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Determining the food choice motivations of Irish teens and their association with dietary intakes, using the Food Choice Questionnaire

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ABSTRACT

During adolescence, teens start making their own food choices. While health and nutrition are important, practical and social concerns are also influential. This study aims to determine factors that motivate the food choices of Irish teens (using Food Choice Questionnaire), using data from the National Teens' Food Survey II (N = 428, 50% male, 13–18 years), and to identify how these motivations relate to dietary intakes (4-day semi-weighed food diaries). Data analysis used PCA to determine the food choice motivation subscales, and correlation and comparative statistical tests (*t*-test, ANOVA). Eight motivating factors were identified for Irish teens: Sensory Appeal, Price & Availability, Health & Natural Content, Familiarity, Ease of Preparation, Mood, Weight Control, and Ethical Concerns. Health and practical aspects to food choice (Price, Availability, Ease of Preparation) are important for teens, but taste (Sensory Appeal) remains a key influence. Food choice motivations vary by sex and by age, BMI status and weight perception, where girls were more motivated by health, weight control, mood and ethical concerns, and older teens were more influenced by mood and ease of preparation. Both those classified as overweight and those who perceived they were overweight were motivated more by weight control and mood for their food choices, whereas those who perceived their weight to be correct placed more importance on health and natural content. Those motivated by weight control had lower energy and higher protein intakes, and those motivated by health and natural content had more health promoting behaviours, with higher physical activity, lower screen time, and higher protein intakes. Understanding the motivations of teens' food choice can help understand why they struggle to meet dietary recommendations, and help to develop more effective health promotion messages by capitalising on the key motivations in the population.

1. Introduction

Food choices involve a complex interaction of considerations, and numerous factors play a role in determining what type of food to choose (Chen & Antonelli, 2020). During adolescence, teens start making more of their own food choices as they gain more independence from their parents (Neufeld et al., 2022). Health and nutrition are important considerations in any food choice, however practical concerns around cost, availability, and taste can play a conflicting role, making it more challenging to choose health-promoting foods (Fleming et al., 2020). As teens get older and socialise independently more often, social concerns around food start to play an increasing role. Teens want to choose foods that are accessible within their social food environments, but also socially acceptable among their peers (Fleming et al., 2020; Neufeld et al., 2022; Neumark-Sztainer et al., 1999; Stevenson et al., 2007).

Dietary recommendations for teens commonly reflect those for adults, with specific advice for higher intakes of calcium-rich foods to support developing bones, and wholegrain-starchy carbohydrates varying depending on age, sex and activity level (Food Safety Authority of Ireland., 2011). The recent National Teens' Food Survey in Ireland (NTFS II) indicated that the dietary intakes of Irish teens remain less than favourable, with low intakes of fruit and vegetables (<3 servings

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per day), and intakes of salt, sugar and saturated fat higher than recommended (IUNA, 2022). There have been changes to the foods being consumed by Irish teens since the previous survey in 2005/2006, with lower intakes of sugar-sweetened beverages, fruit juice, milk and potatoes, and higher intakes of pasta, rice and savouries, fruit and water (IUNA, 2022). Understanding the driving factors behind these new food choice behaviours will be important to help address the continuing concerns for rates of overweight and obesity in the Irish teen population, and the concerns for unfavourable dietary intakes. Many habits that develop in adolescence remain throughout adulthood, so improving the dietary habits of Irish teens will be important to establish good health throughout their adult lives.

One quantitative tool commonly used to understand food choice motivations is the Food Choice Questionnaire (FCQ), which was developed in 1995 as a tool to systematically measure both health and non-health related factors that influence dietary choices, recognising that there are multiple dimensions involved when choosing a food, not only considerations for health (Steptoe et al., 1995). The FCQ contains thirty-six items, generally categorising motivations into nine distinct factors, namely Health, Mood, Convenience, Price, Sensory Appeal, Weight Control, Natural Content, Familiarity, and Ethical Concerns (Steptoe et al., 1995). The FCQ is a useful tool to help understand food choice motives and their impact on dietary intake, and can be used by health promoters and public health policy-makers to help improve diet, health and wellbeing. It has been widely validated worldwide, used in over seventy countries, translated to over forty languages and has been consistently proven to be a valid and useful tool in determining motivations on food choices in different population groups (Cunha et al., 2018), including teen-aged cohorts (Canales & Hernández, 2016; Głąbska et al., 2020; Maulida et al., 2016; Ooi et al., 2015; Share & Stewart-Knox, 2012), and within Irish populations (Markovina et al., 2015; Share & Stewart-Knox, 2012). While the standard FCQ contains thirty-six items forming nine subscales to describe motivations for food choice, many studies using the FCQ use alternative structures with different subscales to describe the motivations in that particular population, and it is recommended that it should be adapted to suit the local cultural context (Cunha et al., 2018).

A global review of studies using the FCQ in 2018 found that sensory appeal was a top-ranked factor motivating food choices in all cohorts, followed by health and price (Cunha et al., 2018). The use of the FCQ tool in teen cohorts is limited, but the findings suggest that the top three motivations for food choice among teens are health, price/convenience, and sensory appeal/mood (Daly et al., 2021). Based on the available data, it could be suggested that teens and adults generally have similar motivations for food choices, but the order of preference can change. Mood and sensory appeal are commonly related, but where reported separately, mood seems to play a slightly more important role in food choice decisions for teens than for adults.

While many studies use the FCQ tool to describe the motivations for food choice in the population without any assessment of food intake (e.g. (Markovina et al., 2015)), including a measure of dietary intake alongside the FCQ can enhance the data even further. Previous research measuring both aspects is limited, but has found those motivated more by health and/or natural content had higher consumption of "healthy foods" such as fresh fruit and brown bread, and lower consumption of "unhealthy foods", like chips and read meat (T. M. Pollard et al., 1998), and higher intakes of fruits and vegetables (J. Pollard et al., 2002). Weight control has been association with higher intakes of low-fat foods (Carrillo et al., 2011), and more recent research comparing the FCQ with NOVA classifications found health to be correlated with increased consumption of unprocessed foods and weight control correlated with decreased consumption of processed culinary ingredients (Souza et al., 2020). In addition, Souza *et al.* found varying associations between other factors on the FCQ with specific food types within the NOVA categories, giving some interesting insight into the complex nature of food consumption patterns. The inclusion of the FCQ within a national nutrition survey not only provides behavioural insights behind the reasons for the food choices, but also provides a detailed description of dietary intakes, enabling the exploration of the relationship between food choice motives and dietary intakes. Understanding the motivations for teens' food choices can help us understand why they struggle to meet dietary recommendations (IUNA, 2022; Rippin et al., 2019), and can provide opportunities for researchers and policy makers to develop more effective health promotion messages.

This research aimed to determine the appropriate classifications of food choice motivations in this sample of Irish teens, thereby describing the current key factors motivating the food choices of Irish teens. In addition, this research aimed to explore the association between these motivations and different population characteristics, and with measured dietary intakes. It was hypothesised that the top motivations for food choice would relate to mood, sensory appeal, price and health, and that those motivated by health or weight control would have lower energy intakes and lower intakes of "unhealthy" foods.

