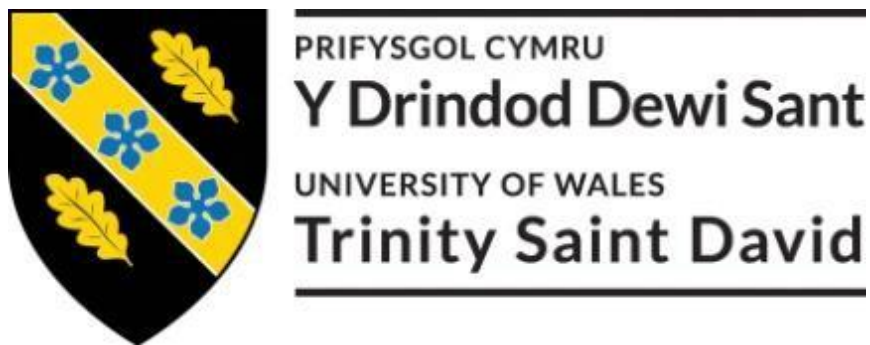




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Submitted in partial fulfilment for the award of the degree of Master's
of Science in Sports and Exercise Nutrition at the University of Wales
Trinity St David

**‘Do demographic characteristics such as gender, age or physical
activity status influence nutritional knowledge and practices in
the UK population?’**

DECLARATION FORM



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1. This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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ABSTRACT

The prevalence of obesity is ever-increasing in the United Kingdom, with the causes of this epidemic being multifactorial. The relationship between nutritional intake and health status has been widely researched, with improved dietary intakes associated with greater health outcomes and lower incidence of disease. The aim of this study was to evaluate the nutritional knowledge and nutritional practices of the UK population and assess whether demographic characteristics such as gender, age and physical activity status influence nutritional knowledge and practices. This research was a cross-sectional study, carried out via opportunistic sampling. The General nutritional knowledge questionnaire was used to assess the nutritional knowledge of the participants and three-day food record diaries were obtained from a small group of respondents to analyse dietary intakes and practices. Total questionnaire scores were encouraging, with an average score of 74%. Gender and physical activity status did not influence nutritional knowledge scores, although, scores did increase with age. People who are physically active were more likely to consume a higher quality diet despite there being no difference in nutritional knowledge. Dietary quality was significantly improved in the active participant group, with higher intakes of fruit, vegetable and fibre observed. BMI did not influence questionnaire scores or nutritional intake. Current health initiatives are therefore likely reaching all population groups in equal measure, with no difference observed in nutritional knowledge or nutritional intake between population groups. Future studies should look to compare the direct relationship between nutritional knowledge and nutritional practices in individuals.

Key words: nutritional knowledge, healthy eating, obesity, exercise

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LIST OF ABBREVIATIONS

BMI – Body mass index

BNF – British Nutrition Foundation

DOH – Department of Health

DRV – Dietary reference values

GNKQ – General nutritional knowledge questionnaire

NDNS – National Diet and Nutrition Survey

NHS – National Health Service

PE – Physical education

PHE – Public Health England

SDT – Self-determination theory

WHO – World Health Organisation

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Chapter 1 Introduction

Consuming a healthy balanced diet is crucial for maintaining good health and helping to protect against noncommunicable diseases such as heart disease, diabetes, and cancer (WHO, 2020). Eating a healthy diet involves eating a wide variety of foods as well as consuming these foods in the correct quantities to meet nutritional needs and to achieve and maintain a healthy body weight (NHS, 2022).

Nutritional recommendations are published regularly, as is information aimed to help people understand the links associated with diet and disease. Public Health England (PHE) published one of the most known tools called ‘The Eatwell Guide’ to provide a visual representation of the UK Government guidelines on healthy eating (PHE, 2016). The guide is being continuously updated to improve the presentation for easy use and to comply with updated guidelines. The Eatwell guide is split into groups – fruit and vegetables, starchy carbohydrates, protein from meat, fish, and legumes, dairy products, unsaturated oils and spreads. With added notes to eat high-fat, high-sugar foods less often and to drink 6-8 glasses of water per day (Office for Health Improvement and Disparities, 2016). Exact nutritional requirements will vary, depending on an individual's characteristics such as age, gender, lifestyle, health conditions and physical activity status. Although, the principles of what constitutes a healthy diet remain the same (WHO, 2020). Important healthy dietary practices change throughout different stages of life. Examples include; breastfeeding in infancy to promote healthy growth, adolescents require sufficient energy to develop throughout puberty, and the elderly population often require additional energy, calcium and vitamin D to prevent malnutrition and osteoporosis. Following healthy eating guidelines and consuming a healthy diet throughout life helps to prevent non-communicable diseases. (Maggini et al., 2018).

The relationship between nutrition and various health issues has been observed for decades and the World Health Organisation draws attention to the fact that a sedentary lifestyle and consumption of unhealthy diets are directly related to various diseases such as cardiovascular disease, cancer and diabetes (WHO, 2011). Unhealthy diets and a lack of physical activity are observed amongst the UK population and are leading to increased risks to health. The increase in production of processed foods, rapid urbanization and changes in lifestyles have resulted in dietary pattern changes. This has resulted in people often consuming larger quantities of unhealthy, high-energy, high-fat, sodium and sugar foods, with a reduction in the consumption of healthy foods including fruit and vegetables and dietary fibre (WHO, 2022). The inflammatory effects of an unhealthy diet high in saturated fats, such as those of typical Western diets, have been observed to have detrimental effects on brain health resulting in cognitive decline and hippocampal dysfunction (Köhler-Forsberg et al., 2019). The leading causes of heart disease and strokes are high blood pressure and high cholesterol, both of which are exacerbated by high sodium levels and unhealthy diets (National Centers for Disease Control and Prevention,

2022). Fruit and vegetables are high in vitamins, minerals and fibre and should contribute to over a third of the food eaten a day. There is evidence that individuals who consume at least 5 portions of fruit and vegetables a day have a reduced risk of heart disease, stroke and some cancers (NHS, 2022).

The relationship between nutrition and mental health is also a topic of particular interest in research in recent years. Epidemiological research has observed that healthy diets, particularly Mediterranean dietary patterns, are associated with a reduced risk of depression and anxiety, due to the removal of the frequent, rapid increases and decreases in blood glucose levels (Firth et al., 2020). A meta-analysis found that even in healthy subjects without diagnosed depression, high intakes of refined carbohydrates and high glycaemic load in controlled settings still increased the incidence of depressive symptoms with moderate to large effects (Salari-Moghaddam et al., 2018). Although the nature of this relationship is complex due to the multidirectional relationship between mental health and diet. Mood can affect our food choices including forms of comforting eating as well as dietary intakes effecting our mood (Lassale et al., 2018).

Most people in the UK overeat and consume unhealthy diets, resulting in increasing rates of obesity and rising rates of comorbidities (The Food Foundation, 2022). ‘Obesity’ is defined as a body mass index (BMI) of 30 or above and a BMI of 25-30 is classified as ‘Overweight’. Obesity is a condition of increased adiposity, resulting from a positive energy balance over a long period of time caused by increased calorie intake and low levels of physical activity. The Health Survey for England (2021) estimates that 25.9% of the adult population in England is obese, with an additional 37.9% being overweight. Over the past few decades, rates of overweight and obesity have been increasing exponentially, with the number of individuals in the UK population who are overweight increasing from 55% in 1993 to 64% in 2019. These increases occurred rapidly between 1992-2001 and there has been a more gradual increase in subsequent years (Health Survey for England, 2022). Data gathered as part of the National Child Measurement Programme published by the NHS found that 10.1% of reception-aged children were obese and a further 12.1% were overweight in the 2021 academic year. These figures increased to 23.4% being obese and 14.3% being overweight at year 6 age (NHS, 2023). Health survey for England identified that mean BMI was found to increase with age from 8% of adults aged 16-24 having a BMI classified as obese, to 32% of adults aged 65-74. Overall the highest prevalence of obesity rates is found amongst adults between the ages of 45-74. Although, BMI is then seen to decrease in 26% of those aged over 75 years presenting as overweight. There is also a greater incidence of obesity in the male population than women, 69% and 59% respectively.

Obesity is a major public health problem in the UK and globally, and the financial burden of obesity and related illnesses is well recognised (Department of Health and Social Care, 2020). Obesity costs the UK government approximately £74 billion every year in direct costs to the NHS, loss of

workforce and reduced life expectancies (The Food Foundation, 2022). This cost is continuing to increase with over 1 million hospital admissions in 2021 related to obesity alone, an increase of 17% since 2018 (NHS, 2021). In recent years medical costs required for the treatment and management of diabetes alone have almost doubled (Whicher et al., 2020). This demonstrates that the global emergence of obesity is becoming as much an economic issue as it is a health issue.

Improving dietary habits is a societal issue not solely an individual issue, particularly in Western societies, and therefore needs to be addressed nationally (WHO, 2024). Tackling obesity in the UK is one of the greatest challenges of long-term health faced by the NHS and the government. It is not possible for a society consisting of individuals living unhealthy lifestyles and consuming inadequate diets to continue to live healthily, perform basic functions, and develop its economy and social prosperity (Hakli et al., 2016).

However, research assessing the public's understanding of nutritional advice has not been encouraging. Therefore, improvements in nutritional knowledge and nutritional practices are fundamental for improving the overall health of the nation. The Broken Plate report highlights the damaging effects resulting from poor nutrition, leading to increased immediate complications of obesity including stunted growth and increased accounts of amputations. The Broken Plate provides a strong argument for change to national policies, to give all UK citizens access to healthy diets and prevent further increases in rates of obesity (The Food Foundation, 2022).

To combat the obesity crisis and reduce obesity-related chronic diseases, increasing individuals' nutritional knowledge and improving dietary practices is crucial. The purpose of the current study is to evaluate the nutritional knowledge of individuals with various demographic characteristics using the General Nutritional Knowledge Questionnaire (GNKQ). As well as to determine demographic differences in eating behaviours by conducting full dietary evaluations to assess the nutritional quality of their diets and to determine whether certain healthy behaviours are related to each other.

Research question: Do demographic characteristics such as gender, age or physical activity status influence nutritional knowledge and practices in the UK population?

This study aims to evaluate the nutritional knowledge and nutritional practices of the UK population.

Chapter 2 **Literature review**

There is a strong correlation between nutrition and health-related outcomes. Understanding the level of nutritional knowledge in the UK population, as well as current dietary practices and the impact that these factors have on each other is vital in helping to combat the obesity epidemic and subsequently lead to healthier populations.

2.1 Current nutritional knowledge

Studies have observed that increased nutritional knowledge leads to better nutritional practices and healthier food choices, with reduced nutritional knowledge being associated with the development of unhealthy eating behaviours and various health complications. However, this is a complex relationship, as the nutritional quality of a diet is not only impacted by an individual's knowledge but can also be influenced by the interactions of many demographic and environmental factors, such as food cost and availability (Wardle et al., 2000).

Previous research investigating the nutritional knowledge of the UK population found that on average participants scored 75.6% in the ratified GNKQ. The study also found that after participants had received an online written information intervention their scores in the questionnaire significantly improved for all sections of the questionnaire except for healthy food choice (Kliemann et al., 2016). Factors including; age, sex, level of education and socio-economic status are well known to influence nutritional knowledge (Parmenter et al., 2000). Multiple studies identified higher levels of nutritional knowledge in female participants compared with males. The same studies also found that women were more open to making dietary changes than men and paid more attention to government health initiatives (Girois et al., 2001; Grunert et al., 2010). It is thought that nutritional knowledge is higher in women due to their typically more prominent role in the responsibility for the nutrition of family members, with higher numbers of women purchasing, preparing and cooking meals in comparison with men (Taillie, 2018). Research investigating the correlation between nutritional knowledge and age has not been conclusive, with some studies observing a positive increase in nutritional knowledge with age and stating that young adults need greater education about nutrition (De Vriendt et al., 2009). On the other hand, another study showed that nutritional knowledge increased with age but only up to 30-49 years of age being the most nutritionally aware, but this increase in knowledge is not seen after this (Hakli et al., 2016). It is therefore important for participants of all ages to be included in research and requiring participants to select an age range in the demographic criteria will help to better ascertain a correlation between knowledge and age. The level of nutritional knowledge in those under the age of 18 years is not currently researched, and participants under 18 will not be included in the study. Due to the evidence demonstrating the relationship between obesity in childhood and obesity in later life, it would be

beneficial for future research to assess the nutritional knowledge of adolescents. This would help to identify areas for improvement in education systems to help prevent unhealthy eating behaviours and increased incidences of obesity in future generations (Simmonds et al., 2015). Socio-demographic factors such as educational status and marital status have been found to affect nutritional knowledge and eating behaviours (De Vriendt et al., 2009). Individuals with a higher educational level or socio-economic status are typically more aware of healthy eating practices (Grunert et al., 2010).

Research has continued to demonstrate that participating in weight loss programs does not have long-term positive outcomes, with the majority of individuals regaining the weight lost when ending the program. In a weight-loss-centered approach to health, thinness is viewed as the optimum goal for improved health (Cogan & Ernsberger, 2002). Unfortunately, this common approach to dieting leads to poorer health outcomes, with nutritional knowledge and the nutritional quality of foods being overlooked. Although multiple factors contribute to the prevalence of obesity, associations between improved nutritional knowledge and improved dietary behaviours have been identified. Improved nutritional knowledge influences not only food choices and consumption but also individuals' perceptions of what a healthy diet entails (Mete et al., 2019). Therefore, improving an individual's knowledge of healthy eating is a vital component in encouraging healthier eating behaviours in the UK population and ultimately tackling the obesity crisis.

