Original Research Article

Title: Methods of producing new nutrient data for popularly consumed multi ethnic foods in the UK.

Abbreviated Running Title: Methods of producing nutrient data of multi ethnic foods in the UK

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Highlights

- UK ethnic foods are popular but information on nutrient composition is lacking.
- Standardised procedures and a UK accredited lab were used to produce nutrient data.
- Quality assurance procedures ensured reliability of the nutrient data.
- These methods will be used to develop a nutrient database of UK ethnic foods.

Abstract

Minority ethnic groups in UK disproportionately suffer from nutrition related diseases compared to the mainstream population, contributing to widening health inequalities. However, reliable nutrient composition data of the traditional foods of these ethnic groups, which play an important part in their diets, is lacking. This makes it impossible to provide adequate and culturally acceptable nutrition interventions to reduce prevalent metabolic disorders. This study aimed to identify and analyse popularly consumed African and Caribbean foods in the UK for macro and micronutrients. Various approaches including **focus** group discussions, individual interviews and 24hr dietary recalls were used to identify traditional foods. Defined criteria were used to prioritise and prepare 33 composite samples (26 dishes, 4 snacks and 3 beverages) for nutrient analyses in a UK accredited laboratory. This study methodology is novel because it uses various approaches to generate new data of commonly consumed ethnic foods and traditional recipes. In addition, the approach used in preparation of the food samples enhanced their authenticity and representativeness compared to previously published work. This paper describes the procedures undertaken and analytical methods used to develop a multi ethnic nutrient data for inclusion in UK food composition tables.

Key words: Nutrient data, Multi ethnic, African, Caribbean, Food composition, Food Analysis & Composite foods

Abbreviations

EU – European Union

FAO – Food and Agricultural Organisation

FAPAS - Food Analysis Performance Assessment Scheme

FFQ – Food Frequency Questionnaire

ISO – International Organisation for Standardisation

SACN – Scientific Advisory Committee on Nutrition

UK – United Kingdom

UKAS – United Kingdom Accreditation Service

WHO – World Health Organisation

WYAS – West Yorkshire Analytical Services

1.0 Introduction

Britain has an increasingly diverse population of a broad range of ethnic groups. Currently the proportion self-identifying as other than White UK is 20% of the population, based on the 2011 census. Furthermore, this is expected to double in the next decades to between 20 and 30% by 2050 (ONS, 2015). It is widely acknowledged that some minority ethnic groups are at greater risk of diet related non-communicable chronic diseases and are more likely to be materially disadvantaged than the majority population (Smith et al. 2011). For example, in the UK, as elsewhere, ethnicity is a correlate of obesity with Black African origin groups at greatest risk (Harding et al. 2010). Further, people of Black African or South Asian descent have a 3 to 6 times elevated risk of type 2 diabetes compared with their White British counterparts, and rates of hypertension and stroke are also higher in these groups (Balfour et al. 2015; Tillin et al. 2013). Emerging evidence suggests that increased risk of type 2 diabetes and other cardiovascular disease among migrant North African groups is similar to that of South Asians. Modifiable risk factors such as healthy diet and lifestyle are important in addressing these ethnic health inequalities, and positive changes can increase life expectancy by up to 10 years (NOO, 2011; Sproston & Mindell, 2006).

Among migrant groups, traditional foods can play an important part in their diet, contributing to the maintenance of cultural customs, social networks and links with home countries (Maynard 2015). Additionally, according to the latest Mintel Report (2016 & 2017) the popularity of minority ethnic foods in the UK is increasing, and with that a rise in sales of these foods by 10% to about £4.4 billion over 2010-15 is evident. The Caribbean restaurant market, for example, is continuing to see new activity such as the ‘Turtle Bay’ chain of 25 restaurants and Levi Root’s (a British Jamaican Chef and Business man) ‘Caribbean Smokehouse’ restaurant (Mintel, 2016). According to the latest Mintel report (2016 & 2017),

there is widespread appeal (80% of British consumers) for minority ethnic cuisines with significant demand for authentic ingredients and cooking methods as well as a broad interest in trying emerging cuisines including African and Caribbean cookery. The Nielsen Company (2014) also estimated that the 'world food' market in the UK would reach over £1 billion by 2019.

Despite the increasing popularity and demand for minority ethnic foods in the UK, reliable nutrient composition data on these foods are limited. In addition, for ethnic minority populations in the UK there is limited understanding of their dietary patterns and the factors that influence them. This contributes to the lack of appropriate and culturally acceptable nutritional interventions (Davidson et al. 2013) to reduce inequalities in nutrition related disorders such as obesity, type 2 diabetes and hypertension. Furthermore, the Food and Agricultural Organisation (FAO) of the United Nations has called for analytical nutrient composition data on African foods. This is because most of the currently available data, such as The West African Food Composition Table (FAO, 2012), have to be used with caution. The West African Food Composition Table (FAO, 2012), comprises mainly of non-analytical, calculated values for cooked foods based on yield factors obtained from sources outside of the region. It also lacks analytical data on vitamins and minerals. In addition, the sampling plans used in acquiring some of the analytical data were not rigorous to represent the foods from the African region.

Given the limited number of Caribbean and African foods in the current UK nutrient database (The McCance and Widdowson's the Composition of Foods, 2015), nutritional composition data for these groups is usually limited to macronutrients, sodium and fibre obtained from food labels, manufacturer websites and West African recipe books and textbooks (Goff et al.