2. Methods

2.1. Survey methods

The analyses were conducted on data from the Irish National Teens Food Survey II (NTFS II), a cross-sectional survey carried out between March 2019 and March 2020 by the Irish University Nutrition Alliance (IUNA, 2022). The survey investigated habitual food and drink consumption, health and lifestyle characteristics, and assessed body weight status of a nationally representative sample of teens aged 13–18 years in the Republic of Ireland (N = 428, 212 males, 216 females). Participants were recruited with an opt-in approach from secondary schools throughout the Republic of Ireland, with an overall survey response rate of 57%. Demographic analysis of the sample has shown it to be representative of teens in Ireland with respect to sex and geographical location when compared to Census 2016 data (CSO, 2017). However, the final sample contained a higher proportion of teens of professional workers and a lower proportion of teens of semi-skilled and unskilled workers than the national population, so data were weighted to account for these differences. Written informed consent was provided by the participants and their parents/guardians. Ethical approval was obtained from the Clinical Research Ethics Committee of the Cork Teaching Hospitals and the Human Ethics Research Committee of University College Dublin (Ref: ECM 4 (II) 04/12/18 & ECM 3 (c) 15/04/19). Further details on the full survey methodologies are available at www.iuna.net (IUNA, 2022).

2.2. Data collection

Data collection took place in person, using paper-based questionnaires and food diaries. The teen participants completed the majority of the responses, with one short section of the Health and Lifestyle Questionnaire being completed by the parent(s) (detailed below). Trained researchers collected the anthropometric measurements.

2.2.1. Food choice questionnaire

The FCQ contains thirty-six items with all items answered on a 4-point Likert scale. Participants respond with the level of importance they assign to each point, preceded by statement *"It is important to me that the food I eat on a typical day is ….."*, with responses being 1 = Not At All Important, 2 = A Little Important, 3 = Moderately Important, and 4 = Very Important. In the present research, the original FCQ format was used in its entirety, without modification or addition of items (Steptoe et al., 1995).

2.2.2. Health and Lifestyle Questionnaire

Participants completed a self-reported Health and Lifestyle Questionnaire, which included information on general health and

perceptions of their weight status and diet styles, as well as information on parental socio-economic status and education level. Age groups were categorised as younger (13–15 years) or older (16–18 years). Ethnicity was classified as white, black, asian and other. Geographical location used the IUNA categories of small town, large town, city, and open country. The education level and socio-demographic level of the participant was defined using the highest category of both parents/guardians, as per IUNA reporting (IUNA, 2022). Perceptions of weight status were categorised as perceiving themselves to be underweight, normal, or overweight. Diet styles were categorised as being on a weight-loss diet, weight-gain diet, no diet, or unknown. Participants interest in a healthy diet was answered on a 10-point sliding scale and categorised into high (>5) or low (≤5) levels of interest.

2.2.3. Anthropometric measurements

All anthropometric measurements for the teen participants were measured by trained researchers during data collection visits. Weight was measured to the nearest 0.1 kg using the Leicester portable height measure (Seca, Birmingham, UK), with the participants barefoot and their head positioned in the Frankfurt Plane. Weight and body composition were measured (in duplicate) to the nearest 0.1 kg using a Tanita body composition analyser BC-420MA (Tanita Ltd, GB).

Body Mass Index (BMI) was calculated as weight (kg) divided by height squared (m^2). The International Obesity Task Force (IOTF) age- and sex-specific BMI cut-offs were used to define thinness, normal weight, overweight and obesity (Cole & Lobstein, 2012).

2.2.4. Physical activity measurements

The validated Youth Physical Activity Questionnaire (Y-PAQ) was used to estimate levels of physical activity for participants (Corder et al., 2009). Physical activity, sedentary activity and screen time were calculated as minutes per day. Participants were classified as meeting physical activity recommendations if ≥ 60 min per day on average was recorded, or not meeting the recommendation if < 60 min per day was recorded (Department of Health, 2009; WHO, 2020). Screen time included all screens (TV viewing and gaming), and was categorised as meeting the recommendation of watching ≤120 min per day or not meeting the recommendation by watching >120 min per day (NICE, 2015).

2.2.5. Dietary intake measurements

Dietary intake data were collected through a 4-day semi-weighed food diary, with participants weighing all food and beverages consumed using a portable food scale (Tanita KD-400, Japan). Other food quantification methods (e.g. manufacturers' information, age-appropriate photographic and food portion sizes) were used where weighing was not possible, as outlined in the main survey report (IUNA, 2022). Nutrient intake data were generated using Nutritics© software to estimate nutrient intakes from food intakes using data from McCance and Widdowson's The Composition of Foods, sixth edition and seventh edition (for a small number of foods) (FSA, 2002, 2015). During the survey, modifications were made to include recipes of composite dishes, nutritional supplements, fortified foods and generic Irish foods that were commonly consumed. Food intake data were also classified as per the 19 food group categories identified by the IUNA research group (IUNA, 2022). The list of 19 food groups can be seen in Table 6.

2.3. Variables included in the analyses

The mean scores for each FCQ subscale were used as separate, continuous, dependent variables in the bivariate analyses. The variables included as categorical, independent variables in the present analyses are grouped as demographic variables (sex, age-group, ethnicity, geographical location, parent social class, parent education level), anthropometric variables (BMI categories), behaviour and attitude variables (weight perception, diet styles, meeting physical activity [PA] recommendations, meeting sedentary activity [SedA] recommendations, high/low levels of screen time [ST] and high/low level of interest in eating a healthy diet).

These variables were included in the comparative analyses to assess their relationship with each of the FCQ subscales. Variables included in the correlation analyses in their continuous form were age, BMI, number of minutes of PA, SedA and ST. Dietary intake variables were also included as continuous variables in correlation analyses, namely daily energy intake (kcal/day), and daily intakes of protein, fat, saturated fat, carbohydrates and total sugars, all expressed as grams per day (g/day) and as percentage of total daily energy intake (%TE). Daily intakes of dietary fibre (g/day), sodium (mg/day), and fruit and vegetables (F&V, g/day) were also included, as these are key markers of health noted as having concerning intake levels in Irish teens (IUNA, 2021; Rippin et al., 2019). Intakes of specific food group categories (g/day) were also included, to determine the specific types of food associated with food choice motivations, as per the IUNA 19 food group categories (IUNA, 2022). Dietary intake variables (including food groups) were used as continuous variables in correlation analyses only, to assess the association between motivations for food choice and measured dietary intake values.

2.4. Statistical analyses

Two rounds of principal component analysis (PCA) with varimax rotation were conducted to validate the FCQ in the NTFS II 2019-20 cohort, one by forced factor analysis (FFA), to identify if the original FCQ structure remained valid, and a second by exploratory factor analysis (EFA) without iteration for items with Eigenvalue >1, to identify the most appropriate structure of the subscales within this teen cohort. A Kaiser-Meier-Olkin (KMO) test was run to assess sampling adequacy to indicate the proportion of variance that might be due to underlying factors, and Bartlett's test of Sphericity was run to test that the items were sufficiently related and therefore suitable for reduction into scales (IBM, 2021). A high KMO (close to 1) and a low Bartlett's Test ($P < 0.05$) is preferable (IBM, 2021). Internal consistency and scale reliability were assessed using Cronbach's alpha. A cut-off of 0.7 was deemed sufficient for adequate reliability (Taber, 2018).

The PCA indicated an alternative structure to the original FCQ subscales. Mean scores for each new subscale were calculated by dividing the sum of responses by the number of items in the subscale, the highest score being four and the lowest score being one. Since the number of items comprising each subscale varied and some were quite small, subscales with any incomplete answers were excluded from the analysis.

Motivating factors were ranked for their order of importance based on these mean scores. All scales were normally distributed, therefore independent samples t-tests and one-way ANOVA with post-hoc Tukey analysis were used to assess differences in mean scores between the FCQ subscales and the categorical variables outlined above. Levene's Test was run to assess equality of variance. Chi-squared tests were run to assess differences in proportions between boys and girls. Pearson's correlations were run to assess the relationship between each of the eight FCQ subscales with each other and with the continuous variables, namely age, BMI, PA, SedA, ST, and all dietary intake variables.

