these concepts and to find how to create a UK MedDiet which is nutritionally sound, broadly acceptable, easy to follow and afford.

4.4.6 Subjectivity and facilitation

The selection of Braun and Clarke (2006,2021) RTA framework for this study was again guided by advice and a desire for methodology which allowed, recognised and even encouraged subjectivity rather than representativeness. I was very aware of my status as a university, postgraduate researcher. This could have created demand characteristics for some participants, or even bias based on a perception of my being an expert in the field. While I believe the impersonal nature of the poster did not allow my gender, ethnicity or appearance to influence the sign-up process, it is possible it affected the FG themselves. In the FG however, I emphasised how all viewpoints were

valuable and the desire to capture their lived experience, beliefs and views was the priority. I further reiterated all responses were valuable and used my trained facilitation skills in non-judgemental listening. These skills had been learned through the Peer Assisted Learning (PAL) program at BU. Having been both a PAL Leader and subsequently a Peer Support Leader (appraising and guiding other PAL leaders), I feel those skills served me well in the FG. Additionally, having run very large projects in the past enabled me to view the challenges of this research as enjoyable experience.

4.4.7 Impact on data analysis

Initial coding was a daunting task, especially when trying to consider how to collate codes from two transcripts. Familiarity with the transcripts was essential. My previous reading around overweight and obesity stemmed from work on facilitators and barriers to dietary and behaviour change. Much of this knowledge was rooted in psychology from years of study and reading. In fact as Albarracín et al. (2024) noted, even use of behaviour change models is no guarantee of success. This perception of the difficulties in behaviour change and dietary adherence did initially lead to more emphasis on the barriers to MedDiet implementation in its default form. However, as I progressed with the iterative repetition and checking in later RTA steps, I did manage to collapse the unnecessary themes and limit the barriers in particular to one theme. Additionally, this allowed me to express the positive experiences related to conviviality within the themes. Given the developing research on loneliness, my advancing years, and being single, I suspect this theme resonated strongly for me (Jentoft et al. 2024). I was very careful with this possible bias and ensured the participants had indeed contributed this essence.

4.4.8 Reflexive summary

Throughout this qualitative research, I regularly updated a reflexive journal and consciously engaged in reflexive practice. Furthermore, by seeking out advice from the supervisor team and receiving much support from the ethics panel at BU, I feel this enabled me to remain open to all types of evidence, even that which might contradict my own beliefs. This reflexivity also served well in creating safe, successful FG sessions. Similarly, in documenting this research, I have sought to be continually reflexive and open to all input.

4.4.9 Rigour

According to Lincoln and Guba (1985), trustworthiness in qualitative research involved establishing four criteria. Although demonstrated throughout, this dedicated section highlights how transparent rigour was achieved. Firstly, credibility was developed through iterative application of Braun and Clarke (2006, 2021) 6-step analysis. Examples of this included iterative coding following repeated reading of verbatim transcripts, accompanied by reflexive journalling throughout to reveal

researcher assumptions or biases. Secondly, establishing transferability included rich detail on the research context, from both inclusion and exclusion criteria to focus on overweight and obesity. These provide contextual depth permitting assessment of application to other populations or settings. Thirdly, dependability evidence can be found in the detailed research design, with clear audit trail and provided documents. This allows tracing of the methodology and decision processes. Finally, the continued reflexivity including bias evaluation and minimisation, demonstrated confirmability. Similarly rich use of verbatim quotes in coding and thematic description support this part of the research integrity and therefore rigour.

4.5 Findings and discussion

A summary of participant demographics has been included in table 9 below. The BMI and MEDAS scores were calculated before the original anthropometric and questionnaire data was removed for anonymisation. The retained data maintains confidentiality and anonymity yet still allows a level of analytical depth.

Group G01 can be described as having 4 participants, 2 of each gender. The mean BMI for this group was 29 kg/m² (overweight) with an average MEDAS score of 4.25 (low adherence to MedDiet). Group G02 can be described as having 5 participants, of whom 3 were female. The mean BMI for this group was 30.6 (obese) with an average MEDAS score of 4.00 (low adherence to MedDiet). The most common age range was 18-25 although older participants were represented. Both groups met the inclusion criteria for overweight or obesity. The elevated BMI suggests a representative sample of the target population for this research. MEDAS scores were consistently low in both groups, possibly suggesting less knowledge of MedDiet and affecting discussions around nutrition.

Table 9 Summary demographics of participants (anonymised and stratified)

Participant	Group	Gender	Age Group	BMI (kg/m ²)	MEDAS score
P001	G02	Male	18-25	34	6
P002	G01	Male	46-55	32	7
P003	G02	Female	36-45	26	4
P004	G02	Female	36-45	39	4
P005	G02	Male	18-25	29	2
P006	G02	Female	18-25	25	4
P007	G01	Female	36-45	26	5
P008	G01	Female	18-25	30	3
P009	G01	Male	18-25	28	2

Each transcript was coded iteratively, with adjustments to coding. The raw codes from each transcript are shown in Appendices VII and VIII. To organise this quantity of codes, initial themes (or sub-themes) were used to group into the major themes as described below.

Theme 1: Challenges in Adopting the Mediterranean Diet

This theme is specific and focused on the practical and financial barriers to adopting the Mediterranean diet, providing detailed insights into the participants' experiences.

- "I think it's expensive. Money is currently the biggest barrier."
- "If you make these meals then is it still as healthy to freeze it?"
- "There is very little options...there's a sandwich available...there's some crisps..."
- "The cost of living going up, it's hard to keep up with eating healthy all the time."

Some variation did however appear in participant views. This can be clearly seen in the contrasting statements:

- "We've gone more for the quality of meat and less of it.."
- "It's just too expensive"

Most participants across the groups agreed costs were high, yet this variability in resourcefulness or resilience suggested some adaptive strategies felt beneficial.

Theme 2: Cultural and Social Dimensions of Diet

This theme delves into the cultural and social aspects of dietary practices, providing a clear and detailed examination of how these factors influence the adoption of the Mediterranean diet.

- "I lived in Spain for a few years...you'd go to a Spanish friend's house...dinner with the whole family."
- "I find our children etc they are so much better educated about food that actually it's not a battle so much to get them to eat healthier..."
- "The shared meals aspect is what I find most appealing about the Mediterranean diet."

