Household Food Consumption Typologies: Examining Population Adherence to Healthy Eating Guidelines for Evidence-Informed Policy Making

E. Beacom[1] · C. McLaughlin[2] · S. Furey[3]

Abstract

Food and nutrition are important issues of interest to policy makers, practitioners, and academics around the world due to the far-reaching consequences for society, households and individuals, and guidelines related to food consumption have been included in several policies both nationally and internationally. This study identifies household 'typologies' with regard to household food consumption of 'marker' food groups, and examines related associations with household demographics, analysing quantitative data on households ($n = 4144$) from the most recently available Northern Ireland Health Survey (2014/2015). Latent Class Analysis identified five household typologies; 'Hedonistic Households (19%), Healthier Households (13%), General Households (42%), Unhealthier Households (3%), Balanced Households (23%)', which individually vary in their adherence to recommended guidelines, and in their demographic composition. The study provides insight into how households' dietary consumption patterns accord with government recommendations, and findings have implications for policy, for example through informing decision-making related to promoting behavioural change, and informing future collection of data related to 'marker' food groups.

✉ E. Beacom
emma.beacom@ucc.ie

1 Department of Food Business and Development, Cork University Business School, University College Cork, Cork, Ireland

2 Department of Hospitality and Tourism Management, Ulster Business School, Ulster University, Coleraine, UK

3 Department of Global Business and Enterprise, Ulster Business School, Ulster University, Londonderry, UK

Introduction

In the modern age of highly advanced food production and retail environments in developed nations, food is abundantly available to consumers who have adequate access and ability to acquire and consume it (Black et al., 2014; Spaargaren et al., 2012). Much of the food available in retailers is ready prepared, making consumption more convenient for consumers and increasing choice (Mills et al., 2017; Spaargaren et al., 2012). However, many of these ready prepared foods could be considered to be less healthy options (Hillier-Brown et al., 2017), for example those included in the 'Foods high in fat, salt and sugar' element of the NHS Eatwell Guide (National Health Service [NHS], 2019), or those coded with a red Front-of-Pack nutrition label (NHS, 2018), of which it is recommended to eat less often and in small amounts. Overconsumption of foods and drinks high in fat and sugar, as well as unhealthy eating behaviours such as frequent snacking on convenience foods, can contribute towards overweight and obesity (Appelhans et al., 2012). It is known that overweight and obesity contributes to various poor health outcomes such as cardiovascular problems and diabetes (Bray et al., 2017). The government therefore promotes healthy eating practices such as limiting consumption of foods high in fat and sugar and eating at least five 80 g portions of fruit and vegetables per day (NHS, 2019). Recommendations for healthy eating are promoted by the government via various mediums and are outlined specifically in policies and frameworks including the UK obesity strategy (Department of Health and Social Care [DHSC], 2020) launched in 2020, and the 'Fitter Future for all' framework (Department of Health, Social Services and Public Safety [DHSSPS], 2012) launched in Northern Ireland in 2012. The Fitter Future for All Strategy identifies 'marker' foods including sugary, fizzy drinks and squashes; confectionery; chips and other fried foods; meat products, such as sausages, burgers, and meat/chicken pies; and fruit and vegetables (DHSSPS, 2012), and government recommendations regarding food consumption and health are often discussed and outlined in relation to these food groups/categories.

Similarly to how foods are categorised into groups to provide health recommendations, consumers are often segmented into typologies according to their consumption habits and demographics for the purposes of aiding more targeted marketing. Segmentation is typically used to inform product development, pricing, distribution and advertising strategies (Yankelovich & Meer, 2006). There currently exists various research from a marketing perspective which examines how various consumer segments view and consume brands and product types, and research from a nutritional perspective which considers food group consumption generally among various samples and populations. However, there is less research which constructs and investigates household typologies in a representative population sample, to examine how they differ in their consumption of specific food groups with regard to dietary guidelines (i.e. food 'marker' groups) (DHSSPS, 2012), and with the aim of providing evidence for future policy communications. Knowledge on population food group consumption is useful to inform policy making with regard to food and health, to both guide public health communications to consumers, and to guide and inform retailer marketing agendas.

Literature Review

Food and nutrition are important issues of interest to policy makers, practitioners and academics around the world due to the far-reaching consequences for society, households and individuals. This is because a poorly nourished population is also less economically

productive limiting the business world's chances for maximising economic activity (Beacom et al., 2021).

There are global targets to 'end hunger, achieve food security and improve nutrition and promote sustainable agriculture' articulated within the Sustainable Development Goals (SDG 2) (UN, 2022). However, the UK Stakeholders for Sustainable Development reported in 2018 that 'while there is an enormous amount to celebrate, the most vulnerable places and people in our society are increasingly being left behind' (UK Stakeholders for Sustainable Development [UKSSD], 2018, p. 4). Given the prevalence of overnutrition (12% of children aged 4–5 in Wales and 10% in England in 2016; 6% of children aged 4–6 in Scotland in 2015 and 5% of children aged 4–5 in Northern Ireland in 2014) and undernutrition (1% of children in England and 0.8% in Wales in 2016, and 0.4% of children in Scotland — there are no equivalent data for NI) in the UK (UK Parliament, 2019), it has proven difficult to 'address malnutrition in all its forms', with 'food insecurity and obesity rising'. Therefore, the nutrition paradox is evident in the UK with 'high and growing levels of obesity and diet-related disease, and among the highest levels of household food insecurity in Europe' (UKSSD, 2018, p. 19).