Data were analysed for the whole group and stratified by sex and age group. Unadjusted statistical significance was set at $P < 0.05$. Due to the multiple analyses conducted, a Bonferroni correction was applied based on the number of independent variables in the analysis, the specific value of which is indicated for each section of the analysis (McEwan, 2017). The statistical software package IBM SPSS Statistics version 28.0 was used for all analyses in the present study.

3. Results

3.1. Description of NTFS II study population

The NTFS II study population had an equal sex balance, 49.5% males and 50.5% females (Table 1). There was a slightly larger proportion of younger teens (13–15 years) than older teens (16–18 years) in the population (55.1% *vs*. 44.9%). The study sample was 90% white. The largest proportion of the study population lived in the open country (37.4%), followed by the small towns (33.2%). Half of the population had parents within the professional social class group, and 80% of the population had parents with tertiary education.

The majority of the teens were classified in the normal-weight BMI category (71%), with only 5% categorised as thin, but over one fifth were classified with overweight or obesity (Table 1). These data show that 62% of participants perceived their weight to be the correct weight, with 13.4% perceiving that their weight was too low and almost a quarter (24.4%) of participants perceiving their weight to be too high. Significantly more boys perceived their weight as underweight than girls (chi-squared = 11.56, $P = 0.003$). Of the total sample, only 6% were actively on a weight-reducing diet, 7% were on a weight-gaining diet and >80% were either on no specific diet or it was unknown (Table 1). A slightly higher number of girls reported being on a weight-loss diet, but significantly more boys reported being on a weight-gain diet (chi-squared = 16.81, $P < 0.001$). Participant responses indicated that most of these diets were self-prescribed, but other key sources for diet recommendations included personal trainers, the internet, parents, friends, and doctors or a nutritionist.

In relation to meeting the physical activity recommendations, 67% met the recommendation of doing ≥60 min per day. However, only 21% of the population met the recommendation for screen time, with the vast majority (79%) watching ≥120 min per day. Most participants (79%) reported a high level of interest in eating a healthy diet (Table 1).

Mean daily energy intake for the full group was 1812 kcal/day. The % total energy from protein, fat and CHO were 16.6%, 34.6% and 47.8%, respectively. Boys had significantly higher intakes of energy than girls ($P < 0.001$). Irish teens consumed 17g dietary fibre on average per day, and more than 2000 mg sodium, with boys have higher intakes than girls for both nutrients ($P < 0.001$). Mean daily intake of F&V was just over 200g per day (Table 2).

Table 1
Descriptive characteristics of the study sample of Irish teens aged 13–18 years, National Teens' Food Survey II (2019–2020) (N = 428).

	Total %	Boys %	Girls %
	(N = 428)	(n = 212)	(n = 216)
Sex			
Male	49.5	–	–
Female	50.5	–	–
Age group			
13–15	55.1	56.1	54.2
16–18	44.9	43.9	45.8
Ethnicity			
White	90.4	92.5	88.4
Black	3.7	2.4	5.1
Asian	1.9	1.4	2.3
Other	4.0	3.8	4.2
Geographical Location			
Open country	37.4	37.7	37.0
Small town	33.2	36.8	29.6
Large town	22.0	20.3	23.6
City	7.5	5.2	9.7
Parents' Education			
Primary & Intermediate	7.3	7.1	7.4
Secondary	12.0	10.0	14.0
Tertiary	80.8	82.9	78.6
Parents' Social Class			
Professional worker	56.8	61.5	54.0
Non-manual skilled	17.9	18.3	17.5
Manual skilled	15.0	13.5	16.6
Semi/Unskilled	9.3	6.7	11.8
Teen Weight Status (BMI)[a]			
Thin	5.3	6.2	4.5
Normal weight	71.0	70.7	71.4
Overweight/Obesity	23.7	23.1	24.1
Weight Perception			
Underweight	13.4	19.0[b]	8.0
Correct weight	62.3	58.5	65.8
Overweight	24.4	22.5	26.2
Diet styles			
Weight loss	6.1	3.8	8.4
Weight gain	7.1	12.4[c]	2.1
Neither	80.0	77.4	82.5
Unknown	6.7	6.4	7.0
Physical Activity			
≥60 min/day	66.9	67.8	66.0
<60 min/day	33.1	32.2	34.0
Screen time			
≤120 min/day	21.1	17.1	25.0
>120 min/day	78.9	82.9	75.0
Interest in Healthy Diet			
Low	20.5	24.8	16.3
High	79.5	75.2	83.7

*Missing data: Parent's education n = 2; Parent's Social Class n = 9; Teen weight status n = 3; Weight Perception n = 3; Diet styles n = 1; Physical activity n = 1; Screen time n = 10.
[a] Thin includes IOTF grade 1&2 thinness, and Overweight/Obesity combine including overweight, obesity and morbid obesity. [b] Significantly more boys perceived their weight as underweight than girls (chi-squared = 11.56, P = 0.003). [c] Significantly more boys reported being on a weight gain diet than girls (chi-squared = 16.81, P < 0.001).

3.2. Motivations for food choice among Irish teens

The factorial structure of the original FCQ was examined on the thirty-six items of the questionnaire. PCA with varimax rotation using FFA did not support items loading fully on the same nine factors of the original FCQ. Subsequently, an EFA without iteration was conducted to identify any changes to the original nine-factor structure that may exist within this specific Irish teen cohort. The scree plot indicated an eight-factor solution for items with Eigenvalues >1, accounting for 63.07% of the total variance. The EFA returned a modified eight-factor structure specific to this Irish teen cohort. The nine-factor structure previously forced from the data retained these new modified subscales and the ninth factor was created by repeating two items. Therefore, the original FCQ factor structure was not fully validated in this Irish population, rather a modified eight-factor structure emerged.

Internal consistency and scale reliability for the new eight-factor

Table 2
Mean daily intakes of energy, macronutrients, dietary fibre, sodium and fruit and vegetables from the study sample of Irish teens aged 13–18 years, National Teens' Food Survey II (2019/2020) (N = 428).

Dietary Intakes		Total	Boys	Girls	P-value
		Mean (SD)	Mean (SD)	Mean (SD)	
Sample	n	428	212	216	
Daily energy	MJ	7.6 (2.2)	8.8 (2.1)	6.5 (1.8)	
	kcal	1812 (531)	2083 (496)	1554 (424)	**<0.001**
Protein	g	74.4 (24.6)	87.2 (23.4)	62.2 (18.8)	
	%TE	16.6 (2.5)	17.0 (2.6)	16.2 (2.5)	**0.033**
Total Fat	g	71.0 (22.3)	80.3 (21.9)	62.0 (18.6)	
	%TE	34.6 (3.7)	34.1 (3.6)	35.1 (3.6)	**0.025**
Saturated Fat	g	29.0 (10.5)	33.4 (10.5)	24.9 (8.7)	
	%TE	14.2 (2.4)	14.3 (2.4)	14.0 (2.4)	0.538
Carbohydrates	g	229 (70.2)	264 (65.7)	196 (56.9)	
	%TE	47.8 (4.1)	47.8 (4.1)	47.7 (4.1)	0.504
Total Sugars	g	76.2 (31.3)	87.2 (32.0)	65.7 (26.7)	
	%TE	15.7 (4.0)	15.8 (4.1)	15.7 (4.0)	0.984
Dietary Fibre	g	16.9 (5.5)	18.9 (5.5)	15.0 (4.8)	**<0.001**
Sodium	mg	2076 (642)	2374 (613)	1791 (530)	**<0.001**
F&V	g	218 (159)	234 (172)	203 (144)	0.05

SD, Standard Deviation; TE, Total energy; F&V, Fruit and vegetables.