2015; Teller, 2010). Furthermore, the UK nutrient database comprises of old foods of minority ethnic groups (Tan et al. 1985). Even though UK Census and market reports have shown large increase in migration with increasing popularity of a wide range of immigrant/ethnic foods (Mintel, 2016 & 17; Nielsen Company, 2014; NOO, 2011; ONS, 2015 & 2017). The Scientific Advisory Committee on Nutrition (SACN, 2008), [a committee of independent scientific experts who advise Public Health England and other UK government organisations on nutrition and related health matters] and a briefing paper by Leung & Stanner (2011) have highlighted the lack of data on the nutritional status and intakes of ethnic minority groups. Reliable nutrient composition databases provide information on the nutritional value of foods consumed by individuals and populations and are essential for establishing relationships between diet and health. They also provide the foundation for the development of education programmes on choosing healthy diets (Greenfield & Southgate, 2003).

The aim of the current study was to identify and analyse popularly consumed traditional African and Caribbean dishes, snacks and beverages in the UK. This study is part of the Migrant Health Research programme at School of Clinical & Applied Sciences, Leeds Beckett University [http://www.leedsbeckett.ac.uk/research/research-areas/research-institutes/institute-for-health-and-wellbeing/migrant-health/] which takes an interdisciplinary approach to investigating migration, ethnicity and public health. One of the aims of the programme is to develop novel, reliable and comprehensive nutrient composition data for popular multi ethnic foods in the UK.

1.1 Specific objectives were to:

a. Use a range of reliable sources and approaches to identify and generate a list of popular African and Caribbean dishes, beverages and snacks in UK.

b. Define criteria to prioritise dishes, beverages and snacks for macro and micronutrient analyses.

c. Define sampling criteria and use them to collect and prepare samples for analysis in an accredited laboratory.

d. Evaluate data generated by the analyses and compile the new nutrient composition data into an Excel spreadsheet, as in the UK McCance and Widdowson's The Composition of Foods https://www.gov.uk/government/publications/composition-of-foods-integrated-dataset-cofid

2.0 Methods

2.1 Identification and generation of a list of popular traditional African and Caribbean dishes, beverages and snacks.

In order to generate a comprehensive list, a range of sources (**Table 1 and details provided in bullet points a-e**) were used to identify the key dishes, beverages and snacks eaten by the target population groups. These sources of information were used to ensure that the data were representative. The resulting initial food list was compiled into excel spreadsheets.

a. Popularly consumed traditional dishes, beverages and snacks reported in food consumption and National Diet and Nutrition Survey data (DEFRA, 2008; Nelson et al. 2007), The Health Survey for England: the Health of Minority Ethnic Groups (1999 and 2004) [Erens et al. 2001; Sproston & Mindell, 2006], as well as Black and Minority Ethnic Health in Greater Glasgow: A Comparative Report on the Health and Wellbeing of African & Caribbean, Chinese, Indian and Pakistani People and the General Population by the National Health Service Greater Glasgow (Heim & MacAskill, 2006).
b. Popularly consumed traditional dishes, beverages and snacks reported in research papers and books on nutrition, dietetics, food and food science, food consumption, dietary patterns and habits (Asante et al. 2015; Earland et al. 2010; Gandy, 2014; Gibson et al. 2015; Gilbert & Khokhar 2008; Goff et al. 2015; Leung and Stanner 2011; Scott & Rajan, 2000; Sharma et al. 1996; Sharma et al. 1999; Sharma & Cruickshank 2001; Sharma et al. 2002; Vyas et al. 2003).
c. Information on most popular traditional dishes, beverages and snacks was based on sales and their availability in the Worldfoods aisles of selected major supermarkets (Morrisons, Tesco, Asda and Sainsbury's i.e. supermarkets of largest market share in UK), in Leeds, Nottingham and London. More dishes, beverages and snacks were identified from the websites of popular ethnic food retailers (e.g. CC Continental), manufacturers (e.g. Grace, Island Sand, Tropical Sun, Sea Island, Supermalt etc) and importers (e.g. Wanis International Foods, Yadco Foods), ethnic food market stalls in Leeds (inspection of stalls and n=3 interviews with the researcher), restaurants (online menus and customer feedback as well as interview with staff from a Caribbean restaurant chain in Leeds) and takeaways (Mintel, 2016 & 2017 reports; online menus and customer feedback identified from Trip advisor; Just Eat, Hungry House, etc.).

d. Food intake data from 10 focus group discussions, 5 individual semi-structured interviews conducted by the Migrant Health research team. Participants were 61 adult males and females (age 18 years and over in the Leeds area of West Yorkshire, recruited from local hubs) of African and Caribbean ethnicity living in the area of Leeds, UK. The topics explored included the types of traditional dishes, snacks, beverages and desserts regularly consumed and the frequency of consumption; traditional food preparation methods and typical recipes; and the influence of acculturation on food choices and habits. Additionally, data were also obtained from twenty four hour (24 hr) dietary recalls completed by each subject (n=82; number includes volunteers who cooked the dishes for analysis; see 2.3). The full methodology and findings of this qualitative study will be published elsewhere.

e. Data from the Nelson Company (2014) and Mintel (2016 & 2017) shows increasing appeal of African and Caribbean foods coupled with immediate access to recipes and related information from the UK Media (print, broadcast and internet). The data from the following sources was collated across the various seasons (autumn, winter, spring and summer, over a year) and with a focus on recipes, cook books, leading cookery and food magazines [e.g. Food Manufacturer; BBC Good Food; Morrisons, Tesco, Asda and Sainsbury's supermarkets own cookery magazine (usually freely available to customers)], the most read newspapers (e.g. The Sun, The Gaudian, Daily Mail), television cooking programmes on ethnic cuisines (e.g. BBC Saturday Kitchen, the Good Food channel), internet and online consumers reviews and blogs on ethnic foods (e.g. platforms such as Trip Advisor).