A study by Mills (1999) hypothesised that perhaps the failure to change to healthier eating behaviours was due to individuals not having adequate knowledge of the health effects of dietary changes and not perceiving a great enough health benefit to make the change. However, these findings are not supported by a Pan-EU study which concluded that the majority of individuals understood that healthier diets lead to the prevention of disease and helping to control a healthy body weight (Margetts et al., 1997). The study did however find that over 70% of participants believed that their diets were already healthy enough and therefore did not adhere to government health recommendations. This conflicts with evidence found in the National Diet and Nutrition Survey (2014), which stated that only 27% of adults consume the recommended five portions of fruit and vegetables per day (NDNS, 2014). Therefore this suggests that despite the government's efforts on producing healthy eating guidelines, this has not yet coordinated a mass change in behaviour.

Health and nutrition guidelines have been developed in many countries to prevent chronic disease and to stunt increasing rates of obesity. Despite the development of policies and guidelines, it is clear that recommendations have not influenced dietary practices (Ayyıldız et al., 2023). Education on nutrition is widespread within schools and government health promotion agencies aiming to deliver messages to improve nutritional intake in the UK population (Spronk et al., 2014). Most members of the public are exposed to education on dietary guidelines and specific educational resources to prevent and manage

lifestyle-related diseases are widely available on government and NHS websites (Broad & Wallace, 2018). Studies have demonstrated that more in-depth nutritional education is effective in increasing the degree of nutritional knowledge in the general population. Therefore emphasising that growing rates of obesity and poor nutritional knowledge is a national issue and requires government interventions to improve education to subsequently improve nutritional knowledge of the population in a way that can be operationalised in practice.

2.2 General nutritional knowledge questionnaire

The tool often used to assess nutritional knowledge is the General Nutritional Knowledge Questionnaire (GKNQ). This questionnaire was developed and validated for the UK population in the 1990s and has since been widely used throughout studies investigating populations' nutritional knowledge. The GKNQ scores can be used reliably as a whole or by analysing independent sections separately (Trakman et al., 2017). The use of this self-administered questionnaire including only closed questions provides multiple benefits for use in research. For example, research has shown that questionnaires involving tick-box answering sections allow participants to answer spontaneously, whilst removing the complication of leading questions or suggesting responses (Bailey et al., 2015). A previous study has identified increased scores in the GKNQ from students studying nutrition compared with their counterparts (Kliemann et al., 2016). This suggests the accuracy of the questionnaire in determining nutritional knowledge whilst also emphasising the importance of the exclusion of nutrition and dietetic student or health professionals in the research sample. Conducting the GKNQ online allows participants to maintain their anonymity as well as reduce additional expenses and resources required to print and distribute the questionnaires physically. However, a limitation of completing the GKNQ online would be that participants could have access to the internet to research any answers (Ball, 2019). Strategies to mitigate this limitation include advising participants on the information page that the questionnaire must be completed independently and without the use of external information to determine answers, as well as reminding the participants that their answers will remain anonymous. All questions had the option 'Not sure' which helps to minimise any guessing in answers. Previous research has identified an accumulation of non-representative responses in online questionnaires as the responses of individuals who lack internet access will not be captured e.g., those of lower incomes, elderly, or those living in remote locations (Andrews et al., 2010). However, this was a common limitation in older research from up to the early 2000s and typically in more modern times, there are very few people within the UK who would not have access to the internet, with the official statistics reporting that 96% of UK household have internet access (Prescott, 2020). The lack of an interviewer can also be a disadvantage in online surveys as support cannot be provided to participants who do not understand the questions asked. This limitation has been minimised with the use of a ratified GKNQ which has been widely used in research for many

years and has been updated accordingly over the years to improve accuracy and useability (Kliemann et al., 2016).

2.3 Current nutritional intakes

As well as assessing nutritional knowledge, it is also important to evaluate whether this knowledge is being implemented in practice. The National Diet and Nutrition Survey (NDNS) is a rolling program used to collect quantitative information about diets and nutrient intakes of the UK population. A statistical comparison is then made to analyse long-term trends in intakes and comparisons between age groups and genders. The figures from the latest NDNS confirm that the UK population continues to consume high intakes of saturated fat, sugar and overall calories and not a high enough quantity of fruit, vegetables and fibre (NDNS, 2022).

The dietary reference value for carbohydrates is 50% of our daily food intake and 5% for free sugars (Department of Health, 1991). Complex carbohydrates provide essential energy and fibre to the diet, however, the intake of these types of carbohydrates is reducing in recent trends. There has been a profound shift in the quality of carbohydrates consumed, from wholegrain-based diets in the early 20th century, to refined carbohydrates from processed foods by the end of the 20th century (Mohan et al., 2018). Future public health messages should focus on promoting the quality of carbohydrates consumed rather than just the quantity, promoting the consumption of fibre-rich carbohydrates, and reducing the consumption of free sugars and ultra-processed foods (Tramontt et al., 2023). The manipulation of carbohydrate intakes is an approach often used by dieters to reduce their weight quickly, this typically involves restricting carbohydrates in favour of increasing protein or fat consumption, or both. Although, this is not a safe strategy for long-term health. Carbohydrate sources such as cereals, vegetables and fruit provide the main sources of fibre intake in the UK population. It is therefore crucial not to encourage the use of very low carbohydrate diets to manage weight loss, to prevent inadequate fibre intake. Studies have also observed increased intakes of animal fats in low carbohydrate diets, which has significant health consequences (Seidelmann et al., 2018). The 2020 NDNS reports that although total fat intakes are estimated within the healthy range (<35%), saturated fat consumption of the UK population is higher than the recommended intake of <10% of total calories consumed. This increased intake of saturated fat is associated with an increased risk of high cholesterol and cardiovascular disease. Prioritising the consumption of mono and polyunsaturated fats can help to reduce this risk of disease, although most health initiatives primarily look at reducing saturated fat, rather than focusing on healthier fat alternatives. The NDNS (2020) also found that free sugars are consumed in excess, this includes all added sugars in foods and drinks. This high intake was seen for all age categories, however, it was observed that men had higher intakes of free sugar than women, 56g and 44g respectively (BNF, 2024). When observing micronutrient intakes, UK diets typically met reference nutrient intakes for

folate, iron and calcium. This was the case for all age groups and sexes (Public Health England, 2018). However, limitations with this use of food frequency questionnaires in the NDNS are that participants typically estimate the quantity and frequency of foods eaten, rather than observing direct nutritional intakes from food record diaries (Jones et al, 2018). The use of food diaries and dietary observations can help to provide a more in-depth representation of total energy and nutrient intakes.

It has been frequently reported that women are more likely to engage in health-promoting behaviour than men and have healthier lifestyles (Gough & Conner, 2006). Although often aware of healthy eating messages, men are typically more sceptical of the health benefits of such dietary alterations (Sobal, 2005). As a result, women typically eat healthier, more varied diets than men in Western societies. Men are typically less likely to meet fibre intake guidelines, however, the latest figures suggest that irrespective of gender, the average intake of dietary fibre is just 60% of the reference nutrient intake (BDA, 2024; Fayet-Moore et al., 2018). Inadequate fibre intakes are associated with an increased rate of comorbidities, type two diabetes, obesity and some cancers (Barber et al., 2020). Fibre is therefore an essential component for analysis when observing the quality of an individual's diet, particularly in preventing comorbidities. Health Survey for England reports that only 28% of UK adults consume the recommended five portions of fruit and vegetables per day, with an average intake of 3.7 portions. Fewer men than women met the five-a-day guidelines and younger adults (16-24) had lower intakes than older adults. Despite the increase in advertisements and numerous government health initiatives at this time, the average portions of fruit and vegetables consumed have remained consistently low over the past few decades (NHS, 2017). It has been observed that higher levels of physical activity, particularly in older adults, are associated with increased intake of fruit and vegetables (Van der Avoort, C. et al., 2021).

This study uses three-day food diaries from participants to analyse their nutritional intakes as an average across the three days. The use of food diaries over food frequency questionnaires helps to provide a more in-depth representation of total energy and nutrient intakes rather than estimating the frequency that particular foods are consumed. A limitation of the use of self-reported food diaries, as opposed to researcher-observed intakes, is seen in previous research which has found that participants' self-reported intake did not equal the measured energy intake when observed by the researcher (Nunes et al., 2023). The omission of certain foods or meals and the inaccuracy of portion sizes are the most frequent obstacles encountered in previous research (Dahle et al., 2021; Bawadi et al., 2021). Research has also found that participants are typically more likely to under report their total intake rather than over report, either unintentionally or to reduce judgement from others by not documenting their unhealthy eating behaviours (Dhurandhar et al., 2014). Nunes et al., (2023) concluded that recommendations on common areas of miss reporting diet should be given to participants before completing any self-reported food diaries, to minimise this inaccuracy when recording. The use of food diary templates will not be

provided to participants, such as guides with meal names or meal and snack times. Previous research has shown that this can result in guiding participant behaviours (Ravelli & Schoeller, 2020). This is important as the aim of this study is for participants intake to remain as close to their regular intake as possible for a more realistic analysis.

2.4 Motivations and influences

Knowledge is not the only factor influencing dietary behaviours and there is growing evidence outlining that there are many complex factors beyond personal decisions or knowledge that can strongly influence an individual's diet and food choices (Bisogni et al., 2002). Food choice is dependent on a wide spectrum of factors, ultimately resulting in the consumption of certain foods and the rejection of others. In developing strategies to promote the consumption of healthy diets it is important to address and examine factors that are likely to influence food choice, as individuals are more likely to be compliant with dietary changes if the changes fit their nutritional attitudes and motivations (Naughton et al., 2015). Influencers on diet is a complex discussion, with many social and economic factors interacting with food choice. These include; income, food availability, and affordability, individual preferences, cultural or religious traditions and beliefs, as well as social norms from current dieting trends, social media, and family or peer influence (WHO, 2020).

Popular dieting trends are seen to influence food choices typically either by limiting the variety of food choices, manipulating macronutrient ratios, or liquidising foods. Although some dieting trends are supported by scientific evidence, many are not. Dieting trends displayed on social media are often described as any diet that promises rapid weight loss, whilst often overlooking the nutritional value of the diet (Khawandanah & Tewfik, 2016). In a study observing influences of dietary behaviours, findings highlighted that participants reported using social media, such as Instagram and Facebook to gain information on healthy eating. Participants also reported to reading online nutrition blogs (Mete et al., 2019). Although it is positive that individuals are seeking education in healthy dietary choices, a limitation with nutrition or health-related blogs is that they are not always written by registered nutritionists or dietitians and are often written by the general population, celebrity personalities or companies promoting health products (Taylor & Humphrey Jr, 2021). There is a lot of evidence to suggest that social norms have a powerful impact on both food choices and the quantity of food consumed, with studies finding that we often model the eating choices of our dining partners and consume similar amounts to what they eat (Higgs, 2015).

Financial implications and considerations will also influence dietary choices and behaviours. Data from The Food Foundation reported that one in five households would have to spend almost half of their disposable income on food to achieve government guidelines on healthy eating. It is often not feasible

for households to spend this sum of money on food as it would leave very little money for other household bills and expenses. Healthy, nutritious foods are nearly three times more expensive than unhealthy, calorie-dense, high-fat products, with healthier food costing an average of £8.51 per 1000 calories compared with just £3.25 per 1000 calories of less healthy foods. The costs of healthy foods have also increased by a greater amount than unhealthy foods, with a rise of 5.1% and 2.5% respectively between the years of 2021-2022 (The Food Foundation, 2022).

As well as understanding individual influence, understanding individuals' motivation to eat healthy and achieve healthy body weights is also important. The self-determination theory (SDT) approach describes motivation as a determinant of healthy eating. The SDT distinguishes between autonomous motivations, controlled motivation, and amotivation (Bonsteel, 2012). These different types of motivations are used to summarise whether an individual's drive is affected by either externally or internally controlled influences, known as locus of control (Mokhtari et al., 2017). A study found that autonomous regulation was the only type of motivation that could predict long-term food choices and was also a significant predictor for long-term engagement in physical activity in both genders (Hartmann et al., 2015). Although, it was found that often individuals who are focussed on the importance of obtaining a healthy BMI, tend to consume a lower quantity of food rather than concerns regarding the quality of food (Pelletier et al., 2004). Studies also identified that even if individuals are conscious of healthy eating behaviours and the importance of a healthy BMI, this does not necessarily correlate with successful weight loss attempts (Heinberg et al., 2000). Previous studies have also acknowledged the negative effect of social pressures on dietary habits and that external regulations were often associated with increased caloric intake (Puhl & Heuer, 2009). These observations suggest that external regulation is likely a consequence of BMI values rather than a cause for raised BMIs and that autonomous motivation played the greatest role in determining dietary choices.

Previous studies exploring eating motivations are typically organised to measure what motivates an individual's food choices once they have already decided to eat, rather than what initially motivates someone to eat. However, studies have shown that psychological motivations to eat are derived before the initial process of preparing a meal (Jackson and Albino, 2003). This suggests that improving nutritional knowledge overall could help to encourage subconscious food choices. Therefore, promoting a healthy food environment requires efforts from both the public and private sectors to alter all areas of influence on dietary behaviours.

2.5 Nutrition and exercise

Regular physical activity is associated with lower rates of morbidity from several non-communicable diseases and reduced rates of mortality. Physically active adults also report having positive mental

and physical health (Centers for Disease Control and Prevention, 2023). UK Government guidelines recommend that each week, adults should partake in at least 150 minutes of moderate-intensity exercise or 75 minutes of vigorous-intensity exercise, with the addition of 2 resistance or strength training sessions per week. It also advises that adults should aim to reduce the amount of time spent being sedentary and try to break up long periods of inactivity with some form of movement (Department of Health and Social Care, 2019). Adequate nutrition, combined with physical activity, is the foundation for a healthy lifestyle. It is generally accepted that the increasing rates of obesity worldwide have paralleled the increase in the consumption of unhealthy, energy-dense fatty foods as well as the reduction in physical activity levels (Niemi et al., 2023). Previous research believes that a potential mechanism for improving dietary behaviour is through increasing amounts of physical activity, though research investigating the relationship between exercise and nutritional behaviours is unclear (Martins et al., 2008). To understand the relationship between physical activity, dietary intake and obesity, it is important to understand the impact of exercise on dietary choices and appetite.