Two individual variations were expressed about this theme. The first related to the potential for ongoing gendered cooking roles:

- "It's mainly women in the family who do the cooking.."
- "I cook separately for my husband – he's fussy."

These originated from female participants, with males not commenting on this specific part of the theme. This could support an assertion that gendered roles in cooking, food choice, and adaptation may be still defaulting to women.

Another single variation to this theme discussed cultural identity:

- “I’ve grown up with certain foods.. to change that is emotional, not just nutritional”

This positioned dietary change as a possible challenge to personal and cultural heritage. An implication could be that both cultural identity and emotional attachment were – for this participant – viewed higher priority than taste preference.

Theme 3: Health and Nutritional Impacts

This theme specifically addresses the health and nutritional aspects of the Mediterranean diet, providing detailed insights into participants' motivations and understanding.

- "The benefits that it has really"
- "Understanding olive oil recommendations"
- "I had to make a serious life change about 18 months ago and lose a significant amount of weight."
- "One of the main reasons I stick to the Mediterranean diet is because of my family history with heart disease."

In this final theme, some variation in trust of authority figures related to nutrition was observed:

- “They told me in [medical unit] that olive oil was good”
- “I’ve heard different things – like it’s still high in calories”

These two participants referred to different information sources, the first related to government advice and dietitians. Meanwhile, the second related to social media, personal experience, and logic. This suggests trust in information could relate on the primary source preferred, rather than independent credibility.

4.5.1 Discussion

While the Mediterranean diet is renowned for its health benefits, adopting it outside of its native region presents challenges. Identified themes from the focus groups considered these challenges, cultural and social influences, and the health and nutritional impacts of the diet. Each theme can be viewed in the context of existing research to identify potential gaps in the literature with practical implications for dietary interventions.

4.5.2 Theme 1: Challenges in Adopting the Mediterranean Diet

The various challenges in adopting MedDiet were consistently raised in both focus groups. Participants highlighted financial barriers, time constraints, and issues related to the quality and availability of food most frequently.

4.5.2.1 *Financial Barriers*

Across both focus groups, participants frequently mentioned the high cost of MedDiet staple foods, such as EVOO, and fresh fruit and vegetables. For instance, Participant 1 from FG1 stated, "I think it's expensive. Money is currently the biggest barrier," and Participant 3 from FG2 echoed this sentiment by noting, "It is really expensive to get local things here." These perceptions mirror findings by Woodside et al. (2022) who highlighted population-specific barriers such as availability of key foods and cost making healthy diets unaffordable for many people. The recent dramatic inflation rate of the cost of food and non-alcoholic beverages was 19.2% in the year to March 2023, though this rate fortunately has since fallen (Office for National Statistics 2024). Such a dramatic rise may be reflected in participants' perceptions. Nevertheless, several examples were made of healthy food being more expensive than less healthy options.

4.5.2.2 *Time Constraints*

Another significant barrier discussed was the time for buying ingredients and meal preparation. Participant 4 from FG2 shared, "Where I can fall away is when I'm very very short of time or running late...". Scarcity of time due to busy lifestyles and demanding work schedules can lead to increased reliance on convenience foods (Jabs and Devine 2006; Imtiyaz et al. 2023). These appear to support the lived experiences of participants. Yet one study by Clifford Astbury et al. (2020) identified gender differences and disagreement with this view, suggesting instead that interventions must consider how to trade time for food-related activities from other parts of the lifestyle. A possible explanation for this divergence of views by Liu et al. (2021) links the exposure to grocery outlets near both work and home as the former may increase access and therefore reduce time. Nevertheless, time was a significant factor in these groups and this complexity requires further investigation.

4.5.2.3 *Quality and Availability*

Concerns about the quality and availability of fresh produce were also prevalent among participants. For example, Participant 2 from FG1 stated, "A lot of vegetables have been picked months and months ago and then they're just frozen," and Participant 5 from FG2 commented on lifestyle in Western countries, saying, "People in the Western world...are very lazy...40-hour work weeks...". The UK is highly dependent on imports (Geyser 2021). Quality of frozen food largely depends on processing time between picking and processing, while UK consumers – and indeed the focus groups – expressed difficulty in managing fresh food expiry and food waste (Heng and House 2022). The perception of laziness could link to the UK growing insufficient produce, increasing reliance on imports. The focus groups highlighted that they felt quality, and freshness, are vital to encourage adoption of MedDiet. This might emphasise the need for policies which improve the availability of fresh local food.

4.5.2.4 *Critical Analysis*

Both the focus groups and literature identify cost and time as significant barriers to adopting MedDiet. However, the literature also provides additional insights into systemic issues like food imports, which are mentioned by the participants. Addressing these barriers requires policy changes to make healthy foods more affordable and accessible. Combined with public health initiatives to encourage meal preparation, knowledge and benefits could improve perception of both UK produce and MedDiet.

4.5.3 Theme 2: Cultural and Social Dimensions of Diet

Cultural and social factors play a crucial role in dietary practice, and this was evident in the focus group discussions. Participants highlighted how eating together, influence of social media, and family dynamics affected their dietary choices.

4.5.3.1 *Communal Meals*

The focus groups emphasized the cultural importance of communal eating practices. Participant 5 from FG2 shared, "I lived in Spain for a few years...you'd go to a Spanish friend's house...dinner with the whole family." Qualitative research by (Ortiz et al. 2024) indeed echoes the need for communal eating and its importance in healthy dietary habits. The shared meals aspect, as noted by Participant 5, mirrors the conviviality of Mediterranean dining. This cultural practice represents a supportive environment for adoption of MedDiet.

4.5.3.2 *Social Media Influence*

Social media's role in disseminating dietary information was another key point. Participant 2 from FG1 mentioned, "Speaking as Gen Zed...there is a lot of access now to people who can show that

they've got good results...". Maher et al. (2014) discusses how social media platforms can both positively and negatively influence eating behaviours. Leveraging social media for health promotion could be a powerful strategy for encouraging the MedDiet adoption, since interactive content can reach many users. Social media has the potential for misinformation and disinformation however, on diets and on broader topics (Suarez-Lledo and Alvarez-Galvez 2021).