FCQ were assessed using Cronbach's alpha. Factor reliability was then calculated for each item loading onto the new eight factors, and a final reliability test was run on the most prominent items loading onto the new eight factors to identify the new subscales for analysis. The factor loadings and internal reliability of the new eight-factor structure is detailed in Table 3. All factor scales were above the cut-off value for adequate consistency of 0.7 for each scale. Thus, the modified eight subscales for this cohort have adequate internal consistency in an Irish teen population.

The mean scores for each subscale were calculated and were listed in order of importance. The highest-ranking subscale with regard to food choice was Sensory Appeal (SA), followed by Price and Availability (P&A), and Health and Natural Content (HNC). Familiarity (Fam) was a mid-ranked subscale, tied with Ease of Preparation (EoP), and the lowest ranking subscales were Mood, Weight Control (WC), and Ethical Concerns (EC) (Table 4).

Table 3
Factor loadings and internal reliability for the modified eight factor Irish-Food Choice Questionnaire.

It is important to me that the food I eat on a typical day ….	Standardised Factor Loadings	Cronbach's alpha
Health & Natural Content		0.91
Contains lots of vitamins and minerals	.820	
Is nutritious	.819	
Keeps me healthy	.816	
Is good for my skin/teeth/hair/nails etc.	.745	
Is high in protein	.719	
Contains no artificial ingredients	.686	
Is high in fibre and roughage	.645	
Contains natural ingredients	.630	
Contains no additives	.593	
Mood		0.82
Helps me relax	.774	
Helps me cope with stress	.758	
Helps me to cope with life	.718	
Cheers me up	.587	
Makes me feel good	.532	
Keeps me awake and alert	.495	
Price & Availability		0.81
Is good value for money	.744	
Is easily available in shops and supermarkets	.729	
Is cheap	.714	
Can be bought in shops near where I live or work	.662	
Is not expensive	.626	
Sensory Appeal		0.72
Has a pleasant texture	.730	
Looks nice	.726	
Smells nice	.685	
Tastes good	.627	
Ease of Preparation		0.80
Easy to prepare	.770	
Takes no time to prepare	.741	
Can be cooked very simply	.738	
Weight Control		0.80
Is low in fat	.739	
Low in calories	.733	
Helps me control my weight	.656	
Familiarity		0.67
Is what I usually eat	.765	
Is familiar to me	.730	
Is like the food I ate when I was a child	.648	
Ethical Concerns		0.72
Comes from countries I approve of politically	.781	
Has the country of origin clearly marked	.644	
Is packaged in an environmentally friendly way	.583	

Table 4
Mean scores for the FCQ motivations for choice in a sample of Irish teens (aged 13–18 years) from the National Teens' Food Survey II (2019/2020).

FCQ Factor	Abbreviation	n	# items	Mean Score	SD	Skewness
Sensory Appeal	SA	427	4	2.87	0.66	−0.16
Price and Availability	P&A	425	5	2.60	0.72	−0.13
Health and Natural Content	HNC	418	9	2.39	0.69	0.001
Familiarity	Fam	427	3	2.25	0.74	0.11
Ease of Preparation	EoP	428	3	2.25	0.70	0.34
Mood	Mood	427	6	2.11	0.68	0.34
Weight Control	WC	428	3	1.91	0.79	0.67
Ethical Concerns	EC	428	3	1.85	0.74	0.74

3.3. Factors associated with the food choice motivations of Irish teens

Girls scored significantly higher than boys on HNC (2.5 *vs*. 2.3), Mood (2.3 *vs*. 2.0), WC (2.1 *vs*. 1.8) and EC (2.0 *vs*. 1.7, all $P < 0.001$). Older teens scored higher than younger teens for EoP (2.4 *vs*. 2.1, $P < 0.001$), and Mood (2.2 vs 2.0, $P = 0.002$). There were no significant differences based on any other demographic factors (Supplementary Table 1).

Differences in mean scores existed within the IOTF BMI categories, where teens classified with overweight or obesity scored higher on WC than those classified as thin (2.2 vs 1.5, $P < 0.001$) and those classified as normal weight (2.2 *vs*. 1.9, $P = 0.001$). Pearson's correlations also showed that BMI was positively correlated with WC ($r = 0.22$, $P < 0.001$) and Mood ($r = 0.14$, $P = 0.003$, data not shown). Similarly, for weight perception, those who perceived their weight to be too high scored higher on WC than those who perceived their weight to be correct (2.2 vs 1.9, $P < 0.001$), and those who perceived their weight to be too low (2.2 *vs*. 1.5, $P < 0.001$). Additionally, those who perceived their weight to be the correct weight scored higher on WC than those who perceived it to be too low (1.9 *vs*. 1.4, $P = 0.004$).

Teens who showed a high level of interest in a healthy diet and teens who were actively pursuing a weight-loss diet scored higher than their counterparts on HNC, WC and EC. Those who reported being on a weight-loss diet showed a greater interest in HNC motivations than those who were on no type of diet (2.9 *vs*. 2.4, $P = 0.003$). Similarly, those who reported being on a weight-loss diet scored higher for WC motivations than those on either a weight-gaining diet, no diet, or on an unknown type of diet (all $P < 0.001$) and those who reported being on a weight-loss diet scored significantly higher on EC than those on a weight-gain diet (2.1 *vs*. 1.4, $P = 0.003$). Those with a high level of interest in eating a healthy diet scored higher than those with a low level of interest on HNC (2.5 vs 1.9, $P < 0.001$), WC (2.0 vs 1.6, $P < 0.001$), and EC (1.9 *vs*. 1.7, $P = 0.003$) (Supplementary Table 1).

Teens who met the recommendations for PA and ST scored slightly higher than those not meeting the recommendations on HNC (2.5 *vs*. 2.3, $P < 0.01$), but this did not reach Bonferroni significance. When measured continuously however, the number of minutes of PA per day was positively correlated with HNC ($r = 0.19$, $P < 0.001$), and the number of minutes spent on ST was negatively correlated with HNC ($r = -0.15$, $P = 0.002$) but positively correlated with Familiarity ($r = 0.16$, $P = 0.001$). There were no correlations between any factor and SedA (Supplementary Table 1).

3.4. Associations between the food choice motivations and dietary intakes of Irish teens

Table 5 shows results of the correlations between dietary intake variables and the eight FCQ subscales indicating motivations for food

Table 5
Pearson correlations between the FCQ motivating factors and continuous dietary intake variables in a sample of Irish teens (aged 13–18 years) from the National Teens' Food Survey II (2019/2020).

	SA	P&A	HNC	Fam	EoP	Mood	WC	EC
Energy (kcal)	−0.05	−0.04	−0.09	−0.05	−0.03	−0.11*	**−0.25****	**−0.21****
Protein (%TE)	−0.05	0.03	**0.22****	−0.09	0.03	0.09	**0.14****	0.02
Fat (%TE)	−0.05	−0.01	−0.07	−0.05	−0.06	0.00	−0.07	0.03
SFA (%TE)	0.08	−0.04	−0.10*	−0.08	−0.03	−0.05	−0.12*	−0.01
CHO (%TE)	0.09	−0.00	−0.04	0.10*	0.01	−0.01	−0.01	−0.02
Total Sugars (%TE)	0.05	−0.05	−0.07	0.02	−0.01	−0.03	−0.06	−0.04
Dietary Fibre (g)	−0.07	−0.10*	0.08	−0.06	−0.06	−0.10*	**−0.14****	**−0.16****
Sodium (mg)	−0.06	−0.05	−0.12*	−0.04	−0.09	−0.07	**−0.23****	**−0.17****
F&V (g)	−0.08	−0.11*	**0.24****	−0.12*	−0.09	−0.01	0.00	−0.01

SA, Sensory Appeal; P&A, Price and Availability; HNC, Health and Natural Content; Fam, Familiarity; EoP, Ease of Preparation; WC, Weight Control; EC, Ethical Concerns; TE, Total Energy; SFA, Saturated Fat; CHO, Carbohydrates; BMI, Body Mass Index; PA, Physical Activity; SAct, Sedentary Activity; ST, Screen Time; F&V, Fruit & Vegetables.
*P < 0.05, **Bonferroni P<0.006 (n=9 tests),***P<0.001.

choice. Daily energy intake was negatively correlated with WC (r = -0.25) and EC (r = -0.21, both $P < 0.001$). Energy coming from protein was positively correlated with HNC (r = 0.22, $P < 0.001$) and WC (r = 0.14, P = 0.004). There were no significant associations between energy from total fat, saturated fat, or carbohydrates and any of the subscales. Dietary fibre intake was negatively associated with EC (r = -0.16, $P <$ 0.001) and WC (r = -0.14, P = 0.003). Sodium intake was negatively correlated with EC (r = -0.17) and WC (r = -0.23, both $P < 0.001$). Total F&V intake was positively correlated with HNC (r = 0.24, $P < 0.001$) (Table 5).