In the UK, there have been various policies developed which seek to address these problems of over- and under-nutrition.

The UK published its Obesity Strategy — *Tackling obesity: empowering adults and children to live healthier lives* — in 2020. Its accompanying *Better Health* campaign aims to reach millions of people who need to lose weight, encouraging them to make behaviour changes to eat better and move more to prevent or delay the onset of serious diseases (DHSC, 2022). The Strategy recognises that multifactorial solutions are needed that encompass individual effort, reduce obesogenic environments, and make the healthy choice the easier option for everyone.

In Northern Ireland, a new Obesity Prevention Strategy is under development but its predecessor is called *A Fitter Future for All Framework for Preventing and Addressing Overweight and Obesity in Northern Ireland 2012–2022*. Similarly to the UK Obesity Strategy, this Framework has as its aim, to 'empower the population of Northern Ireland to make healthy choices, reduce the risk of overweight and obesity related diseases and improve health and wellbeing, by creating an environment that supports and promotes a physically active lifestyle and a healthy diet' (DHSSPS, 2012, p. 7).

The Framework identifies 'marker' foods including sugary, fizzy drinks and squashes; confectionery; chips and other fried foods; meat products, such as sausages, burgers, and meat/chicken pies; and fruit and vegetables. In its 2015 update on short-term actions the importance of monitoring these marker foods via sustained collection of robust data in respect of obesity to inform measurement of Obesity Prevention strategy marker foods, reformulation and food promotions policy analysis and development was reinforced (Department of Health, 2015).

This study aims to classify households in Northern Ireland according to their consumption of 'marker' food groups, as identified in the '*A Fitter Future for All Framework for Preventing and Addressing Overweight and Obesity in Northern Ireland 2012–2022*' and in so doing investigate how households' consumption patterns accord with government recommendations, with the view to informing related policy. The study objectives are therefore as follows: (i) identify household 'typologies' with regard to household food consumption of food groups and in relation to the Eatwell Guide and (ii) examine associations between household typologies and household demographics.

The concept and use of consumer typologies arises from the knowledge that although consumers are heterogenous, they can be classified according to observed or reported

similarities, and these classifications, or typologies, can then be used as a basis for explaining and predicting behaviour, and can further be used to guide decision-making in various contexts, for example marketing strategies, or public health communications or interventions (Myers & Nicosia, 1968; Visschers et al., 2013).

Previous literature has classified consumers according to their use of nutritional labels (Souiden et al., 2013; Visschers et al., 2013), and therefore related recommendations and actions with regard to helping consumers make healthy choices have centred on education and communications around encouraging consumers to use nutrition labels to inform a healthy choice (Visschers et al., 2013). Current literature which classifies households into typologies according to food group consumption is limited, however previous studies assuming this methodology have done so with the purpose of identifying typologies and comparing consumption between regions (Maciejewski et al., 2021), examining typology of eaters according to protein consumption (Van Mierlo et al., 2021) or organic food consumption (Baudry et al., 2016) specifically, and examining typologies in the context of food enthusiasm (Moreo et al., 2022).

Van Mierlo et al. (2021) used a national level database (Belgian National Food Consumption Survey) to examine protein consumption, with the view to inform future personalised communications regarding moving the population towards making more environmentally friendly, healthy food choices. Baudry et al. (2016) also suggest the usefulness of using targeted policies aimed at specific segments to move them towards healthier, sustainable food choices (in the context of organic food consumption).

Ajzen's (1991) Theory of Planned Behaviour (TPB) presents a model to conceptually inform development and targeting of strategies to change consumer behaviour, by identifying influences on behaviour including attitudes, subjective norms, perceived behavioural control, and behavioural intention. Interventions using the TPB are generally created by the underlying beliefs - attitudinal, normative and control, these beliefs underly the intentions to engage in a particular behaviour. This theory therefore indicates that collecting data on the above behavioural influences alongside actual consumption data could be useful to inform and encourage consumer behavioural change towards more healthy food choices, for example through targeted communications and policy strategies. In addition to literature considering the public health and environmental benefits of targeting policy and communications towards specific consumer typologies to encourage behaviour change, the literature also considers how typologies can be used from a marketing perspective to inform marketing strategies (Baudry et al., 2016; Moreo et al., 2022). Marketing strategies could be used to move the population towards more healthful food choices, for example strategies could promote consumption of healthy marker foods, targeting unhealthier household typologies, and could thereby influence positively population health in accordance with policy goals. However, retail or brand marketing strategies can oftentimes conflict with policy aims regarding moving the population towards more healthful and/or sustainable food choices as hedonistic motivations are often appealed to in marketing, and certain strategies (e.g. promotions and placement of foods in store) can encourage consumers to buy less healthy foods and/or to buy more than they need.