4.5.3.3 Family Dynamics

Family dynamics also play a significant role in dietary choice. Participant 4 from FG2 noted, "I find our children etc they are so much better educated about food that actually it's not a battle so much to get them to eat healthier..." This concept aligns with UK and US literature on the importance of early education and family influence on dietary habits (Novilla et al. 2020; Pillay et al. 2022). Early, perhaps even prenatal family support and education, may shape the family dynamics throughout childhood, making healthy dietary choice more acceptable.

4.5.3.4 Critical Analysis

This theme links social factors and social media to dietary behaviour. Understanding these cultural contexts should guide effective dietary interventions, especially in a culturally aware and diverse population such as the UK. Public health campaigns could investigate social media and community programs to promote healthy eating, discussing the importance of communal meals and family involvement.

4.5.4 Theme 3: Health and Nutritional Impacts

The health and nutritional impact of the MedDiet were frequently discussed. The participants shared personal health journeys, lived experiences and motivations for adopting the diet.

4.5.4.1 Health Benefits

Participants reported significant health improvements after adopting the Mediterranean diet. For instance, Participant 4 from FG2 shared, "I had to make a serious life change about 18 months ago and lose a significant amount of weight." Additionally, Participant 5 from FG2 stated, "One of the main reasons I stick to the Mediterranean diet is because of my family history with heart disease.". A meta-analysis by Sofi et al. (2008) found clinically significant improvement in health status across several health risks including overall mortality. Despite this, these participants did not achieve high MEDAS scores on their habitual diets and had BMI greater than 25 kg/m².

4.5.4.2 Nutritional Knowledge

Participants demonstrated varying levels of understanding regarding the nutritional benefits of the Mediterranean diet. For example, Participant 2 from FG1 mentioned, "Understanding olive oil

recommendations," while Participant 6 from FG2 highlighted, "Everybody's kind of learning about it. And I thought that eating a tonne of protein or protein alone is you know doing me good." Wardle et al. (2000) asserted that nutrition knowledge aligned with intakes of fruit and vegetables, although with some sex linkage. Later research supports the relationship between nutritional knowledge and dietary habits in the UK and beyond (Vaudin et al. 2020; Edmonds et al. 2023; Onyenweaku et al. 2023). Enhancing public knowledge about MedDiet's nutritional benefits could promote better adoption and adherence especially for women.

4.5.4.3 Critical Analysis

In this theme, the focus groups appear to broadly align with the literature which highlights the health benefits of MedDiet. Enhancing public levels of nutrition knowledge about the nutritional benefits of MedDiet could improve adoption and adherence within the UK. Health education programs and educators should be grounded in evidence-based information to address common misconceptions and preconceptions about nutrition.

4.5.5 Integration and Synthesis

4.5.5.1 Cross-Theme Analysis

Identifying overlapping issues, such as how cultural factors influence both the challenges and the health benefits of adopting the Mediterranean diet, provides a more comprehensive understanding. For example, the role of communal meals can mitigate some of the practical challenges by providing social support for meal preparation. Additionally, the influence of social media and family dynamics intertwines with practical considerations and health motivations, suggesting that a holistic approach is necessary.

4.5.5.2 Theoretical Implications

Relating the findings to broader theoretical frameworks in nutrition and public health, such as social cognitive theory and the health belief model, enhances our understanding of dietary behaviour. The focus group findings contribute to existing theories by providing real-world insights into how social and cultural factors, combined with practical challenges, influence diet adoption.

4.5.6 Practical Recommendations

4.5.6.1 Policy and Practice

Given the recent increases in inflation discussed earlier, policies which address healthy food cost could make these foods more affordable and accessible. Public health initiatives should promote efficient meal preparation techniques and culturally sensitive dietary interventions.

4.5.6.2 *Community and Education*

Community programs that support communal eating and cooking can leverage social media for health promotion, providing reliable and evidence-based dietary information. Integrating family-based approaches and educational programs can promote healthier eating habits from a young age.

4.5.6.3 *Healthcare*

Healthcare providers play a crucial role in educating patients about the health benefits of the MedDiet. Developing clinical guidelines that incorporate cultural and social dimensions of dietary practices will enhance the effectiveness of dietary recommendations. Incorporating such nutrition education practices in prenatal care could improve family dietary choices, possibly reducing burdens on the NHS from NCDs.

4.5.7 *Conclusion*

In summary, the focus group findings, when integrated with existing literature, provide a comprehensive understanding of the challenges, cultural influences, and health impacts of participants' perceptions of adopting MedDiet. Addressing financial and time barriers, encouraging social support structures, and enhancing nutritional knowledge are key to promoting the diet more broadly. Future research should explore the long-term sustainability of MedDiet in the UK and countries outside the Mediterranean basin.

5 Combining quantitative and qualitative research

This research has sought to address and simplify the concepts surrounding the adoption of – and adherence to – MedDiet in the UK. In the systematic review, the included studies largely demonstrated augmentations to the default MedDiet. It may be inferred these modifications were specific to the study populations despite varying generalisability to the broader UK population. Modifications such as the ketogenic MedDiet suggest experimental interest in causality of benefits from MedDiet on specific outcomes, such as weight loss. While ketogenic diets seek to adapt from glucose to fat use, hypocaloric diets also featured highly in this review, both strategies seeking to develop starvation-motivated adaptations (Jain and Singh 2015; Petre et al. 2022).

Yet almost without exception, in these included studies, the less reductionist concepts such as hydration, sleep, conviviality and even lifestyle stressors are largely unreported or not considered (Tong et al. 2018). If the updated MedDiet pyramid, with its underpinning of these non-dietary components is reduced to purely a dietary intervention, such a diet might not be described as MedDiet. Nevertheless, the WPD in its many forms is highly prevalent in the UK among other Westernised countries. As previously described, the WPD with its many dietary deficiencies is highly detrimental to health. Rodríguez-Monforte et al. (2015) highlighted increased NCD risks from the WPD when compared with prudent dietary patterns (PDP); 31% ($R=0.69$), 17% ($R=0.83$), and 14% ($R=0.86$) reduction for respectively CVD, CHD, and stroke. This same study also finds non-significant risk elevation by 14% ($R=1.14$), 3% ($R=1.03$), and 5% ($R=1.05$) for WPD respectively in CVD, CHD and stroke. In this context, therefore, even the dietary components of MedDiet alone could be mechanistically expected to produce health benefits.