3.4.1. Sex and age stratified analyses

The dietary data were then stratified by sex and age group for analysis (Supplementary Tables 2–3). For boys, the same negative associations between energy and WC (r = -0.20, P = 0.004) and EC exist (r = -0.23, P = 0.001) (Supplementary Table 2a). Energy intake from protein was positively correlated with HNC among boys (r = 0.33, $P <$ 0.001), and positive associations with Mood (r = 0.20, P = 0.003) and WC also exist for boys (r = 0.20, P = 0.004). Energy intake from fat was negatively correlated with WC in boys (r = -0.20, P = 0.004). The associations with dietary fibre intake were weaker in boys (r = -0.18, P = 0.008), however the negative correlation between dietary sodium intake and WC (r = -0.19, P = 0.005) and the positive correlation between F&V intake and HNC remained (r = 0.23, $P < 0.001$).

Fewer associations exist among girls (Supplementary Table 2b). A much weaker association between energy intake and energy from protein with WC exists among girls (r = -0.15, $P < 0.05$) but a new negative correlation between energy from protein and Familiarity appeared (r = -0.20, P = 0.003). A positive correlation exists for girls between HNC and both dietary fibre intake (r = 0.24, $P < 0.001$) and total F&V intake (r = 0.29, $P < 0.001$).

In the younger age group, the negative correlation between energy intake and WC remained (r = -0.23, $P < 0.001$), but the correlation with EC was much weaker (Supplementary Table 3a). Both dietary fibre (r = -0.23, $P < 0.001$) and dietary sodium (r = -0.21, P = 0.002) were negatively correlated with WC, and dietary sodium was also negatively correlated with EC (r = -0.19, P = 0.005). No associations existed on the HNC subscale among younger teens.

In the older age group, energy intake was negatively correlated with SA (r = -0.21, P = 0.003) Mood (r = -0.20, P = 0.006), WC (r = -0.28, $P < 0.001$) and EC (r = -0.24, $P < 0.001$). Energy from protein was positively correlated with HNC (r = 0.25, $P < 0.001$), and dietary sodium was negatively correlated with WC (r = -0.26, $P < 0.001$). Total F&V intake was positively correlated with HNC among older teens (r = 0.24, $P < 0.001$) (Supplementary Table 3b).

3.5. Associations between the food choice motivations and food group intakes of Irish teens

Looking more specifically at the food groups associated with the motivations for food choice, numerous associations were observed. Data were analysed according to the IUNA-19 food group categories to give further detail on the specific types of foods that are associated with different food choices in teens. SA was negatively correlated with fish and fish dishes (r = −0.16, P = 0.001). Positive correlations exist between HNC and fruit and fruit juices (r = 0.20), vegetables and vegetable dishes (r = 0.19), and nutritional supplements (r = 0.20, all P < 0.001), and with nuts, seeds, herbs, and spices (r = 0.16, P = 0.001). No strongly significant associations exist for any food group with P&A, Familiarity, EoP, Mood, WC or EC, but some negative correlations were approaching Bonferroni significance for a number of food groups on P&A, EoP, WC and EC (Table 6).

4. Discussion

The current data suggest that Irish teens' diets are still not meeting dietary recommendations (IUNA, 2022). Understanding the motivations and barriers to this will be key to making improvements to their diet and health. Barriers to healthy eating identified in the same NTFS II cohort show the main barriers to healthy eating refer to food preferences, convenience, availability, and cost (IUNA, 2022). Some self-reported "other" barriers were around social aspects when eating around friends or peers, temptation of treats, eating with braces, and some concerns for religion and diet tracking (data not shown), all of which are concerns specific to the developmental period of adolescence, but which are not captured by the FCQ questions in their current format. These data can tell us useful information about the challenges Irish teens face when trying to eat a healthy diet. The present results suggest that the original nine-factor structure of the FCQ is not directly applicable in this Irish teen cohort, rather a modified structure appears, containing eight factors. Several studies have identified a modified structure of the FCQ when used in different population groups, so this modification is consistent with international research (Cunha et al., 2018; Eertmans et al., 2006). In adolescent cohorts specifically, a modified structure with similarities to this eight-factor structure, has often been identified (Canales & Hernández, 2016; Głąbska et al., 2020; Maulida et al., 2016; Ooi et al., 2015; Share & Stewart-Knox, 2012). Focussed discussion relating to each of the new subscales, combining the most suitably inter-related subscales, and how they relate to other published literature will follow.

4.1. Sensory appeal and Mood

These data show that Irish teens are predominantly motivated by the

Table 6
Correlations between the FCQ motivations for food choice and the dietary intakes categorised into 19 food groups in a sample of Irish teens (aged 13–18 years) from the National Teens' Food Survey II (2019/2020).

	Food Group 19	SA	P&A	HNC	Fam	EoP	Mood	WC	EC
1	Meat and meat products	−0.01	0.07	−0.01	0.04	−0.00	0.06	−0.09	−0.13**
2	Bread and rolls	−0.00	−0.10*	−0.00	−0.07	−0.11*	−0.10*	−0.12*	−0.12*
3	Sugars, confectionery, preserves & savouries	0.01	0.03	−0.12*	0.07	0.03	0.01	−0.13**	−0.10*
4	Potato & potato products	−0.04	−0.04	−0.10*	0.06	−0.06	−0.02	−0.13**	−0.05
5	Milk & Yogurt	−0.07	−0.08	−0.07	−0.05	0.01	−0.13**	−0.05	−0.11*
6	Grains, rice, pasta & savouries	−0.02	−0.01	−0.05	0.00	0.10*	−0.01	−0.10*	−0.08
7	Breakfast cereals	−0.07	−0.05	0.07	−0.08	−0.04	−0.12*	−0.08	−0.04
8	Beverages	0.03	−0.02	0.12*	−0.01	−0.01	0.00	0.03	−0.08
9	Biscuits, cakes & pastries	0.04	−0.05	0.01	−0.07	−0.06	−0.01	−0.11*	−0.04
10	Butter, spreading fats & oils	−0.02	−0.11*	−0.14**	−0.04	−0.13**	−0.09	−0.07	−0.08
11	Fruit & Fruit juices	−0.06	−0.13**	**0.20****	−0.09	−0.10*	−0.06	−0.01	−0.03
12	Creams, ice creams & chilled desserts	−0.04	0.03	−0.01	−0.04	−0.02	−0.10*	−0.04	−0.02
13	Soups, sauces & miscellaneous foods	−0.01	−0.11*	−0.04	−0.04	−0.10*	0.01	−0.11*	0.00
14	Cheeses	0.04	−0.07	−0.01	−0.10*	−0.05	−0.07	−0.06	0.01
15	Veg & Veg dishes	−0.09	−0.03	**0.19****	−0.08	−0.03	0.08	0.09	0.02
16	Fish & Fish dishes	**−0.16****	0.01	0.13**	−0.13**	0.00	0.01	0.02	−0.01
17	Egg & Egg dishes	−0.06	−0.05	0.08	−0.06	−0.03	−0.02	−0.05	−0.02
18	Nuts & seeds, herbs & spices	0.02	0.04	**0.16****	−0.06	0.05	0.07	0.08	0.02
19	Nutritional supplements	0.09	0.06	**0.20****	−0.01	0.002	0.06	0.12*	0.06