2.2 Criteria of selection of popular traditional dishes, beverages and snacks for analysis

A comprehensive nutrient database should include all foods that form a major part of the food supply (Greenfield & Southgate, 2003). However, this would be a challenge to achieve in terms of cost and time, hence prioritised samples were analysed. The current methodology developed as reported here will be applied to the analysis of other dishes, snacks, desserts and beverages from a wide range of ethnic groups, and the data used to create a more comprehensive database.

Prioritisation of dishes, beverages and snacks for analysis was based on relevance to consumer demand, consumption statistics (popularity, amounts and frequency) from sources indicated in 2.1, health inequalities, consumption patterns, common diet related diseases in these ethnic groups, dietary habits, health behaviour and nutritional status (Asante et al. 2015; Earland et al. 2010; Gandy, 2014; Gibson et al. 2015; Gilbert & Khokhar 2008; Goff et al. 2015; Leung and Stanner 2011; Scott & Rajan, 2000; Sharma et al. 1996; Sharma et al. 1999; Sharma & Cruickshank 2001; Sharma et al. 2002; Vyas et al. 2003). **Figure 1** shows the stages involved in the selection of foods for analyses.

Thirty three dishes, snacks and beverages (14 Caribbean, 14 West African and 5 North African) were prioritised. **Table 2** shows the description of the dishes (n=26), snacks (n=4) and beverages (n=3).

2.3 Setting, volunteers and preparation of food samples

Preparation of the samples took place in the Nutrition kitchen at the School of Clinical & Applied Sciences, Leeds Beckett University. Twenty one female volunteers (9 Caribbean, 6 West African and 6 North African) from the Leeds area were recruited from the focus group

(focus group participants were recruited from local hubs such as places of worship and recreation, social enterprise organisations, poster adverts in communities and local newspapers, etc) to prepare the various authentic dishes (*i.e. dishes cooked in the traditional way and with locally acquired or imported traditional ingredients).* All volunteers were provided with an information sheet on the study and written consent was obtained. The study was approved by the former Health & Social Science Faculty Research Ethics Committee, Leeds Beckett University (reference number 22946).

Recipe harmonisation was by identification of common recipes, types and quantity of ingredients and methods of food preparation from interviews and the sources listed in 2.1. A list of the most common recipes, ingredients (including quantities) and cooking methods for each dish, beverage and snack was compiled in excel spreadsheet. Generally, ingredients, recipes and cooking methods were similar. There were slight variations in quantities of ingredients and duration of cooking due to individual preferences. Prior to the cooking sessions, volunteers were provided with the list of dishes, snacks and beverages to prepare, and a cooking schedule. They were also provided with a record form to indicate the typical recipes and ingredients required for each dish, snack and beverage and where they normally purchase them from, in order to ensure authentic items were purchased for the cooking sessions. These recipes and ingredients provided by volunteer cooks matched those in the excel spreadsheet of harmonised recipes. Preparation of dishes, snacks and beverages was based on the harmonised recipes. Available literature on the dietary patterns and habits of Africans and Caribbeans (Asante et al. 2015; Earland et al. 2010; Gandy, 2014; Gibson et al. 2015; Gilbert & Khokhar 2008; Goff et al. 2015; Leung and Stanner 2011; Scott & Rajan, 2000; Sharma et al. 1996; Sharma et al. 1999; Sharma & Cruickshank 2001; Sharma et al.

2002; Vyas et al. 2003) shows that desserts are not commonly consumed and, therefore, these are not included in the list of samples for analysis.

2.4 Food sampling

A major determinant of a nutrient composition data and its representativeness is the food sampling approach (Greenfield & Southgate, 2003). A stratified sampling approach was used because it takes into account the sources and causes of variation and, therefore, is appropriate for developing food composition data (Greenfield & Southgate, 2003). Stratification was based on sources [type of retail outlet or sale point i.e. Morrisons, Tesco, Asda, Sainsbury's (supermarkets of largest market share) and ethnic food shops and stalls, location (Leeds, London and Nottingham)] and brands (manufacturer) of ethnic foods and ingredients. Foods and ingredients were randomly selected within each stratum in order to account for variations such as cultivar, storage and processing conditions, retail and manufacturer's brands and retail outlet. For instance, different brands of *shito* (a spicy Ghanaian sauce; see Table 2) were obtained from supermarkets and ethnic food shops, online and in store in Leeds, London and Nottingham, depending on the availability of stock at the time of purchase. Leeds, Nottingham and London are among the largest UK cities with increasing population of ethnic minority groups. Hence, ingredients and modified foods (i.e. *those sauces, snacks and beverages with ingredients/recipes and cooking methods which have been modified to fit UK tastes*) from ethnic food shops were obtained from these cities in order to account for any variations that may be present. This approach also took into account the various outlets (grocers, markets and supermarkets) from which the study volunteers claimed that they usually obtained their traditional ingredients and modified foods.