Policy can play an important role in shifting consumer behaviour towards healthier choices, through various ways. For example, the sugar tax introduced in the UK in 2018 (HM Treasury, 2018) increased the price of fizzy drinks as a disincentive for consumers to choose high sugar options. This tax further incentivised businesses to reformulate their drinks to lower sugar content, and thereby avoid price increases on their products (Forde et al., 2022). The Food (Promotion and Placement) (England) Regulations 2021 which have phased enforcement in 2022–2023 require retailers to reduce the use of volume

promotions (e.g. Buy One Get One Free) on High Fat, Salt, Sugar (HFSS) foods, and to limit the sale of these products to less prominent, lower footfall areas of the store (DHSC, 2022; Tesco, 2023). Although the regulations regarding restriction of volume promotions on HFSS foods do not come into effect until October 2025, Tesco made the voluntary decision to remove these promotions ahead of the requirement (DHSC, 2023; Tesco, 2023). Sainsbury's has also taken voluntary action related to improving healthiness of diets, informed by government guidelines, having made a number of changes to their food placement, pricing and promotion strategies such as removing confectionery from supermarket checkouts in 2004, aiming to equalise prices between healthier options and their standardised equivalents, and increasing the number of healthier products in prominent store locations (Sainsbury's, 2021a, b). Certain retailers have engaged in significant product reformulation with regard to improving the healthiness of products (reducing fat, salt and sugar content) in response to government policy. For example, Lidl UK's health and nutrition policy to reduce salt, sugar, calories and saturated fat in their own-brand product range was informed by Public Health England's (PHE) salt, sugar and calorie reduction schemes, and the UK's Food Standards Agency (FSA) 2017 salt targets (Lidl, 2019, 2020). Sainsbury's ongoing reformulation programme is informed by Public Health England and World Health Organization guidelines regarding reduction of salt, sugar and trans-fat content in food (and drink) products, and they are engaged in strategies to increase the proportion of fruit and vegetables and starchy carbohydrates in shoppers' baskets in line with the UK Government's Eatwell Guide recommendations regarding relative proportion of consumption of these food groups in the diet (Sainsbury's, 2021c, 2023). These examples evidence how policy designed to promote healthy food consumption can initiate meaningful change by retailers, in both mandated and voluntary capacities.

Therefore, Government collection of data on population food consumption, and identification of household typologies and population/typology adherence to healthy eating guidelines, is useful from the perspective not only of informing policy-related action such as targeted education or interventions for specific groups with a view to improve public health outcomes, but also from the perspective of how diet-related policy can influence related retailer actions, which subsequently impact on consumer buying behaviour. To our knowledge, there has not been a study which is representative at the population level which has examined household typologies in the context of examining adherence to healthy eating guidelines and providing related policy recommendations.

Methodology

This study involved secondary quantitative analysis of an open-access representative dataset (the Northern Ireland Health Survey 2014/15, $n = 4,144$).

Sample — Household Survey Tool

This household survey is disseminated annually to a representative sample of households in Northern Ireland. The most recent publicly available (as of March 2023) version of the dataset was used (2014/15, $n = 4,144$). The survey asks respondents questions relating to a range of topics such as household composition, physical and mental health, dietary information and lifestyle. The survey is administered by an interviewer who visits the respondents at their home and, depending on the sensitivity nature of the questions and the

respondents' ability, alternates between facilitating question response (e.g. using prompts and cue cards) and allowing respondents to self-complete (via a tablet computer). Full details regarding the methodology of the household survey tool can be accessed at Northern Ireland Department of Health (2019).

Variables for Analysis

The survey variables of interest for this study are those relating to food group consumption and household demographics. Data on food group consumption were used to identify 'household typologies' based on frequency of consumption, and demographic data were included in analysis as variables of interest to examine alongside consumer typologies.

The survey collects data on respondents' consumption of a range of food groups (processed meat, potatoes, chips, biscuits, confectionery, savoury snacks, cakes, sugary drinks, fruit, salad/vegetables). The interviewer introduces each food category to respondents in turn, pre-empting this with the statement 'Thinking about the food that you eat, I would like you to tell me how often you usually eat the following foods' (Table 1). Respondents are asked to indicate their frequency of consumption for each food group in accordance with the following responses shown on a prompt card A 'more than once a day'; B 'once every day'; C 'most days'; D 'once or twice a week'; E 'less often or never?' Frequency of consumption responses were combined to create a binary variable regarding consumption, 'more frequently' (responses A, B, and C) and 'less frequently' (responses D and E).

Key sociodemographic variables included in analysis were age, gender, number in household, number of children, highest qualification, employment and two variables related to (self-reported) health ('Health in general' ('How is your health in general, would you say it was': (1) very good; (2) good; (3) fair; (4) bad; (5) very bad) and 'life you lead' (Which of the following best describes the life you lead? (1) Very healthy; (2) fairly healthy; (3) fairly unhealthy; (4) very unhealthy)). The variable relating to alcohol consumption (Do you drink alcohol?) was also included in analysis as a variable of interest due to the synergy between policy recommendations regarding moderation of alcohol consumption, and moderation of certain food groups.