A research project observing the influence of a 15-week exercise training program on dietary patterns amongst young adults found that after exercising for several weeks participants were more likely to choose healthier food options such as lean meats, fruit and vegetables. Desires for unhealthy options such as fried foods and fizzy drinks also typically decreased (Joo et al., 2019). Another study also found improved short-term appetite control in participants who exercise in comparison with those who did not. A greater effect on appetite suppressing was also found from vigorous physical activity (Martins et al., 2008). Despite these observed effects of physical activity on dietary intake, individuals who exercise do not necessarily have a healthier BMI than those who are inactive. One study observing BMI and physical activity status in college students found that although a higher percentage of male participants were overweight compared with female students, 48% and 22% respectively, male participants were found to partake in significantly more physical activity than women (Yahia et al., 2015). This trend has also been observed in many other studies including Haase et al., (2004) and Telford et al. (2016). Although, the same study also found that females scored higher on nutritional knowledge, suggesting a correlation between nutritional knowledge and weight, rather than improved knowledge in physically active participants. Therefore, although physical activity is crucial within a healthy lifestyle and provides significant health benefits, physical activity alone without the presence of adequate nutritional knowledge will not help to tackle the obesity crisis.

A study assessing the nutritional knowledge of recreational sports persons found that although nutritional knowledge was higher than the general population, they still concluded that nutritional knowledge was insufficient (Pawlas et al., 2022). However, one study found that even with the same levels of nutritional knowledge, inactive people ate more unhealthy diets than physically active people (Sodhi, 2010). However, there are limited studies evaluating the nutritional knowledge and practices

of recreational athletes compared with inactive individuals. This study looks to compare the nutritional knowledge and nutritional practices of physically active individuals and those who are inactive.

Physical performance and overall health are crucial for the athletic population, and adequate nutritional intake is important for achieving this. Studies demonstrate that athletes who are supported to follow nutritional guidelines are more likely to achieve peak performance (Beck et al., 2015). A systematic review of nutritional knowledge amongst athletes found that athletes typically have inadequate knowledge to support their athletic performance, including both a lack of general nutritional knowledge as well as a lack of understanding of the importance of nutrition around exercise, such as the physiological demands of the sport and how this relates with nutritional requirements (Alahmadi & Albassam, 2023). Dietary intakes of athletes were also measured and findings illustrated that athletes were not sufficiently fuelling their body for optimal physical performance, with low intakes of overall energy and carbohydrates. Devlin et al., (2017) found that athletes with poorer nutritional knowledge also typically overconsumed intakes of protein, often exceeding the recommended upper limits. Evidence also suggests that there is a negative relationship between the nutritional knowledge of an athlete and the inappropriate use of supplements and ergogenic aids (Boidin et al., 2020).

2.6 Government guidelines and initiatives

There is a well-established connection between our diet and our health and therefore, increasing public knowledge on what healthy eating entails is one of the overarching priorities of global health policies. Governments play a central role in creating adequate food environments to enable the consumption of healthy diets. This includes creating national policies on trading and agriculture, encouraging consumer demand for healthy foods as well as promoting optimal infant and young children feeding practices. In 2018 the WHO agreed to support member states in taking necessary actions to improve global health. WHO member states have agreed to reduce global salt consumption by 30% by 2025 and have agreed to aid the halt in the rise of individuals living with diabetes and obesity, in adults as well as in children (World Health Organisation, 2023).

The success of government attempts has been acknowledged previously, with a 46% reduction in the sugar content of soft drinks since implementing the Soft Drinks Industry Levy in 2018, a 14.9% reduction in the sugar content of breakfast cereals, and a 13.5% reduction in yoghurt products. Legislation change to calorie labelling is also expected to bring health benefits which provide £430million of NHS savings over the next 25 years (Department of Health and Social Care, 2023).

The 2020 UK Government Policy paper reports that the COVID-19 pandemic provided a much-needed wake-up call to the government, seeing first-hand the implications of obesity on health and rates of mortality. The Public Health England 2020 assessment made the recent evidence clear that being overweight and living with obesity is associated with an increased risk of hospitalisation, severe symptoms, and the requirements of more advanced levels of treatment. These risks are found to increase progressively as an individual's BMI increases. The report also declared that tackling obesity is not solely about individual efforts, but also about the environment that we live in, the choices we are offered, and the influences that shape those choices. In attempts to improve the health of UK populations, the government agreed to provide further funding for NHS weight management services to increase the availability of weight loss support to more people. This increase in funding will help to tackle current rates of obesity whilst eventually creating a platform to help with the prevention of obesity. The government has pledged plans for the future, including legislating to end the promotion of unhealthy, high-fat, high-sugar foods in supermarkets both online and in physical stores. As well as restricting the placement of unhealthy foods in supermarkets to reduce impulse purchases. They also implemented compulsory calorie labelling for food provided in businesses and restaurants and organised the banning of advertisements of unhealthy food products on TV during certain hours. The UK Government is also continuing to update its physical activity guidelines based on current research, to increase awareness and compliance with exercise guidelines. The availability of weight loss medications to be offered under medical supervision has also increased (Department of Health and Social Care, 2019).

Improving childhood nutritional education and requirements for school meals and physical education has been a government priority in recent years, helping children to have an active start to life. This was updated in February 2024 to provide £600 million in funding for PE and Sports for children over the next couple of years (Department of Health and Social Care, 2019). There have been numerous policy and curriculum changes within schools to improve knowledge of healthy eating and physical activity. Investing in children and school systems works to invest in the future UK population, aiming for a preventative approach rather than a solely reactive approach (Afshin et al., 2014).

Improving the nutritional knowledge of the UK population is a crucial component in tackling the obesity crisis, although currently, government attempts to reduce the prevalence of obesity focus on reducing the accessibility of unhealthy, high fat, and high sugar foods, with more limited efforts made to improve adult knowledge. Focussing on individual knowledge could help to empower people to make more independent and informed healthy choices. Tackling the obesity crisis is instigated by government policy changes, but for effective change to take place, all communities must work together to educate and encourage healthier dietary choices.

Chapter 3 Methodology

3.1 Research design

This research is a cross-sectional study carried out via convenience sampling. Quantitative data is obtained via an online participant information form, completion of a general nutritional knowledge questionnaire as well as a self-reported diet history to be completed by a smaller sample of participants. The questionnaire was live for completion between 7th and 14th March 2024. This is a non-experimental research study, comparing one criteria to another based on existing characteristics and demographics. The use of a cross-sectional study allows for correlating relationships to be determined from the results, without concluding a cause and effect relationship. This allows for multiple variables, including gender, age, participant anthropometrics, and training status to be observed (Sedgwick, 2014).

3.2 Participants

The research group included in the nutritional knowledge questionnaire consists of a cross-sectional convenience sample, a procedure for selection of participants that provides an equal chance of selection from all members of the population. Section two of the study, requiring participants to complete a food diary involved stratified sampling, where the population is stratified on a particular characteristic, in this case physically active and physically inactive participants. Due to the non-specific basis of this research, the participants consist of a variety of ages and genders, as well as including both participants who are inactive and active. A total of 125 questionnaire responses were received during the 1 week submission of the live questionnaire. There were 122 completed questionnaires after data cleaning, removing any incomplete questionnaires.

Participants under the age of 18 were excluded from the research sample. Due to this population being under parental control and the effect this could have on the participant's freedom of choice of what they eat on a daily basis, thus reducing the reliability of the results (Savage et al., 2007). Additionally, due to their increased knowledge and general promotion of healthy eating behaviours an exclusion in the research sample includes those either studying or working as a dietitian or nutritionist, as this would not be an accurate representation of the general population. Participants who adhere to the recommended government guidelines of physical activity on a weekly basis for a minimum of the past three months will be identified as active participants in the study. Differentiating participants who are physically active and inactive will be required in both sections one and two of the research study.

3.3 Procedure/ protocols

Any incomplete questionnaires are not included in the study and discarded to allow accurate analysis of results as a whole. A total of 125 participants completed the questionnaire. The questionnaires were checked for completeness, and any with missing data were excluded from the analysis. Participants received a link to an information page before continuing to the questionnaire. Participants were required to click to continue, to give consent to participate in the research project. They were then taken to a participant information sheet and were asked to provide some demographic information about themselves, including age, gender, weight, height and training status. Following completion of the demographics document they then proceed to complete the online GNKQ. The nutritional knowledge questionnaire used in the study consists of four independent sections with each section assessing different areas of nutritional knowledge. These include; dietary recommendations, food groups, healthy food choices, and the final section including diet, disease, and weight management. Each of the four sections consists of a series of multiple-choice questions to determine nutritional knowledge against health guidelines in the particular areas (Parmenter & Wardle, 1999).

In section two of the data gathering an additional 16 participants completed 3-day food diaries. Of these 16 participants, 8 were individuals who adhered to government guidelines on physical activity every week and 8 were not physically active. These food diaries were then imported into Nutritics, a nutritional analysis software, to provide an in-depth breakdown and analysis of nutritional intakes (Nutritics, 2024). All participants were made aware that the researcher will know which category they are in, active or inactive, for this component of the study only. Participants were given an information sheet as seen in Appendix 1, with guidance on completing a three-day food diary. The food diary recording form can be seen in Appendix 2.

Ethical concerns to consider are participants feeling any judgement towards the answers given in the questionnaire, this concern was minimised as all questionnaires remained anonymous throughout the process. In regards to the self-reported food diaries, participants were assured that the information collected will be for research purposes only and that only averaged statistics amongst the two groups will be included within the research paper.

3.4 Data analysis

The obtained data from both the GNKQ and the food diaries were analysed using Statistic Package for Social Science (SPSS), version 26, and Microsoft Excel (2013) for tables and charts to be made for a visual representation of the results found. Differences between nutritional knowledge scores and group domains such as gender and physical activity status were analysed using independent samples t-tests

and correlations between age groups' scores were analysed using analysis of variance (ANOVA). Correlations between scores and lienal data such as BMI and self-reported scores were analysed using Spearman's rank order correlation and Pearsons correlation. Significant values were determined at a value of $p < 0.05$ and Cohens D was used for measures of effect size.

Chapter 4 Findings and analysis

4.1 Data analysis

A total of 125 responses were received on the sharing of the questionnaire link. After data cleaning there were 122 complete responses. Any questions with multiple answers ticked were marked as incorrect and any questionnaires with missing answers were also removed from the data sample. There were 73 female and 49 male respondents.

The age range with the largest participant numbers was the 18-24 age range, with 47.5% of participants falling into this category. The age range with the smallest number of participants was 61+ with 8.2% of participants in this category.

4.2 Nutritional knowledge

The average score was 62.9/88 (71.5%), with a range of 40-81 points. On average, participants scored the highest in section 3 - assessing knowledge on healthy food choices and scored the lowest on average in section 1 – dietary recommendation.

Table 1: Average scores for each section of the questionnaire

Section number	Section title	Average scores (%)
1	Dietary recommendations	65.6
2	Food groups	72.5
3	Healthy food choices	80.8
4	Diet, disease and weight management	68.6

People struggled most with questions about different types of fats. With an average of only 29.5% of individuals answering correctly on the main types of fat present in individual foods.

Gender

There were 72 female and 49 male respondents to the General nutritional knowledge questionnaire. Total scores, scores for individual sections, reported scores of nutritional knowledge, BMI, and Physical activity were compared between genders using independent T-tests.

Table 2: Comparisons between Female and Male respondents

Measure	Female (73) Mean $\pm$ SD	Male (49) Mean $\pm$ SD	t	df	p	d	Diff
Scores	63.64 $\pm$ 9.28	61.73 $\pm$ 7.71	1.190	120	0.237	0.220	No
Section 1 scores	11.99 $\pm$ 1.95	11.43 $\pm$ 1.58	1.669	120	0.098	0.308	No
Section 2 scores	26.19 $\pm$ 4.36	26.08 $\pm$ 4.01	0.141	120	0.888	0.026	No
Section 3 scores	10.77 $\pm$ 2.0	10.16 $\pm$ 2.12	1.593	120	0.114	0.294	No
Section 4 scores	14.69 $\pm$ 3.26	14.06 $\pm$ 2.77	1.122	120	0.264	0.207	No
Self-reported score	3.19 $\pm$ 0.938	3.4 $\pm$ 0.70	-1.375	120	0.172	-0.254	No
BMI	24.17 $\pm$ 4.0	26.55 $\pm$ 4.22	-3.159	120	0.002	-0.583	Yes

Gender does not make a significant difference to scores throughout the questionnaire or self-reported knowledge. Gender does make a significant difference to BMI, with males having a significantly higher BMI on average than females.

Males were more physically active than females, with 81.6% of males adhering to government guidelines for physical activity, compared with 68.9% of females.

Physical activity

There were 91 physically active respondents and 31 physically inactive respondents to the General nutritional knowledge questionnaire. Total scores, scores for individual sections, reported scores of nutritional knowledge, and BMI were compared between these two groups using independent T-tests.