The ingredients for five cooking sessions (week days and during university working hours) and modified foods (*e.g. kenkey*, fermented corn dough; Table 2) acquired from the aforementioned outlets were delivered and/or transported to the Nutrition kitchen and stored as appropriate (freezer – 20^{o}C, refrigerator 5^{o}C, and room temperature) within 15 minutes of purchase. Volunteers were also told that they could also use traditional ingredients obtained directly from their home country in their domestic cooking. Such ingredients were documented by the research team to ensure accurate representation of dishes, beverages and snacks. Ingredients and modified foods purchased online were delivered in a refrigerated van and stored within 5 to 10 minutes of delivery. A written record was kept of all ingredients and modified foods which included the list of names, brands, date of purchase, expiry date, listed ingredients, quantity or weight, state of ingredient and modified food as purchased, sample handling and cooking procedures.

2.5 Composite food sample preparation

Volunteers were given a food hygiene and safety briefing prior to each cooking session. Composite samples were prepared according to procedures of Apekey and Khokhar (2011) and as shown in **Figure 2**. A food group composite (similar samples of dishes/ beverages/ snacks combined to form a composite e.g. a composite made of 'Supermalt' and 'Malta', two brands of non-alcoholic barley malt drinks) was used to generate the nutrient composition data. Some modified foods required further preparation, such as cooking, prior to mixing into the composite sample. For such modified foods, the manufacturer's preparation or cooking instructions on the food packaging were followed. All warm or hot samples were allowed to cool to room temperature before weighing and mixing.

Although the individual food approach (each individual food analysed separately) has a major advantage in enabling the contribution of each food to the nutrient data to be known, large numbers of samples must be analysed to obtain a reliable representation of foods normally consumed by each population group (Greenfield & Southgate, 2003). The food group composite sample approach is, therefore, more economical but requires that foods, beverages and snacks should be carefully selected to reflect what is normally consumed by a specific ethnic population (including regional and ethical dietary habits), variations in recipes, ingredients and cooking methods, retail outlets (supermarkets with the largest market share, ethnic food shops and market stalls) and brands as recommended by FAO/WHO (Greenfield & Southgate, 2003) and FAO/INFOODS (Charrondiere et al. 2016).

Equal weights (500g of edible portions) of primary samples were mixed together using a food blender to create a composite sample weighing ≈4000g (**Figure 3**). Composite samples were prepared from 1-8 primary samples (inculdes1-8 samples of ingredients) which would reflect the variability in the composition due to recipe variations.

2.6 Analytical laboratory

To ensure high quality and reliable nutrient data a laboratory accredited by UKAS [the Accreditation Service appointed as the National Accreditation Body for the United Kingdom under the EU Regulation (No) 765/2008], and which is also on the UK Food Standards Agency's list of official feed and food control laboratories (https://www.food.gov.uk/enforcement/sampling/foodcontrollabs), was required for analyses of the study samples. In addition to having a UK accreditation, it was important that the food testing laboratory was within a reasonable travel distance from the Nutrition kitchen in order to ensure a temperature of minus 20 degrees Celsius of the samples was maintained, and to

reduce the cost of transportation. Bids were invited from accredited food testing laboratories that met the above criteria; West Yorkshire Analytical Services (WYAS), which is located in Leeds, was selected. WYAS is one of the official food control laboratories designated by the UK Food Standards Agency as part of the National Control Plan, as required by Regulation (EC) 882/2004.

2.7 Storage and transport of composite samples

Two sub-samples (200g each) were taken from each composite sample; one to be analysed at the West Yorkshire Analytical Services laboratory and the other securely stored in a freezer in the Nutrition kitchen for future use. A list of both sets of samples was kept including preparation dates. Composite samples were stored at -20^0C in number coded, airtight plastic screw-cap containers, and transported in a cool box (to ensure they remain frozen) to the UKAS accredited, West Yorkshire Analytical Services laboratory in Leeds to be analysed.

2.8 General quality assurance practice

The quality assurance practices below were adhered to;

- Where appropriate, packaging was checked for use by/expiration date and suggested storage conditions to ensure ingredients and samples were fit for use and stored as recommended.
- Clean stainless steel spoons were used to draw each primary sample to avoid cross contamination with other samples.
- Equipment was washed and dried after preparation of each composite sample to avoid cross contamination with other samples.
- Standard weight was used to calibrate the measuring scales used.
- Composite samples were accurately labelled and appropriately stored.

- The analytical laboratory was provided with a list of ingredients in each sample to enable them to check for the presence of components which could potentially act as interferents in the analytical procedures and generate incorrect results.
- The resulting nutritional composition data were inspected and samples codes matched with the original list sent to the laboratory.

Furthermore, the bulk of the methods used is accredited through the United Kingdom Accreditation Service to the ISO 17025 standard and as such are fully validated. All nitrogen determinations were performed in duplicate. For other analysis carried out at WYAS, one in ten samples was repeated. These repeat analyses are required to meet the repeatability criteria documented in the methods used. For each of the accredited methods carried out at WYAS, an in-house control sample was analysed with each batch and the results required to fall within a certain range to be acceptable. An independent measure of method performance by WYAS is obtained through participation in external proficiency schemes such as the Food Analysis Performance Assessment Scheme (FAPAS).

2.9 List of analytical methods

Table 3 shows the list of analytical methods used for each nutrient and which are based on national and European (international) agreed standards of testing and procedures. Thus, the advantages of using a UKAS accredited laboratory are technically competent staff, reliable measurements, tests and inspections carried out in compliance with best practices.