Table 1 Food groups and related survey question

Food group	Related survey question
Processed meat	Firstly, Processed meat or chicken products — including meat pies, pasties, sausage rolls, burgers, sausages, chicken nuggets, or breaded chicken
Potatoes	Secondly, potatoes, including boiled, mashed, baked potatoes, but excluding roast potatoes, chips, or potato products, e.g. waffles and smiles
Chips	Chips, roast potatoes, and potato products, e.g. potato waffles and smiles
Biscuits	Biscuits, including wrapped chocolate biscuits, e.g. Twix, Kit-Kat, and Penguin
Confectionary	Confectionery, including sweets and chocolate bars, e.g. Mars and Snickers
Savoury snacks	Savoury snacks, e.g. crisps and tortilla chips
Cakes	Cakes, buns, and desserts, e.g. cheesecakes and apple tart
Sugary drinks	Sugary fizzy drinks or squashes
Fruit	Fruit, including fresh, frozen, dried, tinned, and pure fruit juice
Vegetables/Salad	Salad or vegetables, including fresh, frozen, dried, and tinned vegetables, but excluding potatoes

Analysis Procedure

Initial descriptive analysis provided the breakdown of consumption of each of the food groups according to those 'less frequently' and 'more frequently' consumed. As proposed by our model, we undertook a two-stage approach to the data analysis in order to address the research objectives.

Firstly, we adopted Latent Class Analysis (LCA) as the main statistical approach to explore the number of possible hidden household typologies that exist within the data. In other terms, we examined each of the ten dichotomous overserved indicators with the aim to identify possible subgroups or classifications with the data (Tein et al., 2013; Wang & Wang, 2012). A one-to-six class model was estimated using Mplus 6.11 (Muthén & Muthén, 2010) employing *robust maximum likelihood* (Yuan & Bentler, 2000). Furthermore, to avoid solutions based on local maxima, 100 random sets of start value were used alongside 20 final-stage optimisations. Class model fit was assessed using several information theory-based fit statistics; Akaike Information Criterion (AIC) (Akaike, 1987), Bayesian Information Criterion (BIC) (Schwarz, 1978) and the sample-sized-adjusted BIC (ssaBIC) (Sclove, 1987). Thus, the model that produces the lowest values on each of these is the best-fitting model. Additionally, the Lo-Mendell-Rubin adjusted Likelihood Ratio Test (LMR-LRT) (Lo et al., 2001) has also been employed to assist in class enumeration, where a non-significant value suggests a class lower should be considered. Nylund et al. (2007) have identified the benefits of the LMR-LRT (Lo et al., 2001) over the BIC in aiding decision-making over the number of classes to accept.

During the second phase of the analysis, a multinominal logistic regression (MLR) was used to examine the possible influence of each of the predictor variables (adults in household, number of children in household, head of household age, sex, highest qualification, employment, general health, healthy lifestyle and alcohol intake) on household food typologies. Once the main household typology group was identified, it was used as a referent group and analysis was conducted to understand how the other household typologies differ from the majority household group with regard to sociodemographic factors (predictors).

Results

Table 2 presents the descriptive frequencies of each of the household food indicators broken down by consumed 'less frequently' and 'more frequently'. Overall, most foods were consumed 'more frequently' for the household, except for both sugary drinks ($N = 2,504$, 60.4%) and savoury snacks ($N = 2,116$, 51.1%) which were consumed 'less frequently'.

Stage 1: Fit Indices and Latent Class Analyses — Household Typologies

To explore the number of possible household typologies around the frequency of food indicators and their consumption, each of the LCA models was tested. Model testing ceased once a model failed to reach statistical significance. Table 3 displays the fit indices of each of the models. As a six-class model failed to reach statistical significance, no further models were tested. Since the LRT found that a six-class model was not significantly better than the five-class model; the five-class model was considered the best-fitting model. Even though both the AIC and BIC continue to decrease slightly beyond the five-class solution, this difference is not statistically significant enough to support a six-class solution to the

Table 2 Descriptive frequencies of food group consumption

	Less frequently		More frequently	
	N	%	N	%
Processed meat	1824	44.0	2320	56.0
Potatoes	305	7.4	3839	92.6
Chips	1460	35.2	2683	64.8
Biscuits	1269	30.6	2875	69.4
Confectionery	1864	45.0	2280	55.0
Savoury snacks	2116	51.1	2028	48.9
Cakes	1888	45.6	2256	54.4
Sugary drinks	2504	60.4	1640	39.6
Fruit	400	9.7	3744	90.3
Vegetables/Salad	197	4.8	3947	95.2

Table 3 Fit indices of the Latent Class Analysis models

Class	Logliklihood	Par	AIC	BIC	LRT	Sig
1	−22,641.525	10	45,303.049	45,366.344	---	---
2	−21,643.783	21	43,329.567	43,462.484	1995.483	0.0000
3	−21,421.026	32	42,906.053	43,108.594	445.514	0.0000
4	−21,319.968	43	42,725.936	42,998.101	202.117	0.0000
5	−21,233.863	54	42,575.725	42,917.514	172.211	0.0004
6	−21,176.842	65	42,483.685	42,895.097	114.041	0.0529

model ($p = .0529$). Further, not only does the LRT statistic support a five-class model but it is preferred due to parsimony.