Yet such an artificial overlay of a traditional diet drawn from specific geographical and cultural context may sit poorly in alternate countries such as the UK. EVOO is an ideal example of this. Locally-produced EVOO in countries such as Italy, Greece and Spain, is highly prized especially for flavour. UK palates however may not be adjusted to such flavours (Andrewes et al. 2003). A further complication in the EVOO discussion is that of adulteration (Schwingshackl and Hoffmann 2015). Listed as the second most adulterated product on the food market, it is a highly desirable and profitable product for mixing and mislabelling with ongoing development of detection techniques (Ancora et al. 2021; Maestrello et al. 2022). Health benefits related to EVOO, and even its safety, rely on the processing being the very careful premium cold-pressing and not the solvent-based extraction of lesser olive oils (Lozano-Castellón et al. 2022). As focus participants expressed, EVOO in this is only

one example where the product consumed in Mediterranean countries, or even in well-controlled studies, may not represent the lived experience of broader UK population seeking to follow MedDiet.

Nutrient density in imported food may vary considerably, and with just-in-time provision the UK food chain itself is highly dependent on imports (Timlin et al. 2020). To meet this urgency, food products may be in transition or storage for highly variable times even before consumer timing of consumption. In the focus groups, the palatability of (largely) supermarket fruit and vegetables were poorly viewed in comparison to those freshly grown and consumed in Mediterranean countries. UK produce presents a challenge in terms of the migration of land from traditional farming to industrial farming and more biodiversity-focussed agriculture (Sam-Yellowe 2024). Topsoil erosion across many countries including the UK remains a significant threat to nutrient density (Bhardwaj et al. 2024). Nevertheless, the shorter food chain and higher controls within the UK provide promise of a quality product (Tong et al. 2016a).

Yet UK produce requires high-cost machinery, labour, and logistics compared to many imports. The participant perception of the cost of MedDiet, especially regarding EVOO and fresh produce, was far in excess of WPD foods (Dobрева et al. 2022). Additionally, supermarkets and the takeaways tend to favour pricing on larger portions of UPFs (Minelli and Montinari 2019). This was highlighted in the focus groups in the discussion about the options for lunch and the price of salads from takeaways. When price becomes an issue, consumers often look for calorific density first. This may be in part linked to a perception of calorific density being linked to satiation and satiety. Perception of these issues may be key to broader adoption of healthier MedDiet over WPD. Multiple included studies in this systematic review encouraged adoption using incentivisation. In the PREDIMED studies, provision of EVOO and/or nuts could be considered such (Sleiman et al. 2015). Clearly on a public health level, this would not be a viable option to encourage population-wide adoption. Whether this limits the incentivisation to populations which benefit the most is debatable, but such a choice appears not represent equality and equity. A better alternative might be to consider modification to MedDiet such that the perception and reality of MedDiet adoption is more acceptable to the diverse UK population (Hoffman and Gerber 2013).

Extrapolating the two parts of this thesis into this argument, the first concept is that of substitution. Taking EVOO as an example, a substitute of extra virgin rapeseed oil (EVRO) could offer a viable more-affordable choice with similar health benefits (Haigh et al. 2019). EVRO has equally, if not greater, beneficial MUFA/PUFA ratios although does lack some of the polyphenols (Hoffman and Gerber 2014). Replacing EVOO with EVRO would however practically lower the cost of MedDiet adoption. Similarly, many UK fruit and vegetables are discounted when in season. Seasonality

therefore offers another concept to reduce the cost of MedDiet (Giménez-Legarre et al. 2020). Eating seasonally would also provide a broader diet composition, potentially conferring nutrient variety, increased fibre consumption, and lower environmental footprint (Vargas et al. 2021; Barrett 2022).

The broader public, however, inevitably respond to product availability. Similarly supermarkets respond to consumer demand. This bi-directional dependency represents an incongruity in the food chain. If healthy products are simply not available, the remaining demand is for the UPF and other WPD components with negative health consequences (Elizabeth et al. 2020). This loop may become self-sustaining with both sides believing that this is the only option, especially in areas with poor supermarket access (Raine et al. 2018). Into this picture, supporting both business and consumers with education alone is unlikely to positively change consumer behaviour and supermarket availability, unless policy enables the broader food chain to take risks on provision of healthier foods (Krukowski et al. 2010). While relatively coercive, the sugar tax has sought to exemplify this, applying penalties to price points based on added free sugars (Hyseni et al. 2016). In turn, this motivated food development of lower sugar alternatives, potentially offering ways to drive behavioural change and reduce NCD incidence both through policy and through nudging (Liu et al. 2013). Sadly, recent research does appear to suggest several sweeteners to be equally detrimental to health, only in different ways, yet to be fully researched, to free sugars (Sabarathinam et al. 2023; Silva et al. 2023; Shil et al. 2024). Nevertheless, this policy has been successful in its stated goals which shows promise for well-considered interventions in public food choice often with consumer approval (Piekara 2022).

While specific nutrient and food policies may improve supermarket choice, the effect of these in highly obesogenic environments remains unclear (Congdon 2022; Phulkerd et al. 2022). Density of takeaways for example is invariably higher in areas of lower socioeconomic status (Maguire et al. 2015; Blow et al. 2019). This pattern disadvantages the most vulnerable. Low quality takeaway food combined with being time- and money-poor encourages high-calorie low-nutrient-density food options (Janssen et al. 2018). From the focus groups, the comparison about the high cost of a salad at a takeaway compared to other deep-fried options was made clear. Additionally, the further points about time to shop, prepare and cook healthy options being considerably greater than simply ordering a takeaway while engaged in other activities.