2.10 Evaluation of analytical data

The data were received from the laboratory as excel spreadsheets and the values checked for errors. The values for each nutrient were then compared to published values of similar foods in McCance and Widdowson's 'The composition of foods' (7^{th} edition) [McCance &

Widdowson, 2015], taking into consideration the number of samples and country of origin. The new data were then compiled into a spreadsheet as in McCance and Widdowson's 'The composition of foods'.

3.0 Discussion

3.1 General discussion and novelty of the study

This research was conducted in response to the now urgent need for data on the nutritional status and intake of ethnic minority groups (Leung & Stanner, 2011) in the UK, and to address the lack of analytical nutrient composition data on African foods as suggested by the FAO of the United Nations (Greenfield & Southgate, 2003). This new data of multi ethnic foods which are increasingly popular and contribute to the growing UK World Food market will have various uses including food labelling, development and implementation of appropriate guidelines for healthy eating, diet and nutrition surveys, educational curriculum, contribution to the UK nutrient database and interventions to reduce health inequalities.

3.2 Strengths and limitations

The strengths of this research compared to other published methodological procedures on developing food composition data deserve mention. Similar, to Khokhar et al. (2009), the study team included trained researchers (including a food scientist and registered nutritionists) with experience in food composition and who are of African and Caribbean ethnicities.

In addition to published data from various sources, the use of focus groups, individual interviews, 24 hr dietary recalls and interviews with owners of small ethnic foods stalls enriched and validated the list of popular foods identified. Furthermore, the probing questions used by the researchers in the interviews and 24hr recall were also useful in capturing new

traditional dishes, beverages and snacks, food preparation practices, typical recipes and popularity of foods. By contrast, Khokhar et al. (2009) used FFQs and focus groups to further assess the popularity of selected traditional foods for analyses. In the current study, most of the data from the existing sources were based on FFQs, hence 24hr recall, focus groups and individual interviews were used to expand the traditional food list as well as to prioritise popular dishes, snacks and beverages for nutrient analyses. Another advantage of using these approaches of expanding the food list was to enable the inclusion of new and current traditional dishes, recipes and cooking methods since most of the existing sources of data (see 2.1) were before 2015. Furthermore, given the issues related to dietary assessment tools such as recall bias (Wrieden et al. 2003), using these 3 methods enabled the identification of foods regularly consumed, determination of the frequency of consumption over a period and improved precision. It also improved reliability of the data compared to the Multiple Pass Recall method which is commonly used in dietary surveys of minority populations in UK (Wrieden et al. 2003).

The study volunteers were sampled from one of the most ethnically diverse regions in the UK (West Yorkshire), thereby enabling the findings to be extrapolated to similar population groups in the country and possibly elsewhere. The use of volunteers (of the relevant ethnicity) in the food preparation in a university Nutrition kitchen allowed for variations in recipes and cooking methods thereby enhancing the authenticity of the dishes, beverages, snacks, recipes, cooking methods and ingredients. It also allowed for reliable documentation of cooking/traditional cooking methods, ingredients, personal preferences, etc. Volunteers were made aware that the research aim was to obtain nutrient profiles, hence an accurate representation (e.g. individual preference) of the samples was essential. This was to ensure, as much as possible, that authentic traditional recipes were used. The volunteers interacted very

well with each other during the cooking and compared recipes, which created an informal or uncontrolled setting as would be the case in their home kitchens. During the debrief held with the research team after each cooking session, the volunteer cooks completed a second list of ingredients for each food prepared and this was compared to their initial list from when they were recruited. This was to allow for any discrepancies to be queried and to ensure that recipes were accurate representations of the foods. They were also compared to published recipes and descriptions identified in 2.1. To ensure accurate representation of foods, the ingredients and foods were obtained from the outlets (grocers, markets and supermarkets) indicated by the volunteers. It is acknowledged that volunteers may use ingredients obtained directly from their home country in their domestic cooking. Such ingredients were permitted for use in the current study and documented by the research team; again to ensure accurate representation of foods. By contrast, in the case of Khokhar et al. (2009), authentic dishes were prepared in volunteers' homes. Although this approach also provides representativeness of the foods, it may not allow for detailed and accurate documentation of ingredients, recipe and cooking practices. Further, the samples were analysed by a UKAS accredited laboratory (i.e. *recognised by UK government, to assess against internationally agreed standards, organisations that provide certification, testing, inspection and calibration services*). Finally, the procedures followed in developing these data are in line with the three new FAO/INFOODS guidelines on conversions, data evaluation and food matching for improving food composition data quality (Charrondiere et al. 2016).

A limitation of the study was the use of convenience sampling to recruit volunteers from local hubs (places of worship and recreation, social enterprise organisations, poster adverts in communities and local newspapers, etc.) which may introduce selection bias. It is widely acknowledged that recruitment, participation and retention of minority populations into

research can be challenging, hence the labels ‘hard to reach’ or ‘hidden’ are used to describe them (Sydor, 2013). However, a systematic review (Bonevski et al. 2014) on how to improve recruitment of minority populations into health related research concluded that sampling through community partnerships or organisations just as in the current study was a good approach to improving recruitment and representativeness. Although collection of foods from a range of randomly selected households may provide more representative samples, this approach is more complex, time consuming (Greenfield, 1990) and beyond the scope of the present study.