The five significant classes (household typologies) were then examined with relation to their conditional probability of consumption of each of the eight food types (Table 4), and in relation to how they accorded with the Eatwell Guide's (Public Health England, 2016) recommendations that the greatest proportion of food consumed should come from the starchy carbohydrates and fruit and vegetables food groups, and in lesser amounts from proteins and foods high in fat, salt and/or sugar. Related descriptive labels were assigned to each class. Class 3 was the largest group ($n = 1,732$, 42%) of households (Table 5). Food types with a higher probability of being consumed by this household were vegetables/salad (0.99), fruit (0.97), potatoes (0.96), biscuits (0.94), cakes (0.72), confectionery (0.70), chips (0.64), and processed meat (0.52). Based on the types of food consumed this household group or class could be labelled General Households, as they have both healthy and less healthy food types. The second largest group were those households in Class 5 ($n = 948$, 23%). In this group, households had a higher probability of consuming vegetables/salad (0.98), potatoes (0.95), fruit (0.92), and chips (0.76); suggesting that this group could be labelled as Balanced Households considering how this group's consumption of food groups accords with the Eatwell Guide's recommendations. Out of the five household types, this group had the lowest probability of consumption of high sugar food groups (biscuits, confectionery, cakes). Slightly smaller in size was the next group, Class 1 ($n = 815$, 19%). This group is made up of those households that have a higher probability

Table 4 Conditional probability of food group consumption by Class (Household Typology)

	Class 1	Class 2	Class 3	Class 4	Class 5
Processed meat	0.84	0.16	0.56	0.79	0.49
Potatoes	0.96	0.79	0.96	0.68	0.95
Chips	0.93	0.00	0.64	0.71	0.76
Biscuits	0.95	0.40	0.94	0.71	0.24
Confectionery	0.91	0.28	0.70	0.59	0.13
Savoury snacks	0.89	0.23	0.41	0.52	0.40
Cakes	0.68	0.31	0.72	0.46	0.29
Sugary drinks	0.82	0.13	0.27	0.62	0.32
Fruit	0.90	0.91	0.97	0.21	0.92
Vegetables/Salad	0.94	0.97	0.99	0.46	0.98

Table 5 Sample breakdown by Class (Household Typology)

Class	Name	No. of observations	% of observations
1	Hedonistic Households	815	19
2	Healthier Households	525	13
3	General Households	1732	42
4	Unhealthier Households	124	3
5	Balanced Households	948	23
	Total	4144	100

of consuming all food types (processed meat (0.84), potatoes (0.96), chips (0.93), biscuits (0.95), confectionery (0.91), savouries (0.89), cakes (0.68), sugar (0.82), fruit (0.90), and vegetables/salad (0.94) and based on this they were labelled Hedonistic Households, as they have a high probability of consumption of all food categories. Next, Class 2 ($n=525$, 13%) was labelled Healthier Households, as they had a higher probability of consumption of healthier food types (vegetables/salad (0.97), fruit (0.91), and potatoes (0.79), and their consumption of the other, less healthy food types was relatively restricted in comparison with consumption of these food types among the other household types. Finally, the last and smallest group was Class 4 ($n=124$, 3%) which was labelled Unhealthier Households as this group had a higher probability of consumption of less healthy food groups such as processed meat (0.79), chips (0.71), biscuits (0.71), sugary drinks (0.62), confectionery (0.59), and savoury snacks (0.52), and in comparison with the other household types, this group had the lowest probability of consumption of fruit and vegetables/salad.

Stage 2: Household Typologies and Demographics

A multinominal Logistic Regression was used to analyse key predictors for several groups, such as General Household, Hedonistic Household, Healthier Households, Unhealthier Households, and Balanced Households. The reference category for the outcome variable was General Household as this was the biggest typology or classification; each of the other four groups was compared against this reference group (Table 6). The main focus of this analysis was to examine if key predictors such as number of adults in household, number

Table 6 Results of multinominal logistic regression regarding household typologies and demographics

Referent group: General Households		B	SE	OR		95% C.I.	
						Lower	Upper
Hedonistic Households	Age	−0.533	0.039	0.587	***	0.544	0.634
	Number in household	0.120	0.047	1.127	*	1.029	1.236
	Number of children	−0.032	0.064	0.969		0.855	1.097
	Highest qualification	0.104	0.030	1.110	**	1.046	1.177
	General health	0.056	0.058	1.057		0.943	1.185
	Healthy lifestyle	0.495	0.091	1.640	***	1.371	1.961
	Sex	0.534	0.098	1.706	***	1.408	2.068
	Do you drink alcohol	0.060	0.113	1.062		0.851	1.326
	Employment	0.058	0.116	1.060		0.845	1.330
Healthier Households	Age	0.035	0.051	1.036		0.938	1.144
	Number in household	−0.325	0.071	0.723	***	0.629	0.831
	Number of children	0.104	0.102	1.109		0.908	1.355
	Highest qualification	−0.084	0.036	0.919	*	0.857	0.986
	General health	0.169	0.070	1.184	*	1.033	1.357
	Healthy lifestyle	−0.754	0.119	0.471	***	0.373	0.594
	Sex	−0.368	0.127	0.692	**	0.540	0.888
	Do you drink alcohol	0.149	0.138	1.161		0.885	1.522
	Employment	−0.137	0.138	0.872		0.665	1.144
Traditional Households	Age	−0.519	0.077	0.595	***	0.512	0.691
	Number in household	−0.077	0.102	0.925		0.757	1.131
	Number of children	−0.114	0.156	0.892		0.657	1.212
	Highest qualification	0.257	0.067	1.293	***	1.134	1.473
	General health	0.381	0.108	1.463	***	1.185	1.807
	Healthy lifestyle	0.560	0.168	1.750	**	1.259	2.432
	Sex	0.555	0.208	1.741	**	1.158	2.618
	Do you drink alcohol	0.084	0.230	1.087		0.693	1.706
	Employment	−0.415	0.241	0.660		0.412	1.059
Balanced Households	Age	−0.184	0.038	0.832	***	0.772	0.896
	Number in household	−0.019	0.048	0.981		0.892	1.079
	Number of children	−0.025	0.069	0.976		0.852	1.117
	Highest qualification	0.196	0.029	1.217	***	1.150	1.288
	General health	0.141	0.054	1.151	**	1.035	1.280
	Healthy lifestyle	0.005	0.089	1.005		0.844	1.197
	Sex	0.003	0.097	1.003		0.829	1.214
	Do you drink alcohol	0.241	0.109	1.273	*	1.028	1.576
	Employment	−0.208	0.109	0.812		0.656	1.005