Table 3: Comparisons between active and inactive respondents

Measure	Active (91) Mean $\pm$ SD	Inactive (31) Mean $\pm$ SD	t	df	p	d	Diff
Scores	63.25 $\pm$ 8.27	61.77 $\pm$ 9.94	0.816	120	0.416	0.17	No
Section 1 scores	11.69 $\pm$ 1.71	11.96 $\pm$ 2.14	-0.725	120	0.470	-0.15	No
Section 2 scores	26.33 $\pm$ 4.02	25.61 $\pm$ 4.75	0.818	120	0.415	0.17	No
Section 3 scores	10.69 $\pm$ 1.99	10.03 $\pm$ 2.23	1.545	120	0.125	0.32	No
Section 4 scores	14.54 $\pm$ 2.92	14.16 $\pm$ 3.55	0.587	120	0.558	0.12	No
Self-reported score	3.39 $\pm$ 0.77	2.93 $\pm$ 1.0	2.650	120	0.009	0.55	Yes

BMI	25.32 ± 4.52	24.55 ± 3.23	0.871	120	0.385	0.18	No
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Physical activity status does not make a significant difference to total questionnaire scores, scores of individual sections, or BMI. Physical activity status does make a significant difference to self-reported scores, with the active group scoring themselves as higher on average than the inactive group.

Age

Respondents were categorised into four age groups for the questionnaire, 18-24, 35-40, 40-60, and 61+. Total scores, scores for individual sections, reported score of nutritional knowledge, physical activity status, and BMI were compared between these four groups.

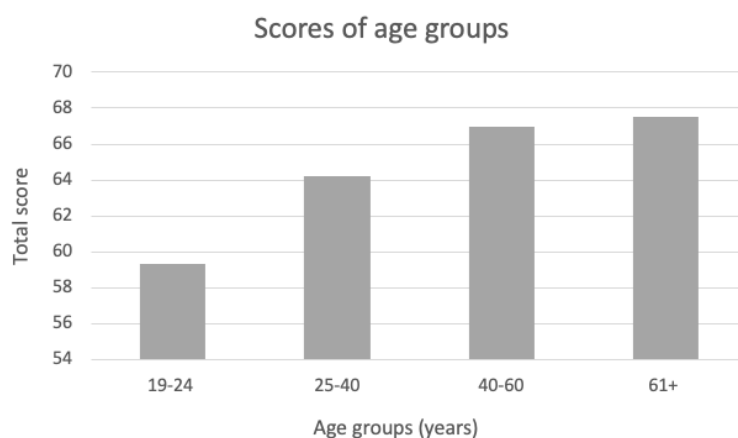
Table 4: Correlations between age groups of respondents

Measure	F	DF	Sig.	Diff
Scores	7.77	3	<0.001	Yes
Physical activity	1.164	3	0.326	No
BMI	2.45	3	0.067	No

Post hoc analysis after correlating age groups and total scores showed a significant difference identified between 18-24 age group and the older two age categories 40-60 and 61+ ($P=0.001$). There was no difference between the age groups of 18-24 and 25-40 ($P=0.077$), as well as no difference between the 40-60 and 61+ age groups ($P=0.997$).

Although scores between all age groups were not significantly different, a linear increase in scores was seen as age increased.

Graph 1: Scores of respondents in each age group



Correlations

Total scores from the questionnaire and BMI were not significantly correlated ($P=0.750$, $r=0.029$). The correlation of total scores from the questionnaire and participants self-reported scores were significant at the 0.01 level 2-tailed ($P<0.001$).

4.3 Nutritional practices

Physical activity

There were 8 active and 8 inactive participants included in the food diary analysis. BMI, calorie intakes, macronutrient breakdowns, fibre, sugar and alcohol intakes were compared between these two groups using independent T-tests.

Table 5: Comparisons between physical activity status and nutritional intake

Measure	Active (8) Mean $\pm$ SD	Inactive (8) Mean $\pm$ SD	t	df	p	d	Diff
BMI	24.81 $\pm$ 2.66	27.4 $\pm$ 4.45	1.68	12	0.12	0.90	No
Calorie intakes*	103.43 $\pm$ 12.96	90.14 $\pm$ 16.46	1.15	14	0.27	0.58	No
Carb intake as % of total calories	44.75 $\pm$ 7.67	44.99 $\pm$ 6.68	0.21	14	0.84	0.11	No
Protein intake as % of total calories	30.82 $\pm$ 5.6	34.68 $\pm$ 6.61	-1.26	14	0.23	-0.63	No
Protein intake as % of protein requirements	96.78 $\pm$ 27	128.6 $\pm$ 28.47	-2.3	14	0.04	-1.15	Yes
Total fat as % of total cals	30.82 $\pm$ 5.6	34.67 $\pm$ 6.6	-1.26	14	0.23	-0.63	No
Sat fat as % of total cals	10.71 $\pm$ 3.47	12.48 $\pm$ 2.92	-1.1	14	0.30	-0.55	No
Sat fat as % of total fat	33.84 $\pm$ 7.17	35.79 $\pm$ 3.89	-0.68	14	0.51	-0.34	No
Fibre as % of 30g daily target	76.75 $\pm$ 19.4	56.25 $\pm$ 13.79	2.44	14	0.03	1.22	Yes
Alcohol as % of total calories	1.4 $\pm$ 2.86	3.08 $\pm$ 8.7	-0.52	14	0.61	-0.26	No
Fruit and veg portions	3.8 $\pm$ 1.28	2.39 $\pm$ 0.94	2.51	14	0.03	1.26	Yes
Sugar as % of total cals	16.41 $\pm$ 5.57	17.43 $\pm$ 5.69	-0.36	14	0.72	-0.18	No

*Outliers beyond one standard deviation from the mean were removed from the data sets on analysis.

Physical activity status makes a significant difference to protein intakes when compared with protein requirements, with the inactive group eating larger quantities of protein than required ($P=0.038$). A difference in fibre intake is observed, with a greater intake of fibre consumed by active individuals ($P=0.029$). Fruit and vegetable intakes were also significantly different with a higher amount consumed by the active group (3.8 portions on average compared with 2.39). The presence of more regular meal patterns was also observed, and active individuals were more likely to consume 3 regular meals each day compared with the inactive group (87.5% and 75% respectively). Physical activity does not make a significant difference to any other aspect of dietary intake.

Table 6: Comparisons between Gender and nutritional intake

Measure	Female (10) Mean $\pm$ SD	Male (6) Mean $\pm$ SD	t	df	p	d	Diff
BMI	26.07 $\pm$ 4.42	26.16 $\pm$ 2.78	-0.48	14	0.96	-0.25	No
Calorie intakes	90.3 $\pm$ 18.53	96.17 $\pm$ 20.56	-0.59	14	0.57	-0.30	No
Carb intake as % of total cal	46.13 $\pm$ 4.85	44.1 $\pm$ 10	0.55	14	0.59	0.29	No
Protein intake as % of total cal	19.87 $\pm$ 5.98	19.21 $\pm$ 4.03	0.24	14	0.82	0.12	No
Protein intake as % of protein requirements	110.17 $\pm$ 31.2	116.9 $\pm$ 34.27	-0.40	14	0.69	-0.21	No
Total fat as % of total cal	33.76 $\pm$ 5.96	31.07 $\pm$ 6.91	0.83	14	0.42	0.43	No
Sat fat as % of total cal	11.83 $\pm$ 2.61	11.2 $\pm$ 4.33	0.37	14	0.72	0.19	No
Sat fat as % of total fat	34.85 $\pm$ 3.86	34.76 $\pm$ 8.32	0.03	14	0.98	0.02	No
Fibre as % of 30g daily target	67.1 $\pm$ 22.12	65.5 $\pm$ 15.71	0.15	14	0.35	0.88	No
Alcohol as % of total calories	0.2 $\pm$ 0.57	5.63 $\pm$ 9.84	-1.78	14	0.10	-0.92	No
Fruit and veg portions	3.33 $\pm$ 1.15	2.7 $\pm$ 1.56	0.93	14	0.37	0.37	No
Sugar as % of total cal	18.19 $\pm$ 4.33	14.81 $\pm$ 6.89	1.21	14	0.24	0.72	No

Gender does not make a significant difference to any aspects of dietary intake.

There was a significant correlation ($p<0.001$) between increased fruit and vegetable intakes and increased fibre intakes. There was no correlation seen between fruit and vegetable intakes and overall energy ($P=0.674$).

Chapter 5 **Discussion**

Through observing differences in select participant groups, including activity status, gender and age I was able to analyse current nutritional knowledge and whether this is incorporated into dietary practices. This allows for greater understanding of the effect of public health initiatives on influencing knowledge and dietary choices. This is vital in the attempt to reduce the ever increasing rates of obesity and to reduce obesity related illnesses (WHO, 2024).

5.1 Nutritional knowledge

The average score for the General nutritional knowledge questionnaire was 65/88 (74%). These results are partly encouraging, with many respondents being aware of most of the major guidelines on healthy eating. These scores are also replicated in previous studies using the GNKQ (Kliemann et al., 2016). On average, participants scored highest in section 3 of the questionnaire, suggesting a higher standard of nutritional knowledge around healthy food choices. Participants, on average, scored lowest in section 1 which asked about dietary recommendations. This suggests that even though participants are generally able to identify which foods are healthy and unhealthy, they are not aware of current dietary recommendations and have limited knowledge on what constitutes an overall healthy diet. Interestingly, a meta-analysis observed significantly higher results in the completion of the GNKQ in recent years when compared with results from previous decades (Parmenter et al., 2000).

There was no observable difference between overall questionnaire scores or scores of individual sections when compared with gender. However, these observations are not consistent with results from previous studies comparing nutritional knowledge and gender, which consistently found that females scored higher than their male counterparts. Females also consistently scored higher on all sections of the questionnaire (Kliemann et al., 2016; Hansbro & Bridgwood, 1997). This trend of increased nutritional knowledge in women was also observed in older studies (Anderson et al., 1988). This difference is believed to be influenced by the fact that women are often more present than men in the organising, preparing, cooking and purchasing of food in UK households (Taillie, 2018). Typically women are also more weight conscious than males and therefore are more likely to look into nutritional aspects of the diet more or pay more attention to government health initiatives (Kiefer et al., 2005).

No difference in total scores or scores of individual sections have been observed between the physically active and inactive groups in this study. These findings are in keeping with results from previous studies such as Heaney et al. (2011). However, other studies including Parmenter et al. (2000) have identified an increase in questionnaire scores in populations who self-reported an excellent health score, when compared with reported poor or good health scores. Therefore, although exercise itself does not

influence nutritional knowledge, an overall interest in general health can be linked with increased nutritional knowledge and increased likelihood to participate in physical activity. This suggests that individuals who are more interested in health are increasingly likely to adhere to nutrition and exercise guidelines, but individuals who solely focus on exercise are not necessarily more health conscious.

Scores from the GNKQ were relatively high with an average score of 74% across all participants. There was no difference observed when comparing scores of male and female participants, as well as no difference being observed in the inactive and active groups.

5.2 Body mass index (BMI)

There was no correlation between BMI and total questionnaire scores, suggesting that BMI does not influence nutritional knowledge. Research assessing BMI and nutritional knowledge are conflicting, a meta-analysis by Barbosa et al. (2016) reported that previous studies have identified positive, negative and no correlations between BMI and knowledge. The lack of observable correlation could be explained as studies exploring nutritional intakes found individuals that focussed on weight and weight loss goals were not necessarily focussed on a high quality diet. Rather they tended to focus on a low quantity diet and the use of low calorie alternatives (Pelletier et al., 2004). These types of diets are often referred to as ‘fad’ diets which are typically identified as a diet low in healthy fats, fibre and containing high intakes of ultra-processed foods (Tahreem et al., 2022). This in turn does not constitute a healthy balanced diet. Studies have observed negative health outcome from ‘fad’ or restrictive diets for prolonged periods of time. This therefore supports the theory that healthy BMI does not necessarily correlate with healthy dietary intakes, just the presence of adequate caloric intakes to maintain a healthy BMI.

On average, male participants had significantly higher BMI than women, averaging 26.55kg/m² compared with 24.17kg/m² for females. This replicates the findings from contemporary UK population statistics with males presenting with a higher BMI on average than females (Stewart, 2024). Although, previous research has suggested that the higher BMI observed in men may not necessarily directly correlate with increased levels of adipose tissue. A meta-analysis observing body fat trends in UK female and male populations concluded that fat mass and body fat percentage is greater in women than men (Meeuwssen et al., 2010). This could be explained by the increased levels of physical activity in the male population compared with females, resulting in higher volumes of muscle mass (Gov UK, 2021). Muscle mass is not accounted for when calculating BMI and therefore may reduce the reliability of using BMI to indicate the degree of adiposity. Alternatively, using skin fold measures or using bioelectrical impedance fat mass calculators measure levels of adiposity rather than overall weight and therefore may be more beneficial in determining healthy body compositions than BMI in future studies (Gutin, 2017). Although, the use of BMI calculating was justified in the present study as it is a less

invasive measure as this was not the primary focus of the research project. The adiposity measures are significantly more time consuming and future studies must evaluate whether this approach would benefit their results. Additionally, due to the extremely high rate of overweight and obesity in the current population and the lack of individuals who typically adhere to government physical activity guidelines, it is unlikely that this inaccuracy in BMI calculating due to increased muscle mass made any significant difference to outcomes.

There is however, a lower average BMI across the whole sample of this study when compared with current UK data. With an average BMI of 25.1kg/m² across participants, with female participants averaging a BMI of 24.2kg/m² and 26.6kg/m² for males. In 2021 the average BMI for UK adults males was 27.5kg/m² and 27.2kg/m² for females (Stewart, 2024). This lower than average BMI observed from the present study could likely be explained as those who are more interested in the topic of nutrition and health may be more likely to respond to the questionnaire invitation than those who do not have a particular interest or focus in nutrition, creating a sample bias. In future, data collection via stratified sampling may be more applicable when replicating a similar study. This will ensure that a greater range of participants are included.