SA, Sensory Appeal; P&A, Price and Availability; HNC, Health and Natural Content; Fam, Familiarity; EoP, Ease of Preparation; WC, Weight Control; EC, Ethical Concerns.
Food groups data were collected as g/day.
*P < 0.05 **P < 0.01 ****Bonferroni P<0.003 (n=19 tests)** *****P<0.001**.

sensory appeal (SA) of food when making their food choices. This means that the food they choose must taste, look, and smell appealing to them. Girls and older teens placed a slightly higher importance on Sensory Appeal than their counterparts, but for the full group, Sensory Appeal remained the top ranked motivation, consistent with findings from a global review of FCQ data (Cunha et al., 2018). Interestingly, in the only other study to use the FCQ specifically in Irish teens aged 14–17 years, the authors found these sensory items to be less important for adolescents, concluding that perhaps these were not a key motivation in Irish teens, rather the Sensory Appeal of food interlinked with teens' mood (Share & Stewart-Knox, 2012).

In the present teen cohort, Sensory Appeal remained separate to mood. However, it was observed that items relating to mood and Sensory Appeal loaded onto similar factors and there was a significant correlation between mood and Sensory Appeal (data not shown), as found in several other similar studies (Carrillo et al., 2011; Markovina et al., 2015; Ooi et al., 2015; Steptoe et al., 1995). This suggests that teen preferences for taste, smell, or appearance of food may vary depending on their mood. These previous authors suggested that revising the items in the FCQ used in adolescent cohorts may be more effective, since taste preferences change throughout adolescence and themselves are influenced by other factors, in this case by the teens' mood (Bawajeeh et al., 2020; Share & Stewart-Knox, 2012). The difference in findings between our research and that in previous Irish teens may be due to slightly different versions of the FCQ tool being used. Share and Stewart-Knox used a modified version with 43 items, adding in items recommended by Lindeman and Väänänen (Lindeman & Väänänen, 2000), and two items relating to contemporary food issues of the food being organic and not travelling excessive distances (Share & Stewart-Knox, 2012). The different content, and the change to the food and social environment in the ten years since, may explain the difference in importance of Sensory Appeal for motivating food choices in Irish teens. Both studies support the idea that motivations for food choice are different between teens and adults and should be assessed relative to the population. However, the present results may imply that the way food choices are construed by young people do in fact change over time, and are slightly different in 2019/2020 than they were in 2012, regardless of the slight methodological differences.

During the initial development of the FCQ tool, the original authors explored the idea that stress can play a key influential role in both what people eat and how much they eat (Steptoe et al., 1995). In the present study, there was no interaction between scores for either Sensory Appeal or mood with any marker of dietary intake, nor did early work with the FCQ tool (T. M. Pollard et al., 1998). This might be an effect of the method of data collection being taken at one point in time when the participants may not have been experiencing a stressed or upset mood while completing their diet records. One of the recommendations from previous authors was that the items relating to both mood and Sensory Appeal could be combined or reduced to form fewer items with broader detail, to more accurately capture the views of the cohort, particularly when researching younger populations (Fotopoulos et al., 2009). This, coupled with the recommendation from Share and Stewart-Knox (2012) to expand the construct of Sensory Appeal in adolescent cohorts would suggest an age-specific FCQ may be a suitable development to appropriately capture the motivations for food choice in teens.

4.2. *Price & Availability and Ease of Preparation (formerly convenience)*

The altered structure of the original "Price" and "Convenience" subscales found in this cohort supports previous findings, particularly among teens, indicating that the lack of financial autonomy at this stage in life may cause these two factors to be closely linked (Maulida et al., 2016; Ooi et al., 2015; Share & Stewart-Knox, 2012). Our findings did not directly combine these two factors, rather "Price" combined with half of the original "Convenience" factor to create a new "Price & Availability" factor (P&A), highlighting how food needs to be both easily available and affordable for teens to choose to eat it. The other half of the original "Convenience" factor became "Ease of Preparation" (EoP), showing that as well as needing access to the food, teens need the knowledge and ability to prepare it, and the time and motivation to prepare, cook and tidy up afterwards, something which is often a concern or barrier for teens when choosing foods (Candel, 2001; Fleming et al., 2020; Neumark-Sztainer et al., 1999; Shepherd et al., 2006; Ziegler et al., 2021).

The Price & Availability subscale ranked second in this cohort, and Ease of Preparation ranked joint fourth. Routinely throughout research, price is a very important factor that people consider when making a food choice (Cunha et al., 2018). Price was the top ranked motivation in Irish adults in the Food4Me project (Markovina et al., 2015), and it was the second most important factor alongside convenience in Irish teens

(Share & Stewart-Knox, 2012). Price and convenience regularly correlate in research using the original nine subscales of the FCQ, which suggests they contain very similar constructs and play a similarly important role in food choice decisions (Carrillo et al., 2011; Markovina et al., 2015; T. M. Pollard et al., 1998; Steptoe et al., 1995). In studies that use modified structures of the FCQ, coincidentally also being in teen cohorts, price and convenience regularly combine to form one subscale, similar to how it was observed in this study (Maulida et al., 2016; Ooi et al., 2015; Share & Stewart-Knox, 2012). The items that formed this Price & Availability subscale in the present cohort show that when considering convenience, this refers to foods being conveniently available but also being convenient to prepare. Hence, the original convenience subscale split into two subscales, the second being around ease of preparation.

Fotopoulos et al. (2009) discussed the potential of combining the two original subscales of price and convenience, but their conclusion reflects our findings - that the full range of items involved may not be suitable to combine, rather certain items warrant combination but others do not (Fotopoulos et al., 2009). Therefore, facilitating the emergence of a new structure to the subscales is suitable practice when analysing data in a new cohort, rather than sticking strictly to the original nine subscales. Both price and convenience in any form are important drivers for food choice, but their level of importance may vary depending on the population being studied. In this instance, teens require food to be affordable within their limited budget, accessible within their environment, and easy or quick to prepare within their busy schedules and potentially limited cooking skills, so convenience becomes important for availability, affordability, and preparation.

No strong dietary intake associations were observed with either the Price & Availability or the Ease of Preparation subscales, nor were they associated with any demographic, anthropometric or behavioural factors, with the exception of Ease of Preparation being more important for older teens. This is likely connected to their busier schedules and greater level of independence as teens age. Other research has also failed to find any strong associations between price or convenience and dietary intakes (J. Pollard et al., 2002; T. M. Pollard et al., 1998; Souza et al., 2020). Convenience has been found to be slightly more important for those who ate less fruit and vegetables (J. Pollard et al., 2002). A weak association between Ease of Preparation and F&V among girls, and between Ease of Preparation and dietary sodium among older teens, appeared in the present cohort. Although not conclusive, it could warrant further research into the types of foods that are considered affordable, convenient and easy to prepare for teens.