Nevertheless, concordance was evident in the groups with regards to the desirability of conviviality and the social aspects of eating. Positive effects both on choice and on enjoyment may present a highly effective motivator for positive behaviour change in diet (Phull et al. 2015; Torre-Moral et al. 2021). Given that MedDiet emphasises non-dietary components, the absence of them being reported and perhaps investigated is concerning. Participants in research often have vested interest

in the topic, perhaps due to the concept of being “worried well” or even because they have a personal motivator e.g. health condition (Sutherland et al. 2022). In this research, the absence of the non-dietary factors provides useful empirical beneficial evidence of MedDiet dietary components, yet this hardly seems disputed. Indeed, improving the MedDiet with further complexity (such as adding even more EVOO or nuts) may achieve specific health outcomes. Yet this strategy might be seen to merely increase the complexity of adopting and adhering to MedDiet for the broader public. Simplification of MedDiet, adaptation to individual food preferences, and cost-reduction methods may offer improvement in adoption, adherence, and subsequent concordance (Kowalkowska and Poínhos 2021). On this note, the need for an adapted, affordable, validated, and simplified UK MedDiet appears to be most pressing.

6 References

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Appendices

Appendix I List of databases

☐ MEDLINE Complete	2,860
☐ Academic Search Ultimate	1,008
☐ CINAHL Complete	737
☐ APA PsycInfo	598
☐ Environment Complete	144
☐ SPORTDiscus with Full Text	129
☐ Education Source	37
☐ SocINDEX with Full Text	28
☐ SocINDEX with Full Text	28
☐ APA PsycArticles	23
☐ Business Source Ultimate	19
☐ Library, Information Science & Technology Abstracts	12
☐ ERIC	8
☐ GreenFILE	6
☐ Communication Source	3
☐ Teacher Reference Center	2
☐ Hospitality & Tourism Complete	1



Faculty of Health and Social Sciences

FOCUS GROUP PARTICIPANTS NEEDED!

TOPIC: UK adaptation of the Mediterranean Diet

YOU COULD TAKE PART IF:

- 18-65 years old
- Body mass index over 25
- Able to attend online
- Not eating Mediterranean Diet already



TO VOLUNTEER AND MORE INFORMATION
lchester@bournemouth.ac.uk

Ethical approval granted by Bournemouth University Ethics Committee (Ethics ID: 51436)

Participant Information Sheet

The title of the research project

Developing an evidence-based and UK-adapted Mediterranean style diet for healthy sustainable eating in overweight/obesity.

Invitation to take part

You are being invited to take part in a research project. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part.

Who is organising/funding the research?

Leigh Chester (postgraduate researcher), Dr Paul Fairbairn, Dr Fotini Tsofliou, and Bournemouth University.

What is the purpose of the project?

This study is designing a UK adaption to the Mediterranean Diet, with consideration for sustainability and affordability. Characteristically, the Mediterranean diet favours olive oil, with a high intake of plant-based foods such as vegetables, fruits, nuts, legumes, and minimally processed cereals. Additionally, fish and seafood should be consumed at moderate-to-high levels, with low-to-moderate intake of dairy products and low intake of meat or meat products. Highly-processed foods are discouraged in this diet. This research is specifically interested in people with a body mass index greater than twenty-five. Focus groups are going to be used to ensure that the diet is realistic and achievable for UK adults to adopt and sustain. Groups of four to eight individuals will be guided through a series of questions about the Mediterranean Diet in general and then modifications which could make it easier to adopt and sustain in the UK.

Why have I been invited?

You have been selected for this study because you match the following requirements:

Inclusion Criteria: Participants are healthy individuals living in the UK, with a BMI (Body Mass Index) between 25.0-34.9kg/m², must be 18-50 years old, able to attend an online video meeting, and with a habitual diet which does not strongly match a Mediterranean Diet.

Exclusion criteria: Pregnant, diagnosed eating disorders or neurological conditions or sleep disorders, ongoing or beginning treatment for coronary heart disease or cardiovascular disease, presence of food allergies or intolerances, and following exclusionary diet patterns (defined as avoiding major food groups which belong to the Mediterranean Diet Pyramid).

Do I have to take part?

It is up to you to decide whether to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a participant agreement form. We want you to understand what participation involves before you decide whether to participate.

If you or any family member have an on-going relationship with BU or the research team, e.g. as a member of staff, as student or other service user, your decision on whether to take part (or continue to take part) will not affect this relationship in any way.

Can I change my mind about taking part?

Yes, you can stop participating in study activities at any time and without giving a reason. Participants may withdraw from the focus group session at any time. Additionally, requests to withdraw from the study, or for data to be withdrawn from the study, should be sent by email to the researcher lchester@bournemouth.ac.uk prior to anonymisation.

If I change my mind, what happens to my information?

After you decide to withdraw from the study, we will not collect any further information from or about you.

As regards to the information we have already collected before this point, your rights to access, change or move that information are limited. This is because we need to manage your information in specific ways for the research to be reliable and accurate. Further explanation about this is in the Personal Information section below.

What would taking part involve?

Upon expression of interest to participate in the study, you will be asked to answer some questions, using a provided survey link, related to your current eating habits to verify that you do not follow a Mediterranean-style diet and to establish eligibility. This would be expected to take 5-10 minutes to complete. The participation agreement form will be signed electronically to confirm inclusion in the study. Subsequently, an online meeting will be organised to facilitate a group discussion on the Mediterranean Diet, its possible adaption for the UK, barriers to adoption, and suggestions and ideas to improve both the diet and its acceptability. Between 4 and 8 participants will be invited to attend one Microsoft Teams meeting at a convenient time, facilitated by trained and qualified researchers. Use of video during the sessions is entirely voluntary. Some general questions about the Mediterranean Diet will be used to guide the group discussion. These will include existing impressions about this diet, views and suggestions on the adaption, and queries on the implications of adopting the diet. These online sessions are expected to last for between 30 and 45 minutes to enable views to be expressed. The group discussions will be transcribed and analysed for common themes according to thematic analysis by Braun and Clarke. Transcriptions and recordings of the group meetings will be deleted following the analysis.

Will I be reimbursed for taking part?

There will be no incentivisation during this study. You will not be reimbursed for taking part.

What are the advantages and possible disadvantages or risks of taking part?

Whilst there are no immediate benefits to you participating in the project, it is hoped that this work will further the development of a UK adaption to the Mediterranean Diet.

Whilst we do not anticipate any risks to you in taking part in this study, you may experience a range of views and opinions in a focus group which could be different to your own.

What type of information will be sought from me and why is the collection of this information relevant for achieving the research project's objectives?