5.3 Physical activity

Males were more likely to adhere to the recommended government guidelines for physical activity than women, 81.6% and 68.9% respectively. These results are similar to those seen in the Health survey for England report (2021) which stated that a higher proportion of men (70%) than women (59%) met the government guidelines for physical activity. Research into gender motives towards physical activity found that males were more motivated by intrinsic factors such as their own goals for strength, challenge and competition. Whereas females are strongly motivated by extrinsic factors such as body weight and appearance to peers (Egli et al., 2011). Another study supporting this concluded that those who participate in more group or team types of physical activity are more likely to enjoy being active and increase rates of compliance (Graupensperger et al., 2019). This would likely explain the increased adherence to physical activity in males as they are more likely to participate in team sports in both adolescence and adulthood than women (Hopkins et al., 2022). Health initiatives, programs and interventions that target the more autonomous motives for exercise may be more successful in initiating long-term adherence to physical activity in females. Current and previous health initiatives focus more on the influence of sports professionals and encouragement in group activities (Wilson & Rodgers, 2002).

It is important to note that although the observed differences in rate of physical activity between genders are mirrored in UK statistics, the overall rates of physical activity are much higher in this participant

group than when compared with the general UK population who are physically active. Studies observing participants physical activity level have often found that participants overestimate their level of physical activity (Janevic et al., 2012). This suggests that participants within the research sample who identified as adhering to government physical activity guidelines may be overestimating their activity and not necessarily be adhering to government guidelines on a regular basis. Additionally, similar to that of BMI, this higher level of physical activity compared with UK statistics could also be suggestive of sampling bias due to the response group received via opportunistic sampling.

Physical activity status did not significantly influence total questionnaire scores or scores for independent sections. This is supported by Sodhi (2010), who found that nutritional knowledge scores were equal for active and inactive groups. Although the study did also observe that despite these equal levels of nutritional knowledge, physically active participants were still more likely to eat healthier diets than inactive participants when assessing dietary intakes. This is supported by Beaulieu et al. (2019) who observed that exercise training reduces the reward for high-fat foods. This suggests that physically active individuals may not be aware of their healthier choices, but rather their healthy choices are driven by a physiological alterations in the body after exercise. It can therefore be concluded that the presence of physical activity does not influence rates of nutritional knowledge.

5.4 Age groups

A linear increase in average scores was observed between age groups, with the youngest age group 18-24 having the lowest scores, compared with the highest average scores seen in the group 61+. The scores from the youngest age group were significantly different to the oldest two age groups, although no other significant differences were identified between other age groups. The reliability of these results could be improved with increased sample size and a more equal split of participants between the different age groups. These findings of increased nutritional knowledge with age are also demonstrated in previous studies such as De Vriendt et al. (2009). However, other studies have also identified a curvilinear relationship between nutritional knowledge and age, where middle age participants had higher scores than younger and older participants (Parmenter et al; 2012; Hakli et al., 2016). This decrease in nutritional knowledge scores later in life was not observed in this study as scores continued to increase in the 40-60 and the 61+ age groups. Although, observations beyond this age cannot be made as the age of participants above 61 was not recorded in the data collection.

There was no differences observed between BMI and age groups, although this does not represent data from UK populations which found that BMI typically increased with age, with the highest BMIs seen in individuals aged 45-54 and this then begins to decrease slowly again after (Stewart, 2024). This trend cannot be observed in the present study as the age categories are likely not sensitive enough to identify

this difference due to their only being 4 adult age ranges, compared with UK statistics including 7 age brackets for individuals. Rates of adherence to physical activity guidelines were consistent between all age groups. Although again, this is not a representative of the UK general population as previous studies have observed a well-established connection between an increase in age and decrease in physical activity in adults (Guthold et al., 2008). Due to the use of opportunistic sampling, age variation was not equally distributed between the categories, with the majority of participants falling into the 18-24 age category (47.5%), and with only a small percentage of participants in the 61+ age category (8.2%). This could also be due to the relatively small sample size (n=122), as well as the use of sharing questionnaire links on social media platforms as the elderly population are typically less digitally active and less present on forms of social media (Tammisalo et al., 2022). This therefore reduces the generalisability of the data collected towards the general population.

5.5 Perceived nutritional knowledge

In this study, total questionnaire scores and perceived reported scores for nutritional knowledge were correlated, with higher self-reported knowledge matching higher scores in the questionnaire. This suggests that participants are accurately aware of their current nutritional knowledge. There was no difference between self-reported scores when compared amongst gender or age groups. Although, physically active participants self-reported higher rates of nutritional knowledge than inactive participants. Interestingly, studies have found that typically individuals feel that their diet is healthier than it actually is (Baranowski & Wansink, 2008), although this was not necessarily the case in the present study.

5.6 Public health messages

The similarities in nutritional knowledge when comparing genders and physical activity status implies that all public health messages are reaching different population groups equally. The only exception to this is the increase in nutritional knowledge in middle-aged and older groups compared with young adults. It is unlikely that educational strategies in school curriculums have decreased over previous years to result in this difference in nutritional knowledge. It could be assumed that as adults age they are likely to deal with health issues that could be directly related to their dietary habits and therefore look for ways to improve this, subsequently increasing their nutritional knowledge.

5.7 Dietary intakes and practices

Knowledge is not, of course, the only influence underlying dietary behaviours. Important influences also include cost, availability, convenience and family preference. It is therefore important to observe

dietary intakes to understand which aspects of nutritional knowledge is reflected and incorporated into food behaviours and which areas are not. Dietary intakes were recorded from self-reported food diaries and participants were organised into groups of those who adhere to government physical activity guidelines and those who do not.

Calorie intakes were fairly consistent between the active and inactive participant groups when comparing intakes as a percentage of individual requirements. These requirements were estimated from the Henry Oxford 2005 equation with the addition of a physical activity level factor. The average calorie consumption of the inactive group was around 90% of their total requirements. This suggests that participants are in a 10% calorie deficit, which would result in weight loss if consumed regularly. However, this was not the case, with an average BMI of 27.4 for the inactive group, classifying participants as overweight. This higher BMI does not match the calorie intakes recorded, suggesting either intentional or unintentional inaccurate reporting of their diet history. Studies observing individual intakes in addition to self-reported food diaries have found that the observed intakes were substantially higher than participants reported (Janevic et al., 2012). Additionally, the National Diet and Nutrition Survey (NDNS) found that although participants recorded their intake correctly, total energy intakes decreased over the four day recording period (Whybrow et al., 2020). This suggests that participants diets may change whilst they are reporting intakes. The NDNS also found that participants with a higher BMI ($>30\text{kg/m}^2$) were more likely to alter their dietary intakes than leaner adults, as well as participants who reported to be actively 'dieting'. Investigating motives to the underreporting of diets or dietary changes when recording intakes has found that participants often alter intakes to what they feel the researcher would want due to fear of judgement (Blundell, 2000).

In the active group, 63% of participants were consuming calorie intakes above their estimated requirements. However, half of these participants presented with a healthy BMI, therefore suggesting the potential inaccuracy of the requirements calculated and the estimated physical activity level. In addition to this, there may be inaccuracy in the participants presenting with an overweight BMI. This is because physical activity is likely to result in increased muscle mass and this is not accounted for when calculating BMI (Sommer et al., 2020). Alternative methods of measuring body composition include skin fold measurements, body circumference measurements or dexta scans, which could be more reliable to use in future research.

Energy intakes were consistent between both inactive and active groups when compared as a percentage of individual energy requirements. Although, inactive participants likely underreported their usual energy consumption.

5.8 **Macronutrient intakes**

Average carbohydrate intakes were slightly lower than the recommended intake of 50% of total calories consumed. Although, recent research has suggested that when assessing diet for weight loss alone, carbohydrate and fat intakes can be interchangeable as long as calorie deficits are met (Ebbeling et al., 2018). However with this being said, carbohydrates are a major source of fibre and therefore ensuring adequate consumption is vital for overall health, irrespective of weight goals. There was no difference in carbohydrate intake between genders or activity status. However, physically active participants would benefit from increasing their carbohydrate consumption. With an average carbohydrate intake of just 44% of their total calories, this is unlikely to adequately fuel physical activity. Due to the increased physiological demand of exercise, the body relies heavily on carbohydrate consumption and therefore adequate intake of carbohydrates is crucial for reducing fatigue, improving sporting performance and promoting recovery. Elite level athletes may even require higher amounts of carbohydrates than this (Hassapidou, 2011).

Total sugar intakes were above the recommended 15% of total energy consumed, with an average intake of 17% across the sample group, with no significant differences seen in gender or activity status. Although, free sugar intakes were not assessed separately from total sugars. Research has shown that higher intakes of free sugars, excluding those from extrinsic milk sugars and fruit, are associated with increased rates of obesity, type two diabetes and dental cavities (BNF, 2024). It would therefore be beneficial to observe free sugar intakes in future research as there are huge health variations dependent on the type of sugar consumed.

Overall fat consumption was within the recommended intakes of <35% of the total calories consumed. However, it is crucial to identify the breakdown of this fat consumption as although total fat intakes were not excessive, these intakes consisted of unhealthy amounts of saturated fat and therefore inadequate quantities of unsaturated fat. Guidelines recommend that total saturated fat intake should not exceed 10% of the total calories consumed and increased intakes are associated with multiple comorbidities and poorer health outcomes (DoH, 1999). Average saturated fat intakes, when measured as a percentage of total calories consumed, were considerably higher than dietary recommendations, with an average intake of 12%, and with some intakes as high as 16%. These findings are supported by other studies that have also observed high saturated fat intakes in the UK population (SACN, 2019). The NDNS also reported an average saturated fat intake of 12.6%. No difference was observed in the study between genders or physical activity groups when comparing both total fat and saturated fat intakes. Data from the British Nutrition Foundation and from the NDNS supports these findings, with similar intakes of total fat and saturated fat consumed by both men and women (BNF, 2024). There is limited research to determine a relationship between total fat or saturated fat intakes and an individual's

physical activity status, although one study did identify that increased saturated fat intakes in the inactive population were associated with raised BMI's, and that this was not the case when compared with active participant groups (Alves et al., 2020). This suggests that a high BMI is associated with increased intake of saturated fat, particularly in inactive populations. However, more research into the composition of fat intakes between active and inactive participants is required to confidently conclude that physical activity does not impact either total or saturated fat intakes.

Protein intakes were consistent in active and inactive groups when compared as a percentage of their total diet. However, a significant difference was observed when assessing individuals protein intakes as a percentage of their estimated protein requirements. Due to their physical activity level status participants who were physically active were given a protein requirement of 1.8g/kg/bw compared with requirements of 0.8g/kg/bw for the inactive group (Department of Health, 1991). This is due to the higher physiological demand for protein for muscle repair and development in active participants. No difference was observed between the two groups when assessing protein intakes as a percentage of overall intakes (average 32.8% of total intakes). However, a difference was observed when comparing total intakes with individual protein requirements. Protein was consumed in excessive quantities in the inactive group, with participants consuming an average of 129% of their protein requirements. This excessive consumption of protein has also been observed in the results from the National Diet and Nutrition Survey which reported that UK adults eat roughly 45-55% more protein than required each day (2019). This higher consumption of protein is not necessarily a problem when viewed in isolation, as harmful intakes of protein are much higher than this, but it can have other consequences when comparing the diet as a whole (Delimaris, 2013). For example, the overconsumption of protein in a diet can ultimately lead to increased calorie intake. On the other hand, if calorie increases are not present, but increased amounts of protein are in place of other foods then this could lead to nutrient deficiencies. It is also important to assess major sources of protein intake as a lot of animal protein will contain high levels of saturated fats (Delimaris, 2013). Thus, although the current excessive consumption of protein is not reaching dangerous levels, it could lead to secondary health complications if over consumed for a prolonged period of time.

Carbohydrate intakes were not influenced by gender or activity status and although total fat intakes were within the healthy range, saturated fat intakes were higher than recommended. These results were consistent in all participant groups. Protein intakes were excessive in the inactive group. Although research has suggested carbohydrate and fat consumption can be interchanged for weight loss, when assessing from a health perspective adequate carbohydrate consumption is needed to increase fibre intakes and help to reduce excessive saturated fat consumption.

5.9 Fruit and vegetable consumption

Fruit and vegetable intakes were consistently higher in the active group when compared with the inactive group. These results are consistent with previous research which found that increased healthy lifestyle behaviours such as physical activity, are associated with improvements in fruit and vegetable intakes. A study observing college students also found associations between fruit and vegetable intake and increased risk of excess body fat, which could be linked to reduced rates of physical activity (Guedes & Santos Silva, 2021). Although fruit and vegetable intakes were higher in the active participant group compared with the inactive group, these intakes are still far below the recommended minimum of 5 portions of fruit and vegetables per day. These results match those from Health Survey England which found that overall fruit and vegetable consumptions are significantly lower than the recommended 5 a day, with only 28% of adults adhering to the 5 a day targets and with an average consumption of just 3.7 portions per day (NHS, 2018).

There was no difference between male and female fruit and vegetable consumption in this study. However, these findings are not replicated in previous research which found that on average women ate significantly higher portions of fruit and vegetables than men (Södergren et al., 2012). It is important to note that this study had a reduced proportion of male participants and therefore the results may not be completely generalisable to the UK population. Increased fruit and vegetable intakes in the study were also associated with increased fibre intakes and although fruit and vegetables are a good source of fibre, individuals are unlikely to meet higher fibre intakes from this alone. Suggesting a diet rich in whole grains and legumes in addition to their increased fruit consumption. Research has associated higher fruit and vegetable intake as a good indicator of healthy eating (Dehghan et al., 2011). However, no other correlations were found when comparing fruit and vegetable consumption with other aspects of the diet such as overall energy intake or intakes of saturated fat.