4.3. Health & Natural Content and Weight Control

The third most important motivation in this sample of Irish teens was health and natural content; a new subscale created by combining the original "health" and "natural content" subscales, with girls placing more importance on Health & Natural Content (HNC) than boys. These separate subscales have often been combined in the literature using this tool (Canales & Hernández, 2016; Eertmans et al., 2006), often along with weight control (WC) (Maulida et al., 2016; Share & Stewart-Knox, 2012). In studies using the nine original subscales there are often strong correlations between the health subscale and the natural content subscale, further supporting their close interaction (Fotopoulos et al., 2009; Głąbska et al., 2020; Markovina et al., 2015; T. M. Pollard et al., 1998; Steptoe et al., 1995). In the present cohort, Weight Control remained a distinct subscale, albeit closely correlated with the Health and Natural Content subscale (data not shown). This may relate to the growing understanding that weight is not a direct marker of health and in fact, instead that Weight Control may be related more to concerns for physical appearance and social acceptability rather than direct concerns for health.

A higher importance being placed on Health & Natural Content was associated with a higher consumption of energy from protein and with a higher F&V intake in this sample, as well as being associated with more physical activity and less screen time. Teens who reported a high level of interest in a healthy diet also scored higher on Health & Natural Content as a motivation. This shows that if the motivation for food choice is based on the health properties or the natural content of the food, this is being reflected in the actions and behaviours of the teens who are following more health-promoting behaviours. In one of the first studies to combine the FCQ tool with measurements of dietary intake, the authors found both the health and natural content subscales to be associated with higher intakes of "healthy" foods, such as fresh fruit and brown bread, and lower intakes of "unhealthy foods", such as chips and red meat (T. M. Pollard et al., 1998). Other research has found an association between health as a motivation and intakes of wholegrains (Souza et al., 2020). Another study found that the strongest motivations affecting F&V intake were the health and natural content subscales, both separately or combined (J. Pollard et al., 2002). Our analysis into food groups showed that the Health & Natural Content subscale in the present cohort was positive correlated with foods that might also be considered "healthy" foods, namely salad vegetables, bananas and beverages other than carbonated drinks such as fruit juices, and those motivated by Health & Natural Content were also more likely to take a nutritional supplement (Table 6). Teens motivated by Health & Natural Content properties of food do appear to act on this motivation through their daily habits and diet, showing it to be a key actionable motivating factor.

While separate to Health & Natural Content, the motivation for Weight Control was lower in priority among these Irish teens (seventh position), but was associated with similar factors as Health & Natural Content. Specifically, Weight Control was higher among girls and those with a higher interest in healthy eating. This is similar to findings from the initial FCQ development (Steptoe et al., 1995). Additionally, Weight Control was considered more important for those classified in a higher BMI category and those who perceived their weight to be higher than it should be, and those motivated by Weight Control were more likely to be on a weight-loss diet. It is often the perception of being overweight that causes people to try a weight-loss diet, which may explain some of these associations (Whyte & Findlay, 2004), and these data suggest that those motivated by Weight Control are actively attempting to lose weight through diet changes. Although the proportion of the population on a weight-loss diet was relatively low, these may be the teens who need most attention to ensure they are not partaking in harmful behaviours or missing key nutrients in their attempts for weight loss.

This motivation for Weight Control also connects with the dietary intakes, where Weight Control was associated with lower energy intakes, higher protein intakes, lower fibre intakes and lower sodium intakes. Higher protein intakes may be connected to protein begin perceived as a "healthy" nutrient, however, in terms of food groups, no strong associations appeared between WC and traditional sources of protein. However, the lower sodium intakes may suggest teens actively on a weight-loss diet to control their weight are reducing commonly "unhealthy" or processed foods, which are typically high in salt. An association between Weight Control and lower salt intakes was noted in a Brazilian cohort (Souza et al., 2020) and others found Weight Control to be a stronger motivation in those eating a diet low in red meat, and was positively associated with "healthy foods" and negatively associated with "unhealthy" foods (T. M. Pollard et al., 1998). The food groups associated with Weight Control in the present cohort show a positive association with salad vegetables and show negative associations with foods that might be considered "unhealthy" or "fattening", such as savoury snacks, confectionery, potatoes, and potato products (Table 6). In Brazilian adults, Weight Control was associated with higher fruit intakes and lower bread and pasta intakes (Souza et al., 2020). Low-fat foods were most likely to be consumed by those motivated by Weight Control in Spanish participants (Carrillo et al., 2011). Therefore, it is reasonable to suggest that those motivated by Weight Control make changes to their diet habits in order to consume foods considered "healthier", in an attempt to lose or control their weight. However, Irish

teens may also be cutting out common "healthy" foods that are higher in fibre, something that may warrant further exploration in future research. While not conclusive, these observations provide some interesting insight into the motivations and diet habits of Irish teens, which may help explain current diet intakes and current concerns for health and weight among a cohort whose bodies are growing and changing through puberty and adolescence. Understanding more about what constitutes a "healthy" diet in the eyes of Irish teens would be useful for future research to explore, to ensure key foods or important nutrients aren't being avoided in this attempt for weight control.

4.4. Familiarity and Ethical Concerns

The final subscales in this research are Familiarity and Ethical Concerns (EC). These retained the same structure from the original FCQ, and Ethical Concerns was ranked with lowest importance, as is found in much research (Canales & Hernández, 2016; Cunha et al., 2018; Głąbska et al., 2020; Markovina et al., 2015; Souza et al., 2020).

Familiarity is often ranked low in order of importance, but in the present teen cohort was ranked joint fourth. Familiarity was removed from analysis in previous teen cohorts (Ooi et al., 2015; Share & Stewart-Knox, 2012) and it merged in with other factors in other teen cohorts (Maulida et al., 2016). This inconsistency, particularly in teen cohorts, suggests different roles for familiarity depending on the participants in the cohort. Familiarity is often seen to merge or correlate with elements of sensory appeal, mood, and price (Fotopoulos et al., 2009; Markovina et al., 2015; Maulida et al., 2016; Steptoe et al., 1995). Understanding what is familiar to people depends on their background, culture, family influences etc., and the connection with dietary intakes is not clear (T. M. Pollard et al., 1998). It has been suggested that people who eat more fruit and vegetables have lower familiarity scores, suggesting the openness to try new foods may be connected to eating a more varied diet (J. Pollard et al., 2002). In our sample, familiarity was also connected with lower intakes of F&V, reflecting the general low intakes of F&V in Irish teens (IUNA, 2022). Interestingly, among girls, a positive association between familiarity and energy from protein was observed. It appears that familiarity is more important in this Irish teen cohort than general FCQ cohorts (Cunha et al., 2018). To address the concerns around familiarity with certain foods among Irish teens, greater exposure to these foods from an early age could help increase intakes of them and therefore the intakes of the beneficial nutrients they contain. Making these foods more available and affordable, and teaching people how to prepare and cook them would also be of benefit.

Ethical concern was the lowest ranking factor, and while consistent with other findings (Cunha et al., 2018), this may be due to how the questions are phrased to make up this construct. There have been many concerns raised about the items included in the Ethical Concerns subscale, mainly that there are only three items and they are specific to the political or geographical origins of food (Fotopoulos et al., 2009). However, there are many other ethical concerns that have potential to be included within this subscale, which may be relevant to the Irish teen population. Lindeman and Väänänen proposed a modification to include dimensions of ecological welfare, political values and religion (Lindeman & Väänänen, 2000). This modified version of the FCQ has been used widely in research, particularly in Asian populations where religion plays a strong influential role on food choices (Cunha et al., 2018; Ooi et al., 2015), and when specifically studying the importance of sustainably sourced foods (Dowd & Burke, 2013). Other studies have excluded the ethical concerns questions completely (Fotopoulos et al., 2009; Johansen et al., 2011; Miller & Branscum, 2012). Although limited by lower numbers, it was noted in the current study that ethical concerns ranked higher for those in the Asian ethic group compared with all groups, even when using the limited original version of items (Supp. Table 1). In the Lindeman and Väänänen version of the FCQ (Lindeman & Väänänen, 2000), the additional "ecological welfare" subscale includes elements for environmental protection and animal welfare, and may be more suitable for use in modern-day cohorts, particularly younger cohorts, who are becoming more aware of and motivated by addressing the impact food has on nature and the environment (Bailey et al., 2022; Bryan et al., 2016).