Reference group is 3. Sig Level: *0.05, **0.01, ***0.001, *C.I. c*onfidence intervals

of children in household, head of household age, sex, highest qualification, employment, general health, healthy lifestyle and alcohol intake differ for each group compared to the main group. Analysis indicated that compared to the General Households, in Hedonistic Households the head of the household was less likely to be older (OR = 0.587), have

a higher likelihood of having more people living in the house (OR = 1.127), more likely to be less qualified (OR = 1.110), more likely to live a less healthy lifestyle (OR = 1.640) and more likely to be female (OR = 1.706). Regarding Healthier Households, in comparison with General Households, these tended to be less likely to have more people living in the household (OR = 0.723), they are less likely to be lower qualified (OR = 0.919), more likely to have poorer general health (1.184) but less likely to think they are living an unhealthy lifestyle (OR = 0.471) and less likely to be female (OR = 0.692). Unhealthier Households differed from General Households in the following manner: They tended to be less likely to be older (OR = 0.595), more likely to be less qualified (OR = 1.293), more likely to report poorer general health (OR = 1.463), more likely to feel their lifestyle is unhealthy (OR = 1.741) and more likely to be female (OR = 1.741). In comparison with General Households, Balanced Households tend to be less likely to be older (OR = 0.832), more likely to be less qualified (OR = 1.1217) and more likely to have perceived poorer general health (OR = 1.151) and interestingly they are more likely not to drink alcohol (OR = 1.1273).

Discussion

Following the identification of the typologies, the contribution of each demographic variable with regard to predicting the typology was assessed to consider how each typology may vary and compare according to demographics. Due to a lack of significance on the number of children and employment variables, we were unable to consider how the household typologies may be differentiated on these factors. Income data were not collected by the survey; however, the variable relating to education can be considered an indicator of household affluence, as education is often linked to income and is thereby generally considered a viable proxy measure for the socioeconomic position (Galobardes et al., 2007; Lindberg et al., 2022). Considering the consumer typologies in relation to the reference group (General Households), three of the groups were less likely to be as qualified, indicating they were perhaps less affluent than the general household's sample, while one group was more likely to be higher educated, therefore indicating they were more affluent than the general sample. Three of the households were also significantly more likely to be younger than the general households. All of the households were more likely to either have poorer health, or to believe they lived a less healthy life, in comparison with those in the General Households sample.

Group 1, 'Hedonistic Households' have a higher probability of consuming all food categories. They are more likely to have more adults in the household, suggesting that this group may include families with grown-up children, and therefore that they buy high-volume food for the family. They are less likely to be educated than the General Households, so may therefore be less affluent; however, considering their high consumption frequency of all food categories, affordability does not appear to be limiting factor for this household type. The 'Hedonistic Households' typology in the current study (which accounted for the third greatest proportion of the sample) was similar in description to the 'foodies' typology in Maciejewski et al.'s (2021) study (the most prevalent typology in the Polish sample, and the second most prevalent typology in the Slovack sample). However, it should be noted that this study is not fully comparable with Maciejewski et al.'s (2021) study, as their typologies were informed not only by actual food consumption but also by responses

to other self-reported questions related to consumption such as perceived adequacy of the diet, seeking of dietary advice, and financial sufficiency.

Group 2, 'Healthier Households' have the lowest probabilities of consumption of most of the food categories. They could be vegetarians/vegan and/or quite health conscious as they have the lowest probability of consumption of processed meat and high probability of consumption of potatoes, fruit and vegetables/salad. They also have low probability of consumption of the remaining less healthy food groups. As they are less likely than the reference group to have more adults in the household it is assumed this group could predominantly include single people, which may also explain the low diversity of probability of consumption across groups, as they are only buying for one person so purchasing only the food groups they consume themselves. In contrast, a larger household is more likely (as indicated from the findings) to have greater consumption diversity across food groups. Considering that this household type was more likely to be higher educated than the General Households, it can be assumed that they are a more affluent group, and that their restriction of food groups is more closely linked to diet preferences and consumption patterns (e.g. avoidance/limitation of meat and less healthy food groups) than to financial constraints. Household factors may also be an influence here considering this household type is more likely to have fewer adults living in it and therefore the related likeliness to purchase less food if only buying for one (or two, as opposed to a larger family). 'Healthier Households' were the only group to be more likely than General Households to think they were living a healthier way of life; however, they were less likely to identify as having good general health.

Group 4, 'Unhealthier Households' was the smallest group, and they were the only household type who were more likely to self-assess as both having poorer general health, and as living a less healthy lifestyle. This group had low probability of consuming fruit and vegetables/salad and a high probability of consuming the other less healthy food groups. Their self-assessment relating to their health and lifestyle however indicates that they are conscious that their food habits are not healthy.