4.0 Conclusion

This paper described the procedures undertaken and analytical methods used to develop a new multi-ethnic nutrient data invaluable for the UK, and possibly of use elsewhere. The procedures developed and described in this paper, will be further used to analyse a wide range of ethnic foods in the UK for a more comprehensive nutrient database. Importantly, these procedures align with the FAO criteria for developing a comprehensive food composition database.

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Conflict of Interest

The authors declare no conflict of interest.

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Table 1 Sources of popular African and Caribbean foods, snacks and beverages

Existing Sources	**Newly Generated Data**
Peer reviewed journals	24 Hour Recall
Books on Nutrition, Food Science and Dietetics	Focus group interviews
UK Diet and nutrition surveys	Individual interviews
UK Health surveys	Interviews with small ethnic food retailers
Nutrition bulletins	
Restaurants and takeaways (ethnic foods)	
UK Supermarkets of largest market share	
Ethnic food supermarkets	
Ethnic food importers	
Ethnic food manufacturers	
Market intelligence reports	
UK Media (print, broadcast and internet)	

Table 2 Description of prioritised dishes, snacks, beverages and number of primary samples

Ethnic Group	Food	Food description/Ingredients	No. of primary samples	Sample source(s)
Caribbean	Rice and peas	Rice boiled with black eyed, split or pigeon peas or kidney beans; onions, vegetable oil and coconut cream may be added.	5	Prepared in Nutrition kitchen
Caribbean	Ackee and saltfish	Tin of ackee, saltfish, onion, garlic, red/yellow pepper and spring onion.	4	Prepared in Nutrition kitchen
Caribbean	West Indian soup	Made with meat, dumplings, large pieces of vegetables such as yam, sweet potato, pumpkin, carrots, noodle and chocho in thin stock.	4	Prepared in Nutrition kitchen
Caribbean	Goat curry	Goat meat usually seasoned overnight and then fried in oil, water is added and left to cook until tender. Coconut cream and tomato may be added.	5	Prepared in Nutrition kitchen
Caribbean	Jerk chicken	Chicken wings, onions, pepper and jerk sauce.	4	Prepared in Nutrition kitchen
Caribbean	Caribbean fish curry	Headless red/white fish/ haddock, garlic, thyme, carrots, curry powder, tomato, spring onion, onions and knob of butter.	4	Prepared in Nutrition kitchen
Caribbean	Caribbean vegetable curry	Red/white onion, cauliflower, carrots, green beans, aubergines, tomato, thyme and knob of butter.	4	Prepared in Nutrition kitchen
Caribbean	Callaloo and saltfish	Tin of callaloo, saltfish, onion, garlic, carrots, red/yellow pepper and spring onion.	4	Prepared in Nutrition kitchen
Caribbean	Cornmeal porridge	Hot milk and cornmeal flour (condensed milk may be added) flavoured with fresh nutmeg, salt, sugar and vanilla.	5	Prepared in Nutrition kitchen
Caribbean	Guinness punch	Guinness, ice cream, bottle milk, carnation evaporated milk and nutmeg.	4	Malta Guinness from supermarket. Punch prepared in Nutrition kitchen.
Caribbean	Rum punch	White rum, syrup, lemon/lime, water and pineapple juice.	4	Prepared in Nutrition kitchen
Caribbean	Fried dumplings	Deep-fried or boiled dough made with white flour. Also called ‘Johnny cake’.	5	Prepared in Nutrition kitchen
Caribbean	Saltfish fritters	Deep fried batter with salt fish/salted cod, which is purchased dried and soaked overnight to remove salt or boiled to rehydrate before cooking	5	Prepared in Nutrition kitchen

Table 2 Description of prioritised dishes, snacks, beverages and number of primary samples

Ethnic Group	Food	Food description	No. of primary samples	Sample source(s)
Caribbean	Meat patties	Semi circular or oval shaped pastry filled with seasoned minced beef. Vegetables may be added.	5	Prepared in Nutrition kitchen
West African	Kenkey*****	Fermented corn dough made into a ball, wrapped in corn husk and cooked over heat.	4	Ethnic food shop in Leeds, London & Nottingham
West African	Shito sauce	Chilli/spicy Ghanaian sauce made with vegetable oil, onion, ginger, tomatoes, dried chillies, smoked fish, smoked shrimps, stock cube and spices.	2	Ethnic food shop in Leeds, London & Nottingham
West African	Cassava & Plantain fufu*****	Cassava, plantain and potato flour which may contain E102, E110, E450, E471 and/or E321	2	Ethnic food shop in Leeds & Nottingham
West African	Malt/Malta drink	Water, barley malt, glucose syrup/sugar, carbon dioxide, colour (E150c), acid (citric acid), liquorice, Nicotinamide, Pantothenol, Thiamin Hydrochloride, Sodium Riboflavin Phosphate and Pyridoxin Chloride	4	Supermarkets, Ethnic food shop in Leeds & Nottingham
West African	Plantain chips (chilli & plain)	Ripe plantain, vegetable oil, sea salt, powdered chillies, spices, citric acid as a flavour enhancer.	8	Supermarkets, Ethnic food shop in Leeds, London & Nottingham
West African	Eba (Gari)	Ground cassava and water.	3	Prepared in Nutrition kitchen
West African	Rice & Peas/Beans	Black eye/brown bean, long grain/basmati rice, salt and water.	6	Prepared in Nutrition kitchen
West African	Jollof Rice	Long grain/basmati rice, tomatoes, hot red pepper, vegetable oil, salt, beef and/or chicken stock, chicken/beef, curry, thyme, onions, ginger, carrot, maggi chicken cube, garlic and scotch bonnet/chilli pepper.	6	Prepared in Nutrition kitchen
West African	Egushi Stew	Egusi, beef stock, stock fish, dried fish, beef, salt, onions, ugu leaf, maggi chicken cube, palm oil, garlic and tomato.	4	Prepared in Nutrition kitchen