Ethical concerns are often closely correlated with the natural content of food (Markovina et al., 2015; T. M. Pollard et al., 1998; Rankin et al., 2018; Steptoe et al., 1995), as was found in our study sample (data not shown), and this could indicate that the understanding of ethical concerns around food relates to the consumption of animal foods, highly processed foods, or foods that have to travel long distances from abroad. Ethical concerns have been found to be more important for those following a vegetarian diet and those eating fewer "unhealthy" foods (T. M. Pollard et al., 1998). This research did not find any strongly significant food group associations in this cohort, but there were some associations with lower meat intakes ($P < 0.01$, Table 6), and significantly lower intakes of energy, dietary fibre, and sodium (Table 5). While the fibre intakes are less easy to interpret, the lower sodium intakes could be connected with the ethical impacts of eating more processed foods, and how many meat products are often cured or preserved in salt. Similarly, it has been seen that those more concerned with Ethical Concerns make more health-conscious food choices, so although the direct connection is unclear, the evidence is suggesting some association between Ethical Concerns and health (T. M. Pollard et al., 1998). It may be that Irish teens do not consider ethical concerns strongly when making food choices in general, or it may be a limitation related to the specific aspects of ethical concerns captured within the current FCQ. There is certainly strong reasoning for the use of modified and expanded ethical concerns items in future research using the FCQ, in all populations and specifically in younger, teenage populations. The recently developed "Sustainable FCQ" may also be useful in teenaged cohorts to capture these relevant motivations for food choice (Verain et al., 2021).

4.5. Strengths and limitations

The present piece of research has a number of strengths, predominantly that it is one of the few studies to explore associations between measured dietary intakes and food choice motivations from the FCQ. It is also one of the few studies to conduct such research in a teen cohort, giving it the ability to identify some unique features of motivations for food choice specific to teens. A further strength is that the data were collected in a rigorous manner *via* weighed food diaries (with a high level of researcher-participant interaction), and using a validated tool for assessing food motivations to allow comparison between reported motivations and measured intakes. While the survey was conducted in a nationally representative sample of teens with regard to age and sex, the sample may have been biased by the higher proportion of teens from the professional social class. Therefore, the results must be interpreted with this in mind. In additional, some analyses were exploratory in nature, with smaller numbers in certain categories, since the sample was not powered for all aspects included within the present study.

However, three main limitations for this research also exist. Firstly, the two methods of data collection are not directly aligned for this purpose, in that the weighed food intake measures food intake at one point in time (albeit over a four-day period), while the FCQ questions relate to general food choice motivations (Dao et al., 2019; Steptoe et al., 1995). Therefore, some of the responses to items such as mood, may not have been relevant while the foods being recorded were being chosen. It may be more suitable to combine FCQ data with habitual dietary intake data from a food frequency questionnaire, as was done in other studies (Carrillo et al., 2011; T. M. Pollard et al., 1998), despite weighed food intake or 24-h recall being considered a more suitable measure of detailed dietary intake (Dao et al., 2019). Secondly, as with any method of dietary intake, participants may have changed their eating habits to appear "healthier" to the researchers or may have made more conscious food choices because of the data collection, which may not reflect habitual food choices, thereby potentially introducing a respondent

bias. Efforts were made by the research team during data collection to minimise this, but it is a limitation of any measure of dietary assessment (Dao et al., 2019). The final limitation is that the original FCQ version developed in adults in 1995 was used. A modified version of the FCQ may have been more suitable, for example the additional ethical concerns items from Lindeman and Väänänen (Lindeman & Väänänen, 2000), or the use of a recently developed "Sustainable FCQ" (Verain et al., 2021), and/or the inclusion of new items considered specific to Irish participants and to teen participants could have enhanced the data quality. Since the original nine-factor structure did not emerge from these data or from data in previous Irish teens, this supports the consideration for a modified version of the FCQ to be used in future research to accurately capture the key motivations for food choice in Irish teens. A limitation of the FCQ in general is that it does not include any component relating to the peer or social motivations for food choice, something which appears quite often in qualitative research on teen or adolescent food choices (Fitzgerald et al., 2010; Fleming et al., 2020; Neufeld et al., 2022; Neumark-Sztainer et al., 1999; Story et al., 2002; Ziegler et al., 2021). For future research on teen food choices, using a modified version of the FCQ tool that includes questions relating to peer or social influences could enhance the data around the motivations for food choice in teens.

4.6. Summary & future directions

In summary, this research identifies that sensory appeal (i.e. taste) is the predominant motivation for food choice among Irish teens, but this may depend on their mood. Price, availability and ease of preparation (i.e. convenience) are important practical considerations for teens when making a food choice. While health considerations rank highly for teens' food choice, it may not always be practically possible to choose healthy and nutritious foods. Weight control ranked lower as a motivation, and remained separate from the health motivation, but both of these subscales connected with "healthier" dietary intakes. Familiarity and ethical concerns were less important motivations for teen food choices, however these may be potential ways to improve diet quality through appropriate health promotion messaging and exposure to "healthy" foods.

Future research could aim to understand which foods are considered "healthy" or "fattening" by teens, to help improve diet quality while capitalising on the key motivations for their food choices (i.e. taste, convenience, and health). In additional, future research might explore how food choices may change depending on the situation or context, for example how a stressful mood might lead to different food choices than regular day to day life. Finally, future research using the FCQ tool should create subscales appropriate to the research population, rather than using the original nine subscales directly, and should include additional or updated questions relating to ethical concerns/sustainability.

5. Conclusion

Overall, the findings of the present research reflect many findings in other teen cohorts, in other Irish cohorts, and in other studies using the original or modified versions of the FCQ tool. It is clear that key motivations for teen food choice are the Sensory Appeal and Price and Availability of food, while Health and Natural Content is also of high importance. While it is encouraging to see heath being a key motivator for food choice among Irish teens, the practical barriers around taste and affordability may be reducing teens' ability to eat a more health-promoting diet. All relationships between the factors found in our cohort reflect those of the original FCQ during development and early research, and show that food choice is never standalone and there is rarely only one key factor that is considered over others when making food choices. Rather, there are a range of considerations when making a food choice, with different factors playing stronger roles depending on the population and age group at hand.

The results of the present research add to the literature on motivations for food choice in teen-aged cohorts. It also shows some connection between food choice motivations and health promoting behaviours and dietary intakes. There are many considerations involved when making a food choice, but understanding key motivations of population subgroups can help to understand the challenges and opportunities that exist, to help researchers and policy makers design more effective health promotion messages, programmes and policies, with the overall aim of improving the health of the teen and future adult populations. Health promotion messages to teens may be more effective if they draw on elements of sensory appeal, health and mood as key motivations for food choice, rather than focussing on restriction or weight control.

Author contributions

Aisling Daly conducted all data analysis, interpretation and manuscript preparation. Elizabeth J O'Sullivan and John M Kearney supervised the research and provided in-depth feedback on the manuscript preparation. Janette Walton, Laura Kehoe and Breige McNulty coordinated the data collection and reviewed the final manuscript.

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Ethics statement

The present research was conducted in accordance with the Declaration of Helsinki and was approved by the Clinical Research Ethics Committee of the Cork Teaching Hospitals and the Human Ethics Research Committee of University College Dublin (Ref: ECM 4 (II) 04/12/18 & ECM 3 (c) 14/05/19.

Declaration of competing interest

None to declare.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2023.106981.

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