Group 5, 'Balanced Households' was the second largest group following the General Households reference group. This group had a high probability of consumption for only four groups (potatoes, chips, fruit, vegetables/salad) and was therefore similar to Group 2 with regard to appearing to be more likely to restrict consumption of less healthy food groups, but different in having higher probability of processed meat consumption, and in having much higher probability consumption of chips. Group 5 was also unique with regard to being the only group less likely to drink alcohol.

There were some demographic similarities between Group 4 and Group 5 with regard to both groups being more likely to be younger, more likely to be less educated, and more likely to have poorer health. However, with regard to consumption they differ in that one has greater probability of consumption of food groups generally and of less healthy food groups in particular (Group 4) and the other has a greater probability of more restricted consumption across the food groups, particularly of less healthy food groups (Group 5).

This study is unique in that it, to the best of the authors' knowledge, is the only study to date which examines household typologies with regard to probability of consumption of food groups aligned with dietary guidelines, using a large population-level dataset which is representative. The current study's findings are therefore of interest to other regions both nationally and internationally as they represent not only a range of demographics of households in the region in which the data were collected, but this demographic profile is also reflective of other areas. However, research indicating that different regions can have variations with regard to consumer typologies in relation to food (Maciejewski et al., 2021)

rationalises the need for study in other geographical areas to determine specific applicability to various populations internationally. The nature of the survey in covering a wide range of lifestyle topics, in which the questions related to food are just one aspect, is considered useful to reduce bias. However, it is acknowledged that awareness of the survey title ('NI Health Survey') and the presence of an interviewer, may lead to some bias in responses with regard to respondents leaning towards more socially desirable responses. Therefore, we acknowledge the limitation of the study in that statistical methods used to identify household typologies are not exact measures of actual food consumption, but they are useful in providing a general proxy with regard to how assessing how households accord with guidelines related to consumption of marker foods, and demographics associated with the varying household typologies. Due to the survey's particular interest in 'marker food' consumption, the NI Health Survey does not provide a full overview of all food groups e.g. unprocessed meat, and dairy products are not included in the survey questions regarding food group consumption. The exclusion of these groups and the focus on the marker food groups only is understandable considering priorities in relation to policy; however, the inclusion of these two groups would be useful to allow for a wider comparison of food consumption in relation to other government guidelines, for example the Eatwell Guide, to allow for more accurate comparison with other population-level datasets which collect data on consumption of all food groups; and would also provide insight on other aspects of consumption behaviour related to, for example, sustainable diets and general consumption trends.

Policy Implications

Considering the reference to these 'marker' food groups in the Fitter Future for All Framework (DHSSPS, 2012) the findings from this study provide insight into how household food consumption in the NI population accords with recommendations regarding the consumption of (less) healthy food groups. Evident disparities between policy recommendations regarding food consumption, and actual population food consumption, would therefore inform interventions.

Identifying consumer typologies with relation to food choices is an even more useful approach as assessing population food consumption from the specific perspective of typologies can aid with the development and implementation of interventions which are specifically targeted (Funk et al., 2021), and thereby are considered more effective (Aschemann-Witzel et al., 2016). Identifying typologies can also rationalise spending on targeted interventions or communications related to the relative size of the typology in the population whose behaviour the intervention is aimed at changing and/or informing. Considering all five household types, all groups apart from the smallest ('Unhealthiest Households', which accounted for only 3% of the sample) have high frequency of consumption of the healthy food marker groups (fruit and vegetables/salad), while the group with the lowest consumption of all the less healthy food groups ('Healthiest Households') was the second smallest group in the sample (accounting for 13%). With regard to policy implication, this finding appears positive with regard to indicating the effectiveness of previous/current communications and interventions with regard to consumption of the healthy food groups; however, it does not provide specific insight with regard to the types, diversity, and amount of foods consumed in these groups. Therefore, it is not clear from this finding whether respondents were achieving government recommendations with regard to five portions (80 g) of fruit and vegetables per day (NHS, 2019). Further, as per Table 1, 'Fruit' includes

pure fruit juice, therefore there is potential that respondents could have self-classified themselves as frequently consuming 'fruit' based solely on regularly drinking fruit juice (and/or other forms of fruit, such as dried, which may be higher in sugar, or less beneficial nutritionally than other forms). Findings indicate that consumption of the less healthy food groups is an eating pattern engrained among the majority of NI consumers (as approximately two-thirds of the sample were accounted for in household typologies (Class 1, 3, and 5) with higher frequency consumption of the less healthy food groups). It is reasonable to suggest therefore that policy attention relating to promoting behavioural change with regard to decreasing consumption of less healthy food groups (i.e. food groups high in fat, salt and sugar) remains important to achieve positive population public health outcomes, as outlined in the Fitter Future for all Framework (DHSSPS, 2012) and other government publications (e.g. Public Health Agency (2016), DHSC (2020). The findings also indicate scope for further promotion of the importance of consumption of the healthier food groups, particularly considering that households in the group with the lowest consumption of healthy foods were more likely to report poorer general health and having a less healthy lifestyle. Considering the cost burden on government resources (NHS) of diet-related ill health (Rayner & Scarborough, 2005), targeted intervention with this group could be merited. However, if intervention was to be targeted to this group, further research would need to examine a wider range of demographic predictors of households in this group, in order to more specifically target interventions. As there was limited differential significance of the findings relating to the sociodemographic characteristics of each household typology, we cannot conclusively suggest any policy implications at the demographic level. Considering the Northern Ireland Health Survey in relation to other population-level surveys that include questions on food consumption, the NI Health Survey is more limited with regard to the food groups it includes. Others such as the Belgian National Food Consumption Survey, examined in Van Mierlo et al.'s (2021) typology study, or the French National Food Consumption Survey (INCA2), examined in de Gavelle et al.'s (2018) food intake pattern study, encompass a wider variety of food groups including meat and dairy products. Although it is acknowledged that from a financial perspective population surveys only include the most relevant questions, and that the groups included in the NI Health Survey relate to the marker foods identified in the Fitter Future for All Strategy, it is considered that in order to allow for a better understanding of food consumption at the population level, and to facilitate comparison with other countries, including the categories of meat and dairy products (and meat/dairy alternatives) in the survey would be a useful addition.