Table 2 Description of prioritised dishes, snacks, beverages and number of primary samples

Ethnic Group	Food	Food description	No. of primary samples	Sample source(s)
West African	Groundnut Soup	Peanut butter, tomato, tomato puree, scotch bonnet, maggi chicken cube, beef, goat, fish, ginger, vegetables (optional - okro/okra, garden eggs), onions and salt.	4	Prepared in Nutrition kitchen
West African	Meat stew	Tomato, tomato puree, pepper, beef, vegetable oil, maggi cube, salt, scotch bonnet/chilli pepper, onions, curry, thyme and ginger.	5	Prepared in Nutrition kitchen
West African	One pot pepper/light soup	Soup prepared with vegetables (tomato, tomato puree, scotch bonnet, ginger, garlic, etc), meat, goat, chicken and fish, salt, cow foot, nutmeg, maggi stock cube, thyme (optional – okra/okra, garden egg also known as eggplant)	5	Prepared in Nutrition kitchen
West African	Okro soup/stew	Okro, tomato, scotch bonnet/chilli pepper, ginger, garlic, palm/vegetable oil, beef, fish, spinach, maggi stock cube,	5	Prepared in Nutrition kitchen
West African	Ewedu soup	Ewedu leaves, fish, maggi stock cube, salt and locust beans.	3	Prepared in Nutrition kitchen
North African	Couscous with chicken	Couscous, chicken, onion, oil, tomato, mixed spices, carrots, chilli, coriander and chickpeas.	2	Prepared in Nutrition kitchen
North African	Couscous with vegetables	Onion, hummus, tomato, spice, water, onion, chilli, pepper, butternut, parsley, ghee, tomato paste, potato, carrots, squash, couscous and spices.	3	Prepared in Nutrition kitchen
North African	Couscous with lamb	Onion, lamb, chilli, pepper, butternut, parsley, ghee, tomato paste, potato, carrots, squash, couscous and spices.	1	Prepared in Nutrition kitchen
North African	Traditional Libyan Soup	Lamb, onion, tomato, vegetable oil, herbs, water, tomato paste, ghee (veg), salt, spices, parsley, tomato puree and mixed spices.	3	Prepared in Nutrition kitchen
North African	Kunafa	Kunafa pastry, walnuts, oil, butter and extra thick cream.	1	Prepared in Nutrition kitchen

***** *Modified foods* i.e *ingredients and or recipes and cooking methods modified to fit UK taste buds*.

NOTE: *Food is used in the table to represent dishes, beverages or snacks*.

Table 3 Description and reference of analytical methods

Nutrient	**Test Description & Reference**
Ash	The test portion is dried, then incinerated at a temperature of 550 ± 25°C. After cooling the mass of the residue is determined. **BS4401-1 1998 ISO 936:1998**
Moisture	The test portion, thoroughly mixed pre-mixed with sand and water if required, is dried to constant mass at 102 ± 2°C, after pre-drying on a water bath if required. **BS4401-3:1997 ISO 1442:1997**
Nitrogen **(Total nitrogen)**	Nitrogen (organic + inorganic) is determined by complete combustion of the sample in an oxygen atmosphere in a furnace where organic or oxidisable nitrogen is converted to nitrogen and nitrogen oxides. The combustion gases pass through a series of filters and reagent tubes to remove particulate matter and interfering materials after which nitrogen oxides are reduced to nitrogen by a heated catalyst. An aliquot of the cleaned, reduced combustion gas is then passed through a thermal conductivity cell using a flow of carbon dioxide as both carrier and reference gas. The resulting voltage from the detector is processed by computer and a direct reading of the nitrogen content of the sample is output. **Elementar Rapid N Cube Condensed Manual**
Fatty Acids by FAME Profile (MUFA, PUFA, SFA, Trans)	Fat is extracted from the sample. The glycerides in the fat or oil are transesterified with methanolic potassium hydroxide solution and extracted into heptane. The solution of fatty acid methyl esters is analysed by gas chromatography using a suitable column and a flame ionisation detector. The fatty acid composition is determined using an internal normalisation procedure, uncorrected for any variations in the detector response factors. **Kirk, R S, Sawyer, R, Pearson's Composition and Analysis of Foods, 9th edn, Longman, 1991, p24.**
Sugars	The sample is dissolved in water, with heating, clearing and dilution if necessary, and analysed by high performance liquid chromatography using refractive index detection.
Chloride	The test sample is extracted in hot water, filtered and analysed by ion chromatography.
Inorganics (K, Ca, Mg, P, Fe, Cu, Zn, Cl, Mn, Se)	The samples are digested using a digiprep digestion block and analysed by ICP-MS.
Sodium	The sample is ashed, the ash dissolved in water and the sodium content determined by Flame Photometry.
Dietary Fibre (AOAC)	The sample is digested with enzymes, simple sugars are removed from the sample by precipitation using ethanol followed by filtration. The non-digestible precipitate is weighed and the fibre content is calculated by subtracting the weight of protein and inorganic material. (AOAC method 985 29).
Dietary Fibre (NSP)	The sample undergoes enzymatic hydrolysis of starch, precipitation of NSP in ethanol, acid hydrolysis of the NSP and measurement of the released constituent sugars (Englyst).