Existing knowledge of the Mediterranean Diet

Possible benefits of adopting this diet and lifestyle pattern

Views on the adaptations to the Mediterranean Diet

Comparison of the suggested diet to existing diet pattern

Perceived motivations to pursue a healthy lifestyle

Perceptions about food preparation for the adapted diet

Perceptions about the cost of the adapted diet

Current methods of finding and accessing information about diet and lifestyle

Perceptions about healthy eating resources and their helpfulness

Additional views will be welcome and will enrich the research.

Will I be recorded, and how will the recorded media be used?

The focus group meetings will be recorded. The audio recordings of your activities made during this research will be used only for analysis and the transcription of the recording(s) for illustration in conference presentations and lectures. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings. Once the analysis has been completed and verified, the recording and transcriptions will be deleted.

How will my information be managed?

Bournemouth University (BU) is the organisation with overall responsibility for this study and the Data Controller of your personal information, which means that we are responsible for looking after your information and using it appropriately. Research is a task that we perform in the public interest, as part of our core function as a university.

Undertaking this research study involves collecting and/or generating information about you.

We manage research data strictly in accordance with:

- Ethical requirements; and
- Current data protection laws. These control use of information about identifiable individuals, but do not apply to anonymous research data: “anonymous” means that we have either removed or not collected any pieces of data or links to other data which identify a specific person as the subject or source of a research result.

BU's [Research Participant Privacy Notice](#) sets out more information about how we fulfil our responsibilities as a data controller and about your rights as an individual under the data protection legislation. We ask you to read this Notice so that you can fully understand the basis on which we will process your personal information.

Research data will be used only for the purposes of the study or related uses identified in the Privacy Notice or this Information Sheet. To safeguard your rights in relation to your personal information, we will use the minimum personally-identifiable information possible and control access to that data as described below.

Publication

You will not be able to be identified in any external reports or publications about the research without your specific consent. Otherwise your information will only be included in these materials in an anonymous form, i.e. you will not be identifiable.

Security and access controls

BU will hold the information we collect about you in hard copy in a secure location and on a BU, password protected secure network held electronically.

Personal information which has not been anonymised will be accessed and used only by appropriate, authorised individuals and when this is necessary for the purposes of the research, or another purpose identified in the Privacy Notice. This may include giving access to BU staff or others responsible for monitoring and/or audit of the study, who need to ensure that the research is complying with applicable regulations.

Further use of your information

The information collected about you may be used to support other research projects in the future and access to it will not be restricted. You will not be able to be identified in the data without your specific consent. To enable this use, the data will be added to an appropriate research data repository such as BORDaR (BU's Data Repository); [this is](#) a central location where data is stored, which is accessible to the public.

Keeping your information if you withdraw from the study

If you withdraw from active participation in the study, we will keep information which we have already collected from or about you, if this has on-going relevance or value to the study. This may include your personal identifiable information. As explained above, your legal rights to access, change, delete or move this information are limited as we need to manage your information in specific ways in for the research to be reliable and accurate. However if you have concerns about how this will affect you personally, you can raise these with the research team when you withdraw from the study.

You can find out more about your rights in relation to your data and how to raise queries or complaints in our Privacy Notice.

Retention of research data

Project governance documentation, including copies of signed **participant agreements**: we keep this documentation for a long period after completion of the research, so that we have records of how we conducted the research and who took part. The only personal information in this documentation will be your name and signature, and we will not be able to link this to any anonymised research results.

Research results:

As described above, during the study we will anonymise the information we have collected information from you as an individual. This means that we will not hold your personal information in identifiable form after we have completed the research activities.

You can find more specific information about retention periods for personal information in our Privacy Notice.

<https://www.bournemouth.ac.uk/about/governance/access-information/data-protection-privacy/research-participant-privacy-notice>

We keep anonymised research data indefinitely, so that it can be used for other research as described above.

Contact for further information

If you have any questions or would like further information, please contact lchester@bournemouth.ac.uk at any time.

In case of complaints

Any concerns about the study should be directed to Dr Fotini Tsofliou ftsofliou@bournemouth.ac.uk or Dr Paul Fairbairn pfairbairn@bournemouth.ac.uk. If your concerns have not been answered, you should contact Professor Jane Murphy the Deputy Dean

for Research & Professional Practice in the Faculty of Health and Social Sciences at Bournemouth University by email to researchgovernance@bournemouth.ac.uk.

Finally

If you decide to take part, you will be given a copy of the information sheet and a signed participant agreement form to keep.

Thank you for considering taking part in this research project.



Participant Agreement Form

Full title of project: Developing an evidence-based and UK-adapted Mediterranean style diet for healthy sustainable eating in overweight/obesity

Name, position, and contact details of researchers and supervisors:

Leigh Chester, lead researcher, lchester@bournemouth.ac.uk

Dr Paul Fairbairn, supervisor, pfairbairn@bournemouth.ac.uk

Dr Fotini Tsofliou, supervisor, ftsofliou@bournemouth.ac.uk

To be completed prior to data collection activity

Section A: Agreement to participate in the study

You should only agree to participate in the study if you agree with all of the statements in this table and accept that participating will involve the listed activities.

I have read and understood the Participant Information Sheet and have been given access to the BU Research Participant Privacy Notice which sets out how we collect and use personal information (https://www1.bournemouth.ac.uk/about/governance/access-information/data-protection-privacy).
I have had an opportunity to ask questions.
I understand that my participation is voluntary. I can stop participating in research activities at any time without giving a reason and I am free to decline to answer any <u>particular question(s)</u> .
I understand that taking part in the research will include the following activity/activities as part of the research: • Joining an online focus group meeting • Sharing existing views, knowledge, and opinions on the Mediterranean Diet • Providing views, suggestions, and opinions related to adapted Mediterranean Diet • Having the participation recorded and transcribed • Filling out an eligibility questionnaire
I understand that, if I withdraw from the study, I will also be able to withdraw my data from further use in the study except where my data has been anonymised (as I cannot be identified) or it will be harmful to the project to have my data removed.
I understand that my data may be included in an anonymised form within a dataset to be archived at an appropriate research data repository such as <u>BORDaR</u> (BU's Data Repository).