Examining diets at a population level can also be used as an indicator of the environmental impact of a population's diet (Van Mierlo et al., 2021), and considering recommendations for consumers to reduce meat and dairy consumption, a potential application of this methodology could relate to assessing the environmental impact of diet and awareness of sustainability issues with regard to food consumption. For example, Graca et al. (2019) examined population food consumption with the view to assess consumer willingness and barriers to transition to plant-based diet consumption, and Funk et al. (2021) developed consumer typologies with regard to their environmental impact related to food, with the view to inform communication strategies and policy making. This methodology of classifying household typologies is relatively novel (to the best of our knowledge only two studies have undertaken this approach with regard to food consumption: one considering food groups generally (Maciewjewski et al., 2021) and the other considering protein consumption specifically (Van Mierlo et al., 2021). Therefore, with regard to policy implications at the international level, it is considered that identifying household typologies at a country or state level, can help to assess a population's compliance with health guidelines, and inform

targeted communications and interventions with regard to changing consumer behaviour in relation to consumption of healthy/less healthy food types. Layering this analysis with data on related aspects of food consumption such as consumers' satisfaction with their diets, how they perceive their finances, and perceived cooking skills, would provide a deeper level of insight which could further inform policies relating to health promotion and education (e.g. secondary level education related to food and budgeting, or cooking skills). As previously discussed, policy related to food and health is often used to inform retailer strategy with regard to designing healthier food products and related to promotion of diets according with health guidelines. Therefore, policy-level changes can influence householders' consumption behaviours directly (e.g. consumers who consciously make healthier choices as a result of being exposed to communications or interventions formulated by policy impetus) and also indirectly (e.g. making below the line interventions available to the broadest number of consumers as possible by reducing HFSS product visibility in store, devising promotional strategies to encourage healthier purchase, and continuing product reformulation for the betterment of its nutritional profile to reduce saturated fat, sugar, salt, calorific value and provision of smaller portion sizes of energy-dense foods to deliver a healthier and informed choice for consumers at the point of choice via responsible *choice editing* permitting healthy choices to happen naturally due to the number of healthy lines present from which to choose.

As this study focused on a quantitative dataset, we do not have access to data on consumer motivations and knowledge with regard to each of the food groups consumed. Behavioural insights are useful to inform interventions and policy (Bauer & Reisch, 2019). Other studies have examined how consumers appraise and perceive foods, for example how they use nutritional tables on food labels (Souiden et al., 2013; Visschers et al., 2013), or the attention they pay to price when purchasing food (Maciewjewski et al., 2021). Research has indicated evidence that healthier foods are significantly more expensive than less healthy, energy-dense foods (Kenny et al., 2018). The actual or perceived higher cost of healthier foods can be a barrier that prevents some consumers from achieving a diet that aligns with health recommendations, and this barrier can be particularly intractable for low-income consumers (Kenny et al., 2018). Further research could therefore examine consumer motivations and knowledge regarding consumption of these marker food groups to provide a deeper perspective into why the identified consumer typologies make the choices they do: For example, are there commonalities among typologies with regard to either physical or financial accessibility to certain food groups; are food typologies explained by cost, health, cooking skill or time motivations. More precise suggestions could then be made for targeted interventions among each of the household typologies (Visschers et al., 2013).

Conclusion

In conclusion, this study presents a method to examine population adherence to dietary guidelines, segmenting the population into 'household typologies' according to their frequency of 'marker' food groups. This method can be used to inform targeted communications and interventions. Findings provide insight into household typologies in Northern Ireland and associated demographic characteristics of these typologies. Findings rationalise further promotion of behavioural change towards decreasing consumption of less healthy food groups, and promotion of the links between healthy food group consumption and good health. It is suggested that inclusion of meat (in addition to, or as opposed to, processed meat) and dairy as marker food groups would allow for comparison with other

government guidelines relating to health and would further allow for potential monitoring of the environmental impact of diets (and monitoring of related current/future targets to change dietary patterns towards inclusion of more sustainable protein alternatives). Further research to identify motivations and knowledge with regard to each of the food groups consumed is recommended, to inform more targeted interventions.

Declarations

Ethics Approval Ethical guidelines from author institutions complied with as appropriate.

Consent to Participate Not applicable.

Consent for Publication Not applicable.

Conflict of Interest The authors declare no competing interests.

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