5.10 Fibre intakes

The average intake of fibre when measured as a percentage of the recommended 30g per day (Department of Health, 1999), was 77% in the active group and just 56% in the inactive group. The 2015 SACN report emphasised the importance of fibre and the impact of the inadequate consumption of fibre in UK diets. A study comparing NDNS reports from 2008/09 and 2016/17 found that despite improvements in the nutritional quality of food products with increasing amounts of fibre, overall fibre intakes have remained fairly stable across these years (Gressier & Frost, 2021). These reports also found that fibre intakes were significantly higher in adults when compared with adolescent population groups, likely secondary to the observed increased consumption of fruit and vegetables in adults. Fibre intakes were higher in the active group in comparison with the inactive group, with inactive participants

consuming extremely inadequate intakes of fibre. Although there is limited research investigating the correlation between fibre intakes and rates of physical activity, studies have found that individuals who value health, report greater intakes of fibre and also tend to make similar healthy lifestyle choices such as engaging in regular physical activity (Birkenhead & Slater, 2015). However, it is unknown whether the reported link between healthier lifestyle choices and exercise observed in the general population also applies to athletes as their exercise motives can differ from those of the general population and dietary habits are often solely performance-related rather than health-conscious (Thomas et al., 2016).

There was no difference in fibre consumption between male and female participants and these results have been replicated in previous research (Fernstrand et al., 2017). Although, one study found that women had consistently similar intakes of fibre (around 15g/day) irrespective of health status, whereas disparities in male intakes were much larger. Men who recorded a low health rating ate 0-10g of fibre per day, compared with males who reported a high health rate consuming 15-25g of fibre (Bennett et al., 2018). This therefore suggests that although average intakes are similar between genders, fibre intakes in the male population have greater variation.

Dietary fibre is associated with overall metabolic health through key pathways including insulin sensitivity and the promotion of the gut microbiome, with increased intakes of fibre subsequently reducing the prevalence of multiple comorbidities such as certain types of cancers and heart disease (Barber et al., 2020). The optimisation of fibre within diets represents an important public health strategy, with previous strategies involving enriching food products. It is therefore crucial that future health initiatives have a major focus on encouraging individuals to increase their fibre intake.

Active participants consumed higher quantities of fibre in their diet than inactive participants and there were no differences in fibre intake between genders. However, generally, fibre intakes were insufficient.

5.11 Gender and nutritional intakes

No difference was observed in any aspect of dietary practices when comparing the diets of male and female participants. However, this is not consistent with previous findings which have found that women typically eat healthier than men when looking at intakes of fruit and vegetables, whole grains, saturated fat, fatty meats, alcohol, and sugar (Kiefer et al., 2005). These results are not specific to the UK, with a meta-analysis comparing intakes in 187 countries finding that women consistently had better dietary patterns than men (Imamura et al., 2015). The study also found that dietary practices were better in older adults, although this study did not investigate age when comparing dietary intakes.

During the data collection of the food diaries, adequate proportions of active and inactive participants were prioritised, and therefore gender was not equally distributed, with only 38% of the sample being males. As these findings are not consistent with those from previous studies, the results are therefore not generalisable to the UK population when investigating dietary practices of genders.

Although no differences were observed between the dietary intakes of male and female participants, this is not consistent with previous research.

5.12 Limitations

Hydration was not included in the dietary analysis as not all participants included water volumes in their food diaries, although this is an important component of a healthy diet and should be accounted for in future studies. Previous research observing fluid intakes in the UK population reported that adults do not typically meet adequate water intakes, and often rely on alternative fluids for hydration, which are often higher in sugar or contain large amounts of caffeine (Gandy, 2012).

Despite ensuring that all possible measures were taken to avoid methodological issues, a few limitations were presented during data collection and analysis. Due to the opportunistic sampling method used for data collection, there is likely to be a sampling bias from the groups who chose to respond. This is demonstrated as there are very high numbers of physically active participants, with 75% of total questionnaire participants reporting adhering to government guidelines. This does not correlate with current data of physical activity levels amongst the UK population. Health Survey England reports that only 62% of the UK adult population adheres to physical activity guidelines of 150 minutes of moderate exercise per week (NHS, 2017).

Additionally, the use of self-reported food diaries has its well-established limitations, including misreporting, altering eating patterns to suit social norms, and inaccurate recordings due to fear of judgment. However, these were minimised by removing any meal or timing prompts and advising participants that all diaries would remain anonymous (Ravelli & Schoeller, 2020). Another limitation of self-reported food diaries are that they rely on participants honesty and reliability with the dietary recalls. In this study, estimations were made during the food diary inputting, including estimations of portion sizes based on participants descriptions and quantities of ingredients used. This therefore reduces the accuracy of the dietary analysis. This could be minimised by either asking participants to weigh their foods, although this is particularly invasive and time-consuming, or participants could have been asked to take pictures of their meals to gage a better estimation of portion sizes.

5.13 Future research

Studies have observed that increased nutritional knowledge is positively correlated with the consumption of healthier diets and adherence to healthier dietary practices (Wardle et al., 2000). In this study food diaries were recorded irrespective of questionnaire scores and due to the questionnaire being anonymous, comparisons could not be made between nutritional knowledge scores and actual dietary practices. This would be beneficial to determine the direct influence of nutritional knowledge and dietary practices and therefore identify whether improvement in nutritional education alone would help to influence better dietary habits across the UK population. Future research should aim to assess the influence of nutritional knowledge directly on nutritional practices and dietary intake. This will help to accurately evaluate the effectiveness of current health initiatives in reducing the prevalence of obesity in the UK population and to identify if improving nutritional knowledge should be a key focus for future public health strategies

Chapter 6 **Conclusion**

Total scores from the GNKQ were relatively high across all participants and no difference was seen in total scores between participant characteristics such as gender or physical activity status, although nutritional knowledge was seen to increase with age groups. Perceived rates of nutritional knowledge were fairly accurate against total questionnaire scores, with individuals accurately reporting their level of nutritional knowledge. Male participants were more physically active than female participants and typically had higher BMIs, although BMI did not correlate with improved nutritional knowledge or improved dietary intake. The use of the BMI equation may not be the most accurate measure of health and levels of fat adiposity and the use of more extensive measurements such as skin folds may be more appropriate when categorising participants as overweight or obese. The respondents for the GNKQ were a particularly active group of individuals and higher rates of physical activity were recorded compared with the general statistics of the UK population, therefore this sample may not be a true representation.

Energy intakes from the food record diaries were similar for both the inactive and active participant groups when compared with individuals' estimated requirements. However, it is suggested by the overweight BMI classification that inactive participants were likely to have underreported their energy intake. Despite overall calorie intakes being similar, active participants did consume healthier diets, with higher intakes of both fibre and fruit and vegetables. Whereas inactive participants typically ate unhealthier diets and consumed excessive intakes of protein. Although no differences were observed between the dietary intakes of male and female participants, this is not consistent with previous research which has observed healthier diets in the female population.

Nutritional knowledge amongst the UK population is adequate, with average participant scores of 74% in the General nutritional knowledge questionnaire. Despite no difference in knowledge between genders and physical activity status, nutritional intakes were healthier in active participants. More research is required to coordinate a direct relationship between individuals' nutritional knowledge and nutritional practices. This will help to better understand current dietary trends and to develop the most effective health initiatives to coordinate successful behaviour change and combat the ever-increasing rates of obesity in the UK.

References

- Afshin, A. *et al.* (2014) 'Dietary policies to reduce non-communicable diseases', *The Handbook of Global Health Policy*, pp. 175–193. doi:10.1002/9781118509623.ch9.
- Alahmadi, A.K. and Albassam, R.S. (2023) 'Assessment of general and sports nutrition knowledge, dietary habits, and nutrient intake of physical activity practitioners and athletes in Riyadh, Saudi Arabia', *Nutrients*, 15(20). doi:10.3390/nu15204353.
- Alves, A.G., Lima, M.F. and Silva, M.S. (2020) 'Dietary fat intake had a different influence on body mass index in active and inactive subjects: A cross-sectional study', *Journal of Health Sciences*, 22(2), pp. 164–170. doi:10.17921/2447-8938.2020v22n2p164-170.
- Andrews, D., Nonnecke, B. and Preece, J. (2010) 'Electronic survey methodology: A case study in reaching hard-to-involve internet users', *International Journal of Human-Computer Interaction*, 16(2), pp. 185–210. doi:10.1207/s15327590ijhc1602_04.
- Ayyıldız, F. *et al.* (2023) 'Emotional and intuitive eating: An emerging approach to eating behaviours related to obesity', *Journal of Nutritional Science*, 12. doi:10.1017/jns.2023.11.
- Bailey, P., Pritchard, G. and Kernohan, H. (2015) 'Gamification in market research', *International Journal of Market Research*, 57(1), pp. 17–28. doi:10.2501/ijmr-2015-003.
- Ball, H.L. (2019) 'Conducting online surveys', *Journal of Human Lactation*, 35(3), pp. 413–417. doi:10.1177/0890334419848734.
- Baranowski, T. and Wansink, B. (2008) 'Mindless eating: Why we eat more than we think', *The American Journal of Clinical Nutrition*, 87(3). doi:10.1093/ajcn/87.3.795.
- Barber, T.M. *et al.* (2020) 'The health benefits of dietary fibre', *Nutrients*, 12(10). doi:10.3390/nu12103209.
- Barber, T.M. *et al.* (2020) 'The health benefits of dietary fibre', *Nutrients*, 12(10), p. 3209. doi:10.3390/nu12103209.
- Barbosa, L.B. *et al.* (2016) 'Estudos de Avaliação do Conhecimento nutricional de Adultos: Uma Revisão Sistemática', *Ciência & Saúde Coletiva*, 21(2), pp. 449–462. doi:10.1590/1413-81232015212.20182014.
- Bawadi, H. *et al.* (2021) 'Validity and reproducibility of a food frequency questionnaire to assess macro and micro-nutrient intake among a convenience cohort of healthy adult Qataris', *Nutrients*, 13(6). doi:10.3390/nu13062002.
- BDA (2024) *Fibre*, British Dietetic Association. Available at: <https://www.bda.uk.com/resource/fibre.html> (Accessed: 14 May 2024).
- Beaulieu, K. *et al.* (2019) 'Exercise training reduces reward for high-fat food in adults with overweight/obesity', *Medicine & Science in Sports & Exercise*, 52(4), pp. 900–908. doi:10.1249/mss.0000000000002205.
- Beck, K. *et al.* (2015) 'Role of nutrition in performance enhancement and postexercise recovery', *Open Access Journal of Sports Medicine*, p. 259. doi:10.2147/oajsm.s33605.

- Bennett, E., Peters, S.A. and Woodward, M. (2018) 'Sex differences in macronutrient intake and adherence to dietary recommendations: Findings from the UK Biobank', *BMJ Open*, 8(4). doi:10.1136/bmjopen-2017-020017.
- Birkenhead, K.L. and Slater, G. (2015) 'A review of factors influencing athletes' food choices', *Sports Medicine*, 45(11), pp. 1511–1522. doi:10.1007/s40279-015-0372-1.
- Bisogni, C.A. *et al.* (2002) 'Who we are and how we eat: A qualitative study of identities in Food Choice', *Journal of Nutrition Education and Behavior*, 34(3), pp. 128–139. doi:10.1016/s1499-4046(06)60082-1.
- Blundell, J.E. (2000) 'What foods do people habitually eat? A dilemma for nutrition, an Enigma for Psychology', *The American Journal of Clinical Nutrition*, 71(1), pp. 3–5. doi:10.1093/ajcn/71.1.3.
- BNF (2024) *Fat*, British Nutrition Foundation. Available at: <https://www.nutrition.org.uk/nutritional-information/fat/> (Accessed: 06 May 2024).
- Boidin, A. *et al.* (2020) 'The effectiveness of nutrition education programmes on improving dietary intake in athletes: A systematic review', *British Journal of Nutrition*, 125(12), pp. 1359–1373. doi:10.1017/s0007114520003694.
- Broad, J. and Wallace, M. (2018) 'Nutrition and public health in medical education in the UK: Reflections and next steps', *Public Health Nutrition*, 21(13), pp. 2523–2525. doi:10.1017/s1368980018000800.
- Centers for Disease Control and Prevention (2022) *Chronic disease fact sheets, Poor nutrition*, National Center for Chronic Disease Prevention and Health Promotion. Available at: <https://www.cdc.gov/chronicdisease/resources/publications/factsheets/nutrition.htm#:~:text=Consuming%20unhealthy%20food%20and%20beverages,in%20postmenopausal%20women%2C%20and%20colorectal> (Accessed: 09 March 2024).
- Centers for Disease Control and Prevention (2023) *Benefits of physical activity*, Centers for Disease Control and Prevention. Available at: <https://www.cdc.gov/physicalactivity/basics/pa-health/index.htm#:~:text=Regular%20physical%20activity%20is%20one,ability%20to%20do%20everyday%20activities>. (Accessed: 09 March 2024).
- Cogan, J.C. and Ernsberger, P. (2002) 'Dieting, weight, and Health: Reconceptualizing Research and policy', *Journal of Social Issues*, 55(2), pp. 187–205. doi:10.1111/0022-4537.00112.
- Conroy, D.E. *et al.* (2015) 'Daily physical activity and alcohol use across the adult lifespan.', *Health Psychology*, 34(6), pp. 653–660. doi:10.1037/hea0000157.
- Dahle, J. *et al.* (2021) 'Underreporting of energy intake in weight loss maintainers', *The American Journal of Clinical Nutrition*, 114(1), pp. 257–266. doi:10.1093/ajcn/nqab012.
- De Vriendt, T. *et al.* (2009) 'Determinants of nutrition knowledge in young and middle-aged Belgian women and the association with their dietary behaviour', *Appetite*, 52(3), pp. 788–792. doi:10.1016/j.appet.2009.02.014.
- De Vriendt, T. *et al.* (2009) *Determinants of nutrition knowledge in young and middle-aged Belgian women and the association with their dietary behaviour*, 52(3), pp. 788–792. doi:10.1016/j.appet.2009.02.014.