Table 3 Description and reference of analytical methods

Nutrient	**Test Description & Reference**
Energy	Calculated from the protein, fat, carbohydrate (including sugars), and AOAC fibre using the values in Annex XIV of Regulation (EU) No 1169/2011. No allowance was made for the presence of any polyols, salatrims, alcohol, organic acid or erythritol.
Protein	Total nitrogen multiplied by 6.25
Total Fat	The sample is heated with hydrochloric acid to dissolve the protein and free bound lipids. The fat separates as a layer on top of the acid and is extracted using diethyl ether with the addition of petroleum ether to reduce the solubility of non fatty materials. Separation is assisted by the addition of alcohol which helps prevent the formation of emulsions. The solvent containing dissolved fat is siphoned off into a weighed flask, and is removed by distillation. The residue is dried in an oven, and the flask re-weighed. The method is based on **BS:4401:Part 4 1970**
Carbohydrate	Available carbohydrate is calculated by difference (100 minus the sum of protein, total fat, ash, moisture, alcohol and AOAC fibre) in 100 g of food.

NOTE: From the known ingredients of the foods it was considered that polyols, salatrims alcohol organic acids and erythritol would make a zero or negligible contribution to the energy content so they were not included in the analysis. Dietary fibre was included in the energy calculation

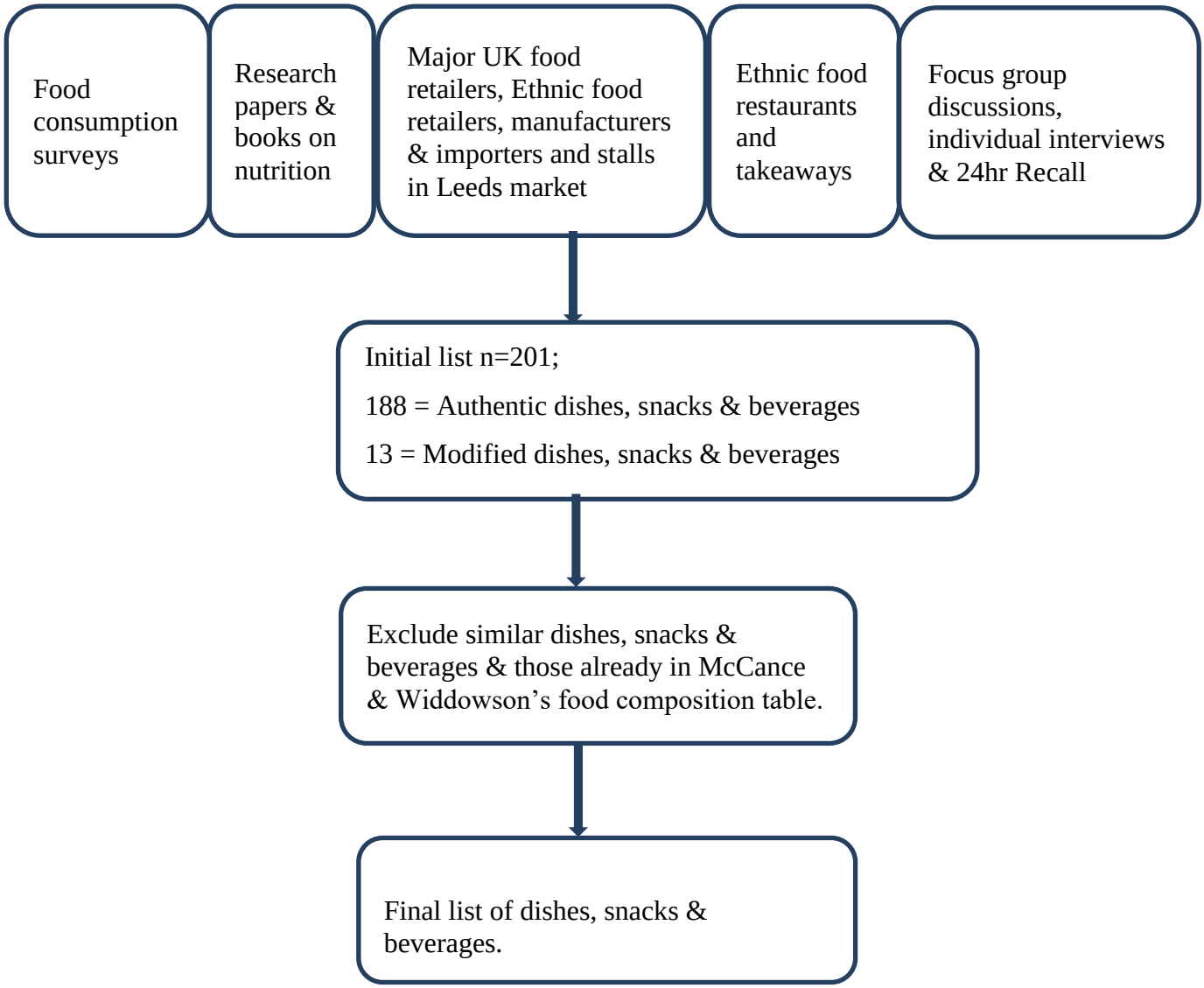

Figure 1 Stages in prioritisation of popular dishes, snacks and beverages.