	Initial box to agree
I consent to take part in the project on the basis set out above (Section A)	

Name of participant
(BLOCK CAPITALS)

Date
(dd/mm/yyyy)

Name of researcher
(BLOCK CAPITALS)

Date
(dd/mm/yyyy)

Further use of your information

The information collected about you may be used in an anonymous form to support other research projects in the future and access to it in this form will not be restricted. It will not be possible for you to be identified from this data. To enable this use, anonymised data will be added to BU's [Data Repository](#); this is a central location where data is stored, which is accessible to the public.

Appendix V Ethics approval



Online Ethics Checklist - OEC

About The Online Ethics Checklist

General Guidance

At BU, all research is subject to appropriate ethical reflection, leading if necessary to a formal ethics review.

Apply for a formal ethics review before commencing your research activities by completing the online ethics checklist.

Information about applying for a formal ethics review can be found on the [Research Governance & Integrity website](#).

To start, please click 'Create New'

If you encounter any problems whilst using this system then please email researchethics@bournemouth.ac.uk.

Create New

My Checklist Dashboard

Show entries Search:

Ethics ID	Project Name	Risk	Status	Checklist	Feedback	View/Edit	Delete	Amendment
51436	Focus	Low	Approved					

Appendix VI Online questionnaire and MEDAS detail

The online questionnaire provided the Participant Information Sheet and the Participant Agreement Form before requesting consent to continue. The subsequent pages requested age, height, weight, and then proceeded to ask the questions detailed below, adapted from Shannon et al. (2019).

Supplementary Table 1: Components and scoring of the MEDAS and MEDAS Continuous Mediterranean diet adherence scales

Food component	Contributing foods from the EPIC-Norfolk food frequency questionnaire	MEDAS ¹ Servings required for 0 points	Servings required for 1 point	MEDAS Continuous ² Servings required for 0 points	Servings required for 1 point
Olive oil ³	Main fat used for frying? Main fat used for baking?	Non-consumption <4 tbsp/d	Consumption ≥4 tbsp/d	Non-consumption 0 tbsp/d	Consumption ≥4 tbsp/d
Olive oil ³	Based on standardised recipe quantities for fat/olive oil associated with FFQ items AND answer to main fat question where relevant				
Vegetables ^{3,7}	Vegetable soup, ketchup, pickles, carrots, spinach, broccoli/ sprint greens/ kale, sprouts, cabbage, marrow/ courgettes, cauliflower, parsnip/ turnip/ swede, leeks, onions, garlic, mushrooms, peppers, green salad/ lettuce/ cucumber/ celery, beansprouts, green beans/ broad beans/ runner beans, watercress, tomatoes, sweetcorn, beetroot, coleslaw, avocado	<2/d (and/or not including 1/d raw or salad)	≥2/d (including ≥1/d raw or salad)	0/d	≥2/d (including ≥1/d raw or salad)
Fruit ³	Apples, pears, oranges/satsumas/mandarins, grapefruits, bananas, grapes, melon, peaches/plums/apricots, strawberries/raspberries/kiwi, tinned fruit, fruit from pies/ tarts, fruit juice	<3/d	≥3/d	0/d	≥3/d
Red meat ⁴	Beef, pork, lamb, beefburgers, red meat soups (e.g. oxtail), bacon, ham, corned beef, sausages, savoury pie, liver, lasagne	>1/d	<1/d	≥2/d	<1/d
Butter, margarine or cream ⁴	Single cream, double cream, butter, low fat spread	>1/d	<1/d	≥2/d	<1/d
Sweetened or carbonated drinks ⁴	Fizzy soft drinks, fruit squash/ cordial	>1/d	<1/d	≥2/d	<1/d
Wine ³	Wine	<7/wk	≥7/wk	0/wk	≥7/wk
Legumes ³	Peas, baked beans, dried lentils/ beans/ peas	<3/wk	≥3/wk	0/wk	≥3/wk
Seafood ³	Fried fish, fish fingers/fish cakes, white fish, oily fish, shellfish, fish roe/taramasalata	<3/wk	≥3/wk	0/wk	≥3/wk
Sweets or pastries ⁴	Chocolate biscuits, plain biscuits, readymade cakes, readymade buns/ pastries, readymade fruit pies, readymade sponge, milk puddings, ice cream, chocolates, chocolate bars, sweets/ toffees/ mints	>2/wk	<2/wk	≥4/wk	<2/wk
Nuts ³	Nuts, peanut butter	<3/wk	≥3/wk	0/wk	≥3/wk
White meat ⁴	Chicken and other poultry, white meat soups (e.g. chicken)	Less white meat than red meat	More white meat than red meat	Less white meat than red meat	More white meat than red meat
Sofrito ³	Lasagne	<2/wk	≥2/wk	0/wk	≥2/wk

¹Scoring for the MEDAS scale was calculated according to the methods detailed by Martinez-González et al. (2012). A score of 1 point was awarded if participants achieved a dietary target. Otherwise, participants were awarded 0 points. ²Scoring for the MEDAS Continuous scale used the same dietary components as the standard MEDAS scale. However, rather than awarding points on a binary basis, points were awarded continuously based on linear equation principles ($y = ax+b$, where y is the number of points scored between 0 and 1, a is the slope and b is the intercept). ³A high intake of olive oil, vegetables, fruit, wine, legumes, seafood, nuts, and sofrito was recommended. For the

Appendix VII Coding first focus group

Quote	Code
"Can I ask a question please? So you said recommended seven spoonfuls of olive oil..."	Understanding olive oil recommendations
"I think supermarkets and stuff to some extent capitalised on this whole idea of healthy eating in Mediterranean."	Perception of Mediterranean diet costs
"Whereas if you go to somewhere very Mediterranean...it will just be very available."	Accessibility of fresh produce
"A lot of vegetables have been picked months and months ago and then they're just frozen."	Quality of vegetables in the UK
"There is very little options...there's a sandwich available...there's some crisps..."	Limited healthy fast food options
"I would agree with push points so far. About the quality...trying to replicate the diet outside of the Mediterranean..."	Replicating diet outside Mediterranean
"I don't eat a lot of red meat myself."	Personal dietary preferences
"People in the Western world...are very lazy...40 hour work weeks..."	Cultural differences in eating habits
"I lived in Spain for a few years...you'd go to a Spanish friend's house...dinner with the whole family."	Cultural importance of communal meals
"I think it's expensive. Money is currently the biggest barrier."	Financial barriers to following the diet
"They eat what is in season now. So freshness is because that's what's available and cheaper."	Seasonal eating practices
"I've just visited Croatia...a lot of the freshness is because they're picking from their gardens..."	Personal experiences with fresh produce
"I think I would agree with push points so far. About the quality I sort of wonder if trying to replicate the diet outside of the Mediterranean..."	Quality differences between regions
"There is very little options...there's a sandwich available...there's some crisps and that fizzy drink..."	Limited healthy fast food options