- Dehghan, M., Akhtar-Danesh, N. and Merchant, A.T. (2011) 'Factors associated with fruit and vegetable consumption among adults', *Journal of Human Nutrition and Dietetics*, 24(2), pp. 128–134. doi:10.1111/j.1365-277x.2010.01142.x.
- Delimaris, I. (2013) 'Adverse effects associated with protein intake above the recommended dietary allowance for adults', *ISRN Nutrition*, 2013, pp. 1–6. doi:10.5402/2013/126929.
- Delimaris, I. (2013) 'Adverse effects associated with protein intake above the recommended dietary allowance for adults', *ISRN Nutrition*, 2013, pp. 1–6. doi:10.5402/2013/126929.
- Department of Health (1991) *Report 41: Dietary reference values for food energy and nutrients for the United Kingdom*.
- Department of Health and Social care (2019) *UK Chief Medical Officers' Physical Activity Guidelines*, Department of Health and Social care. Available at: <https://assets.publishing.service.gov.uk/media/5d839543ed915d52428dc134/uk-chief-medical-officers-physical-activity-guidelines.pdf> (Accessed: 09 March 2024).
- Department of health and social care (2020) *Tackling obesity: Empowering adults and children to live healthier lives*, GOV.UK. Available at: <https://www.gov.uk/government/publications/tackling-obesity-government-strategy/tackling-obesity-empowering-adults-and-children-to-live-healthier-lives> (Accessed: 11 March 2024).
- Department of health and social care (2020) *Tackling obesity: government strategy*, GOV.UK. Available at: <https://www.gov.uk/government/publications/tackling-obesity-government-strategy> (Accessed: 09 March 2024).
- Department of Health and Social Care (2022) *Physical activity for adults and older adults: 19 and over*, GOV.UK. Available at: <https://www.gov.uk/government/publications/physical-activity-guidelines-adults-and-older-adults/physical-activity-for-adults-and-older-adults-19-and-over-text-of-the-infographic> (Accessed: 09 February 2024).
- Department of health and social care (2023) 'Government plans to tackle obesity in England', *Department of Health and Social Care Media Centre* [Preprint]. doi:10.12775/jehs.2022.12.07.031.
- Devlin, B.L. *et al.* (2017) 'Dietary intake, body composition, and nutrition knowledge of Australian football and soccer players: Implications for sports nutrition professionals in practice', *International Journal of Sport Nutrition and Exercise Metabolism*, 27(2), pp. 130–138. doi:10.1123/ijsnem.2016-0191.
- Dhurandhar, N. *et al.* (2014) 'Energy balance measurement: When something is not better than nothing', *International Journal of Obesity*, 39(7), pp. 1109–1113. doi:10.1038/ijo.2014.199.
- Drichoutis, A.C. (2005) 'Nutrition knowledge and consumer use of nutritional food labels', *European Review of Agriculture Economics*, 32(1), pp. 93–118. doi:10.1093/erae/jbi003.
- Ebbeling, C.B. *et al.* (2018) 'A randomized study of dietary composition during weight-loss maintenance: Rationale, study design, intervention, and assessment', *Contemporary Clinical Trials*, 65, pp. 76–86. doi:10.1016/j.cct.2017.12.004.

- Egli, T. *et al.* (2011) 'Influence of age, sex, and Race on college students' exercise motivation of physical activity', *Journal of American College Health*, 59(5), pp. 399–406. doi:10.1080/07448481.2010.513074.
- Fayet-Moore, F. *et al.* (2018) 'Dietary fibre intake in Australia. paper I: Associations with demographic, socio-economic, and anthropometric factors', *Nutrients*, 10(5), p. 599. doi:10.3390/nu10050599.
- Fernstrand, A.M. *et al.* (2017) 'Dietary intake of fibers: Differential effects in men and women on perceived general health and immune functioning', *Food & Nutrition Research*, 61(1), p. 1297053. doi:10.1080/16546628.2017.1297053.
- Firth, J. *et al.* (2020) 'Food and mood: How do diet and nutrition affect mental wellbeing?', *BMJ*, p. m2382. doi:10.1136/bmj.m2382.
- Fleig, L. *et al.* (2011) 'Intervention effects of exercise self-regulation on physical exercise and eating fruits and vegetables: A longitudinal study in orthopedic and Cardiac Rehabilitation', *Preventive Medicine*, 53(3), pp. 182–187. doi:10.1016/j.ypmed.2011.06.019.
- Gandy, J. (2012) 'First findings of the United Kingdom Fluid Intake Study', *Nutrition Today*, 47(4). doi:10.1097/nt.0b013e31826265e3.
- Girois, S. *et al.* (2001) 'A comparison of knowledge and attitudes about diet and health among 35- to 75-year-old adults in the United States and Geneva, Switzerland', *American Journal of Public Health*, 91(3), pp. 418–424. doi:10.2105/ajph.91.3.418.
- Gough, B. and Conner, M.T. (2006) 'Barriers to healthy eating amongst men: A qualitative analysis', *Social Science & Medicine*, 62(2), pp. 387–395. doi:10.1016/j.socscimed.2005.05.032.
- Graupensperger, S. *et al.* (2019) 'Perceptions of groupness during fitness classes positively predict recalled perceptions of exertion, enjoyment, and affective valence: An intensive longitudinal investigation.', *Sport, Exercise, and Performance Psychology*, 8(3), pp. 290–304. doi:10.1037/spy0000157.
- Gressier, M. and Frost, G. (2021) 'Minor changes in fibre intake in the UK population between 2008/2009 and 2016/2017', *European Journal of Clinical Nutrition*, 76(2), pp. 322–327. doi:10.1038/s41430-021-00933-2.
- Grunert, K.G., Wills, J.M. and Fernández-Celemín, L. (2010) *Nutrition knowledge, and use and understanding of nutrition information on food labels among consumers in the UK*, 55(2), pp. 177–189. doi:10.1016/j.appet.2010.05.045.
- Guedes, D.P. and Santos Silva, A.L. dos (2021) 'Exercise and fruit/vegetable intake, and their associations with body weight status in university students', *Official organ of the Spanish Society of Parenteral and Enteral Nutrition*, 38(3), pp. 545–554.
- Guo, Y. *et al.* (2014) 'Socioeconomic status and the prevalence of health problems among married couples in late midlife', *American Journal of Public Health*, 91(1), pp. 131–135. doi:10.2105/ajph.91.1.131.
- Guthold, R. *et al.* (2008) 'Worldwide variability in physical inactivity', *American Journal of Preventive Medicine*, 34(6), pp. 486–494. doi:10.1016/j.amepre.2008.02.013.

- Gutin, I. (2017) 'In BMI We Trust: Reframing the body mass index as a measure of Health', *Social Theory & Health*, 16(3), pp. 256–271. doi:10.1057/s41285-017-0055-0.
- Haase, A. *et al.* (2004) 'Leisure-time physical activity in university students from 23 countries: Associations with health beliefs, risk awareness, and National Economic Development', *Preventive Medicine*, 39(1), pp. 182–190. doi:10.1016/j.ypmed.2004.01.028.
- Hakli, G. *et al.* (2016) 'Nutritional knowledge and behavior of adults: Their relations with sociodemographic factors', *Pakistan Journal of Nutrition*, 15(6), pp. 532–539. doi:10.3923/pjn.2016.532.539.
- Hansbro, J. and Bridgwood, A. (1997) 'What people know, what people think, what people do : a survey of adults aged 16-74 in England', *Health in England 1996* [Preprint].
- Hartmann, C., Dohle, S. and Siegrist, M. (2015) 'A self-determination theory approach to adults' healthy body weight motivation: A longitudinal study focussing on food choices and recreational physical activity', *Psychology & Health*, 30(8), pp. 924–948. doi:10.1080/08870446.2015.1006223.
- Hassapidou, M. (2011) 'Carbohydrate requirements of elite athletes', *British Journal of Sports Medicine*, 45(2).
- Health Survey for England (2022) *Overweight and obesity in adults, NHS choices*. Available at: <https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2021/overweight-and-obesity-in-adults> (Accessed: 09 March 2024).
- Health Survey for England, 2021: Data tables (2022) *NHS digital*. Available at: <https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2021/health-survey-for-england-2021-data-tables> (Accessed: 11 March 2024).
- Heaney, S. *et al.* (2011) 'Nutrition knowledge in athletes: A systematic review', *International Journal of Sport Nutrition and Exercise Metabolism*, 21(3), pp. 248–261. doi:10.1123/ijsnem.21.3.248.
- Heinberg, L.J. *et al.* (2000) 'Body image and weight loss maintenance in elderly African American hypertensives', *American Journal of Health Behavior*, 24(3), pp. 163–173. doi:10.5993/ajhb.24.3.1.
- Higgs, S. (2015) 'Social norms and their influence on eating behaviours', *Appetite*, 86, pp. 38–44. doi:10.1016/j.appet.2014.10.021.
- Hopkins, C.S. *et al.* (2022) 'A systematic review of factors associated with sport participation among adolescent females', *International Journal of Environmental Research and Public Health*, 19(6). doi:10.3390/ijerph19063353.
- Imamura, F. *et al.* (2015) 'Dietary quality among men and women in 187 countries in 1990 and 2010: A systematic assessment', *The Lancet Global Health*, 3(3), pp. 132–142. doi:10.1016/s2214-109x(14)70381-x.
- Janevic, M.R., McLaughlin, S.J. and Connell, C.M. (2012) 'Overestimation of physical activity among a nationally representative sample of underactive individuals with diabetes', *Medical Care*, 50(5), pp. 441–445. doi:10.1097/mlr.0b013e3182422a52.

- Jones, N.R., Tong, T.Y. and Monsivais, P. (2017) 'Meeting UK dietary recommendations is associated with higher estimated consumer food costs: An analysis using the National Diet and Nutrition Survey and Consumer Expenditure Data, 2008–2012', *Public Health Nutrition*, 21(5), pp. 948–956. doi:10.1017/s1368980017003275.
- Joo, J. *et al.* (2019) 'The influence of 15-week exercise training on dietary patterns among young adults', *International Journal of Obesity*, 43(9), pp. 1681–1690. doi:10.1038/s41366-018-0299-3.
- Khawandanah, J. and Tewfik, I. (2016) 'FAD diets: Lifestyle promises and health challenges', *Journal of Food Research*, 5(6). doi:10.5539/jfr.v5n6p80.
- Kiefer, I., Rathmanner, T. and Kunze, M. (2005) 'Eating and dieting differences in men and women', *The Journal of Men's Health & Gender*, 2(2), pp. 194–201. doi:10.1016/j.jmhg.2005.04.010.
- Kiefer, I., Rathmanner, T. and Kunze, M. (2005) 'Eating and dieting differences in men and women', *The Journal of Men's Health & Gender*, 2(2), pp. 194–201. doi:10.1016/j.jmhg.2005.04.010.
- Kliemann, N. *et al.* (2016) 'Reliability and validity of a revised version of the General Nutrition Knowledge Questionnaire', *European Journal of Clinical Nutrition*, 70(10), pp. 1174–1180. doi:10.1038/ejcn.2016.87.
- Kliemann, N. *et al.* (2016) 'Reliability and validity of a revised version of the General Nutrition Knowledge Questionnaire', *European Journal of Clinical Nutrition*, 70(10), pp. 1174–1180. doi:10.1038/ejcn.2016.87.
- Kliemann, N. *et al.* (2016) 'Reliability and validity of a revised version of the General Nutrition Knowledge Questionnaire', *European Journal of Clinical Nutrition*, 70(10), pp. 1174–1180. doi:10.1038/ejcn.2016.87.
- Köhler-Forsberg, O. *et al.* (2019) 'Efficacy of anti-inflammatory treatment on major depressive disorder or depressive symptoms: Meta-analysis of clinical trials', *Acta Psychiatrica Scandinavica*, 139(5), pp. 404–419. doi:10.1111/acps.13016.
- Lassale, C. *et al.* (2018) 'Healthy Dietary Indices and risk of depressive outcomes: A systematic review and meta-analysis of observational studies', *Molecular Psychiatry*, 24(7), pp. 965–986. doi:10.1038/s41380-018-0237-8.
- Maggini, S., Pierre, A. and Calder, P. (2018) 'Immune function and micronutrient requirements change over the life course', *Nutrients*, 10(10), p. 1531. doi:10.3390/nu10101531.
- Martins, C., Morgan, L. and Truby, H. (2008) 'A review of the effects of exercise on appetite regulation: An obesity perspective', *International Journal of Obesity*, 32(9), pp. 1337–1347. doi:10.1038/ijo.2008.98.
- Meeuwssen, S., Horgan, G.W. and Elia, M. (2010) 'The relationship between BMI and percent body fat, measured by bioelectrical impedance, in a large adult sample is curvilinear and influenced by age and sex', *Clinical Nutrition*, 29(5), pp. 560–566. doi:10.1016/j.clnu.2009.12.011.
- Mete, R. *et al.* (2019) 'What is healthy eating? A qualitative exploration', *Public Health Nutrition*, 22(13), pp. 2408–2418. doi:10.1017/s1368980019001046.

- Mohan, V. *et al.* (2018) 'Are excess carbohydrates the main link to diabetes & its complications in Asians?', *Indian Journal of Medical Research*, 148(5), pp. 531–538. doi:10.4103/ijmr.ijmr_1698_18.
- Naughton, P., McCarthy, S.N. and McCarthy, M.B. (2015) 'The creation of a healthy eating motivation score and its association with Food Choice and physical activity in a cross sectional sample of Irish adults', *International Journal of Behavioral Nutrition and Physical Activity*, 12(1). doi:10.1186/s12966-015-0234-0.
- NHS (2017) *Physical activity in adults*, *Health Survey for England*. Available at: <http://healthsurvey.hscic.gov.uk/support-guidance/public-health/health-survey-for-england-2016/physical-activity-in-adults.aspx#:~:text=66%25%20of%20men%20and%2058,of%2010%20minutes%20or%20more>. (Accessed: 06 May 2024).
- NHS (2018) *Fruit & Vegetables*, *Health Survey for England*. Available at: <http://healthsurvey.hscic.gov.uk/data-visualisation/data-visualisation/explore-the-trends/fruit-vegetables.aspx> (Accessed: 06 May 2024).
- NHS (2021) *Statistics on Obesity, Physical Activity and Diet, England 2021*, *NHS Digital*. Available at: <https://digital.nhs.uk/data-and-information/publications/statistical/statistics-on-obesity-physical-activity-and-diet/england-2021> (Accessed: 11 March 2024).
- NHS (2022) *Eating a balanced diet*, *NHS UK*. Available at: <https://www.nhs.uk/live-well/eat-well/how-to-eat-a-balanced-diet/eating-a-balanced-diet/> (Accessed: 09 March 2024).
- NHS (2023) *National Child Measurement Programme*, *NHS Digital*. Available at: <https://digital.nhs.uk/data-and-information/publications/statistical/national-child-measurement-programme> (Accessed: 11 March 2024).
- Niemiro, G., Rewane, A. and Algotar, A. (2023) *Exercise and fitness effect on obesity*, *StatPearls [Internet]*. Available at: <https://www.ncbi.nlm.nih.gov/books/NBK539893/> (Accessed: 11 March 2024).
- Nunes, C.L. *et al.* (2023) 'The impact of body composition on the degree of misreporting of Food Diaries', *European Journal of Clinical Nutrition* [Preprint]. doi:10.1038/s41430-023-01382-9.
- Nutritics (2024) Nutritics Products. Available at : <https://www.nutritics.com/app/#> [Accessed 26 January 2024].
- Office for Health Improvement and Disparities (2024) *The Eatwell Guide*, *GOV.UK*. Available at: <https://www.gov.uk/government/publications/the-eatwell-guide> (Accessed: 09 March 2024).
- Parmenter, K. and Wardle, J. (1999) 'Development of a general nutrition knowledge questionnaire for adults', *European Journal of Clinical Nutrition*, 53(4), pp. 298–308. doi:10.1038/sj.ejcn.1600726.
- Parmenter, K., Waller, J. and Wardle, J. (2000) 'Demographic variation in Nutrition Knowledge in England', *Health Education Research*, 15(2), pp. 163–174. doi:10.1093/her/15.2.163.
- Parmenter, K., Waller, J. and Wardle, J. (2000) 'Demographic variation in Nutrition Knowledge in England', *Health Education Research*, 15(2), pp. 163–174. doi:10.1093/her/15.2.163.

- Pawlas, A. *et al.* (2022) 'Nutritional knowledge and nutritional status of the recreationally active population', *Journal of Education, Health and Sport*, 12(7), pp. 330–339. doi:10.12775/jehs.2022.12.07.031.
- Pelletier, L.G. *et al.* (2004) 'Why do you regulate what you eat? relationships between forms of regulation, eating behaviors, sustained dietary behavior change, and psychological adjustment', *Motivation and Emotion*, 28(3), pp. 245–277. doi:10.1023/b:moem.0000040154.40922.14.
- Piazza-Gardner, A.K. and Barry, A.E. (2012) 'Examining physical activity levels and alcohol consumption: Are people who drink more active?', *American Journal of Health Promotion*, 26(3), pp. 95–104. doi:10.4278/ajhp.100929-lit-328.
- Prescott, C. (2020) *Internet access – households and individuals, Great Britain: 2020, Office for National Statistics*. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/bulletins/internetaccesshouseholdsandindividuals/2020> (Accessed: 09 February 2024).
- Public Health England (2018) *PHE publishes latest data on nation's Diet*, GOV.UK. Available at: <https://www.gov.uk/government/news/phe-publishes-latest-data-on-nations-diet> (Accessed: 30 March 2024).
- Puhl, R.M. and Heuer, C.A. (2009) 'The stigma of obesity: A review and update', *Obesity*, 17(5), pp. 941–964. doi:10.1038/oby.2008.636.
- Ravelli, M. and Schoeller, D. (2020) 'Traditional self-reported dietary instruments are prone to inaccuracies and new approaches are needed', *Frontiers in Nutrition*, 7(3). doi:10.3389/fnut.2020.00090.
- Read, J.P. and Brown, R.A. (2003) 'The role of physical exercise in alcoholism treatment and recovery.', *Professional Psychology: Research and Practice*, 34(1), pp. 49–56. doi:10.1037/0735-7028.34.1.49.
- SACN (2019) *Saturated fats and health, Scientific advisory committee and nutrition*. Available at: https://assets.publishing.service.gov.uk/media/5d1f88af40f0b609dba90ddc/SACN_report_on_saturated_fat_and_health.pdf.
- Salari-Moghaddam, A. *et al.* (2018) 'Glycemic index, glycemic load, and depression: A systematic review and meta-analysis', *European Journal of Clinical Nutrition*, 73(3), pp. 356–365. doi:10.1038/s41430-018-0258-z.
- Savage, J.S., Fisher, J.O. and Birch, L.L. (2007) 'Parental influence on eating behavior: Conception to adolescence', *Journal of Law, Medicine & Ethics*, 35(1), pp. 22–34. doi:10.1111/j.1748-720x.2007.00111.x.
- Sedgwick, P. (2014) 'Cross sectional studies: Advantages and disadvantages', *BMJ*, 348(2). doi:10.1136/bmj.g2276.
- Seidelmann, S., Claggett, B. and Cheng, S. (2018) 'Dietary carbohydrate intake and mortality: a prospective cohort study and meta-analysis', *Lancet Public Health*, 3(9), pp. 419–428. doi:10.1016/S2468-2667(18)30135-X.

- Simmonds, M. *et al.* (2015) 'Predicting adult obesity from childhood obesity: A systematic review and meta-analysis', *Obesity Reviews*, 17(2), pp. 95–107. doi:10.1111/obr.12334.
- Sobal, J. (2005) 'Men, meat, and marriage: Models of masculinity', *Food and Foodways*, 13(1–2), pp. 135–158. doi:10.1080/07409710590915409.
- Södergren, M. *et al.* (2012) 'Associations between fruit and vegetable intake, leisure-time physical activity, sitting time and self-rated health among older adults: Cross-sectional data from the well study', *BMC Public Health*, 12(1). doi:10.1186/1471-2458-12-551.
- Sodhi, M. (2010) 'TV Viewing versus Play - Trends and Impact on Obesity', *Online Journal of Health and Allied Sciences*, 9(2), p. 1. doi:10.4103/2278-344x.96404.
- Sommer, I. *et al.* (2020) 'The performance of anthropometric tools to determine obesity: A systematic review and meta-analysis', *Scientific Reports*, 10(1). doi:10.1038/s41598-020-69498-7.
- Spronk, I. *et al.* (2014) 'Relationship between nutrition knowledge and dietary intake', *British Journal of Nutrition*, 111(10), pp. 1713–1726. doi:10.1017/s0007114514000087.
- Spronk, I. *et al.* (2014) 'Relationship between nutrition knowledge and dietary intake', *British Journal of Nutrition*, 111(10), pp. 1713–1726. doi:10.1017/s0007114514000087.
- Stewart, C. (2024) *BMI of individuals by gender 2021*, Statista. Available at: <https://www.statista.com/statistics/333865/bmi-of-individual-by-gender-in-england-uk/#:~:text=In%202021%2C%20the%20mean%20body,among%20both%20men%20and%20women>. (Accessed: 06 May 2024).
- Tahreem, A. *et al.* (2022) 'FAD diets: Facts and fiction', *Frontiers in Nutrition*, 9. doi:10.3389/fnut.2022.960922.
- Taillie, L.S. (2018) 'Who's cooking? trends in US Home Food Preparation by gender, education, and Race/ethnicity from 2003 to 2016', *Nutrition Journal*, 17(1). doi:10.1186/s12937-018-0347-9.
- Tammisalo, K. *et al.* (2022) 'Predictors of social media use in two family generations', *Frontiers in Sociology*, 6, pp. 1–10. doi:10.3389/fsoc.2021.813765.
- Taylor, K.A. and Humphrey Jr, W.F. (2021) 'Impact of medical blog Reading and information presentation on readers' Preventative Health Intentions: Mixed Methods, multistudy investigation', *Journal of Medical Internet Research*, 23(12). doi:10.2196/23210.
- Telford, R.M. *et al.* (2016) 'Why are girls less physically active than boys? findings from the Look Longitudinal Study', *PLOS ONE*, 11(3). doi:10.1371/journal.pone.0150041.
- Thomas, D.T., Erdman, K.A. and Burke, L.M. (2016) 'Nutrition and athletic performance', *Medicine & Science in Sports & Exercise*, 48(3), pp. 543–568. doi:10.1249/mss.0000000000000852.
- Trakman, G. *et al.* (2017) 'Developing and validating a nutrition knowledge questionnaire: Key methods and considerations', *Public Health Nutrition*, 20(15), pp. 2670–2679. doi:10.1017/s1368980017001471.
- Tramontt, C.R. *et al.* (2023) 'Do markers of adiposity and glycaemia mediate the association between low carbohydrate diet and cardiovascular risk factors: Findings from the UK national diet and

- nutrition survey (NDNS) 2008–2016’, *BMJ Nutrition, Prevention & Health*, 6(2), pp. 153–163. doi:10.1136/bmjnp-2022-000551.
- van der Avoort, C. *et al.* (2021) ‘Higher levels of physical activity are associated with greater fruit and vegetable intake in older adults’, *The Journal of nutrition, health and aging*, 25(2), pp. 230–241. doi:10.1007/s12603-020-1520-3.
- Wardle, J., Parmenter, K. and Waller, J. (2000) ‘Nutrition Knowledge and Food Intake’, *Nutrition knowledge and food intake*, 34(3), pp. 269–275. doi:10.1006/appe.1999.0311.
- Wardle, J., Parmenter, K. and Waller, J. (2000a) ‘Nutrition Knowledge and Food Intake’, *Appetite*, 34(3), pp. 269–275. doi:10.1006/appe.1999.0311.
- WHO (2012) *Guideline: Potassium intake for adults and children*, World Health Organization. Available at: <https://www.who.int/publications/i/item/9789241504829> (Accessed: 11 March 2024).
- WHO (2012) *Guideline: Sodium intake for adults and children*, World Health Organization. Available at: <https://www.who.int/publications/i/item/9789241504836> (Accessed: 11 March 2024).
- WHO (2020) *Healthy diet*, World Health Organization. Available at: <https://www.who.int/news-room/fact-sheets/detail/healthy-diet> (Accessed: 09 March 2024).
- WHO (2024) *Nutrition*, World Health Organization. Available at: https://www.who.int/health-topics/nutrition#tab=tab_1 (Accessed: 11 March 2024).
- WHO (2024) *Unhealthy Diet and Noncommunicable diseases*, World Health Organization. Available at: <https://www.emro.who.int/noncommunicable-diseases/causes/unhealthy-diets.html> (Accessed: 09 March 2024).
- Whybrow, S., Horgan, G.W. and Macdiarmid, J.I. (2020) ‘Self-reported food intake decreases over recording period in the National Diet and Nutrition Survey’, *British Journal of Nutrition*, 124(6), pp. 586–590. doi:10.1017/s000711452000118x.
- Wilson, P.M. and Rodgers, W.M. (2002) ‘The relationship between exercise motives and physical self-esteem in female exercise participants: An application of self-determination Theory1’, *Journal of Applied Biobehavioral Research*, 7(1), pp. 30–43. doi:10.1111/j.1751-9861.2002.tb00074.x.
- Whicher, C.A., O’Neill, S. and Holt, R.I. (2020) ‘Diabetes in the UK: 2019’, *Diabetic Medicine*, 37(2), pp. 242–247. doi:10.1111/dme.14225.
- World Health Organization. (2024) *Obesity and overweight*, Available at: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight> (Accessed: 06 May 2024).
- Wu, G. (2016) ‘Dietary protein intake and human health’, *Food & Function*, 7(3), pp. 1251–1265. doi:10.1039/c5fo01530h.
- Yahia, N. *et al.* (2015) ‘Assessment of weight status, dietary habits and beliefs, physical activity, and nutritional knowledge among university students’, *Perspectives in Public Health*, 136(4), pp. 231–244. doi:10.1177/1757913915609945.

Appendices

Appendix 1 – Guide to completing an accurate food diary

Completing an accurate food diary

General tips:

- Try to write down foods and drinks consumed as soon as possible after eating/drinking, whilst the information is still fresh in your mind.
- Please do not change what you usually eat. The information in your food diary is confidential and the content will not be judged. An accurate food diary will help us to make links between dietary intake and symptoms, allowing us to tailor a dietary plan that meets your individual needs.
- Don't forget snacks, sweets and drinks, including alcohol.

Describing foods and measuring portion sizes:

- Try to give an accurate description, e.g., a sandwich is 3 foods (bread, filling and butter or spread).
- Spoons - indicate teaspoon, dessertspoon, or tablespoon, and whether they are level or heaped.
- Bread - what type of bread and how thick were the slices?
- Butter or margarine - was it spread thickly or thinly?
- Describe meat, fish, and cheese portions e.g.
 - 2 large thin slices ham
 - 2 small lamb chops (no fat eaten)
 - Small fillet of cod grilled with 1 teaspoon spread
 - Small matchbox sized portion of Cheddar cheese
- Vegetables, cereals, puddings etc. can be measured in tablespoons.
- For dishes prepared at home, please give a recipe and state the proportion eaten e.g., half a portion.
 - How was the food prepared? e.g. fried (with fat or oil), boiled, casseroled, roasted, or grilled.
- Remember to look at labels and wrappers. Write down the brand name, weights and proportions eaten
- State whether drinks are in glasses, mugs or cups and measure the volume e.g., 240ml mug of tea with semi-skimmed milk (no sugar).

Appendix 2 – Food diary recording form

Time of Day	Description of food/drink	Amount consumed

Medications and Supplements taken:

Description	Time taken