"People don't spend time and people don't appreciate sort of the whole concept of eating or creating meals."	Lack of time for meal preparation
"I think it's expensive. Money is currently the biggest barrier."	Financial barriers to following the diet
"I would say what I've said before...just it's expensive."	Cost concerns
"I've noticed that you would go to a Spanish friend's house...eat with the whole family and it's a whole thing..."	Communal eating habits
"I've just visited Croatia...a lot of the freshness is because they're picking from their gardens..."	Personal experiences with fresh produce
"I think it's just about research...it's all about research."	Importance of research for diet
"Speaking as Gen Zed...there is a lot of access now to people who can show that they've got good results..."	Influence of social media
"I think generally the younger generation is starting to learn the basic principles of nutrition and healthy eating."	Young people's nutrition awareness
"Traditionally they have been. So like women now don't have that much time women are doing similar things to men and same and more. And so yeah no one's got time for food and no one's prioritising food."	Gender roles and time constraints
"I think there's lots of different ways of achieving cost effective cooking and one of the things we've done is we've gone more for the quality of the meat and fish and eat less of it and have more vegetables."	Strategies for cost-effective healthy eating
"I have to say though, with the cost of living going up, it's hard to keep up with eating healthy all the time."	Impact of cost of living on diet
"One of the main reasons I stick to the Mediterranean diet is because of my family history with heart disease."	Personal health motivations

Appendix VIII Coding from second focus group

Quote	Code
"The benefits that it has really"	Perceived benefits of the diet
"I think the ratios of the different food types is quite interesting."	Interest in food balance ratios
"I think I'll be able to do it but the thing I think I'll struggle probably the most with is when it comes to reducing like sweets."	Struggle with reducing sweets
"Where I can fall away is when I'm very very short of time or running late..."	Time constraints
"Mediterranean diets and that is a lot of they don't always just stick with the one the one plate of foods..."	Variety in Mediterranean meals
"It is really expensive to get local things here"	Cost of local products
"It is all about the freshness of the product."	Importance of fresh products
"My current motivations for following a healthy lifestyle and eating pattern like this diet?"	Motivations for healthy eating
"I had to make a serious life change about 18 months ago and lose a significant amount of weight."	Personal health journey
"I am very vitamin deficient especially in like an iron."	Vitamin deficiencies
"If you make these meals then is it still as healthy to freeze it?"	Concerns about meal prep and freezing
"It's relatively easy doing it over here. You just got to get the right spices..."	Adaptability of the diet
"I have my friend she's Portuguese and I think that even the style of food is very Mediterranean."	Cultural influences
"It just makes a bit of fun as well."	Social aspects of cooking
"You can just incorporate it gradually"	Gradual diet incorporation
"I think the most expensive thing would probably be like olive oil as well."	Cost of olive oil
"There is a difference in the pure olive oil...then you could from the shop and I bought it over there..."	Quality of olive oil

"If you were to adopt...they get used to that or don't eat."	Family acceptance of diet changes
"I find our children etc they are so much better educated about food that actually it's not a battle so much to get them to eat healthier..."	Children's education about healthy eating
"There is a lot of people out there that give out the wrong information to people."	Misinformation about diets
"I was just talking to a good friend the other day and and I was saying that when I want to really focus on the diet I want to focus on the weight loss."	Focus on weight loss over nutrition
"It's like you know I'm not gonna be a size 12 in two weeks if I you know drink this lemon juice..."	Unrealistic diet expectations
"Everybody's kind of learning about it. And I thought that eating a tonne of protein or protein alone is you know doing me good."	Misconceptions about protein intake
"One of the things that really motivated me was seeing the impact on my friend's health after she switched to a Mediterranean diet."	Influence of others on dietary choices
"I always think about the sustainability aspect as well, you know, is this diet good for the environment?"	Sustainability concerns
"The shared meals aspect is what I find most appealing about the Mediterranean diet."	Appeal of shared meals

Appendix IX Sample transcript

so what are your thoughts on following the Mediterranean diet?

Speaker 3 2:43

Think I've thought this, if you don't mind, I think so sort of living in, say, a foreign country away from the Mediterranean, I think supermarkets and stuff, to some extent capitalised on this whole idea of healthy eating in Mediterranean. So for example, buying olive oil is probably at least double the amount it is to buy normal sunflower oil or vegetable oil. So I think there's a premium associated with this sort of healthier, fancy foreign lifestyle. So I think that's definitely one barrier for me personally are following it, especially as a student, there are some huge financial constraints with that. Whereas if you go to somewhere very Mediterranean say a local village in Italy, it will just be very available to you as it's just sort of what everyone has, to some extent. So I think it's definitely a bit of a culture thing that impacts our ability to, to have it.

Researcher 3:47

Okay, and would that extend to the vegetable side as well? Do you think? Yeah,

Speaker 3 3:52

so it's, well, what I've sort of noticed in England and stuff like that, a lot of the vegetables have been picked months and months ago. And then they're just frozen. And I'm sure most of us are aware of freezing stuff, it loses especially in terms of vegetables, and it loses, its almost given diminishes in value of nutrition, and some of those key vitamins and things like that, that are needed in sort of a Mediterranean diet. Whereas Mediterranean diet, the tomatoes that you're eating were probably pick two hours ago off of someone's farm that's at the bottom of a volcano. So this is it. Right? It's so the quality of food. It's not I think the quantity of food in the UK and other western society is there. We have the same if not more as some of these other Mediterranean places. But the quality I think is the crucial aspect in this.

Researcher 4:49

All right, excellent.

Anyone else want to contribute on that question? Your thoughts on following the Mediterranean diet?