Title:

Exploring the association between mental wellbeing, health-related quality of life, family affluence and food choice in adolescents

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Abstract:

Young people choose energy-dense, nutrient-poor diets, yet understanding of potential determinants is limited. Associations between food choices, mental wellbeing, health-related quality of life (HRQoL) and family affluence were explored to identify targets for intervention to promote dietary health and wellbeing in young people. Adolescents were recruited via post-primary schools in the UK and surveyed at two time-points when aged 13-14 years and 15-16 years. The questionnaire enquired about mental wellbeing using the Short Warwick-Edinburgh Mental Wellbeing Scale, HRQoL using the KIDSCREEN-10, socio-economic status using the Family Affluence Scale and food choice by Food Frequency Questionnaire (FFQ). With missing and anomalous cases excluded, the sample comprised 1208 cases. Factor analysis on the FFQ indicated five food choice factors: 'Junk Food'; 'Meat'; 'Healthy Protein'; 'Fruit/Vegetables'; 'Bread/Dairy'. Multivariate regression analysis indicated that frequent consumption of Junk Food was associated with being male and lower mental wellbeing. Frequent Meat intake was associated with being male and with lower HRQoL. Frequent choice of Bread/Dairy foods was more common among males and associated with higher wellbeing and greater affluence. Those who consumed Fruit/Vegetables frequently were more likely to be female, have higher HRQoL, higher mental wellbeing, and greater family affluence. These direct associations endured between time points. The dietary factors were not mutually exclusive. Those who frequently chose Junk Food were less likely to choose Fruit/Vegetables. Frequent choice of Meat was associated with more frequent choice of Junk Food and Healthy Protein. Intervention to improve dietary and psychological health in young people should target males, those in less affluent households, seek to reduce consumption of 'junk' food, and increase fruit and vegetable intake.

Keywords:

Food choice; health-related quality of life; mental wellbeing; family affluence; adolescents; survey

[1]Introduction

Adolescence is a period of rapid physiological and psychological development, when self-identity and independence is established (Viner et al., 2015; Schwartz, Zamboanga, Luyckx, Meca & Ritchie, 2013). Adolescence is also an important but overlooked stage for the establishment of long-term health behaviour (Nelson, Story, Larson, Neumark-Sztainer & Lytle, 2008). During adolescence young people experience changes to their home and educational environment, develop strong peer networks, and achieve financial independence, all of which have been shown to be associated with dietary behaviour in young people (Draper, Grobler, Micklesfield & Norris, 2015; Driessen, Cameron, Thornton, Lai & Barnett, 2014; El Ansari, Stock & Mikolajczyk, 2012). Food choices are established during adolescence and lay the foundations for dietary habits in adulthood (Craigie, Lake, Kelly, Adamson & Mathers, 2011). Young people's dietary choices are influenced by intrapersonal, interpersonal, community and societal factors (Story, Neumark-Sztainer & French, 2002). Previous research has suggested that young people have a tendency towards consumption of 'junk' (energy dense/low nutrient) food (de Oliveira Figueiredo et al., 2019; Davison, Share, Hennessy & Stewart-Knox, 2015a; McKeown & Nelson, 2018; Zahra, Ford & Jodrell, 2014; Share & Stewart-Knox, 2012; Fraser, Clarke, Cade & Edwards, 2011; Kerr et al., 2009), consumption

[1] Abbreviations:

DENI (Department of Education NI); FAS (Family Affluence Scale); FFQ (Food Frequency Questionnaire); HRQoL (Health-related Quality of Life); KS-10 (KISCREEN-10); sWEMWBS (Short-form Warwick-Edinburgh Mental Wellbeing Scale); SET (Social Ecological Theory); WiSe (Wellbeing in Schools study); YPBAS (Young Persons Behaviour and Attitudes Survey)

of which appears to increase through adolescence (Mosley, Banna, Lim, Failkowski & Novotny, 2018; Schneider, Dumith, Lopes, Severo & Assincao, 2016; Kerr et al., 2009; Larson et al., 2008; Post-Skagegard et al., 2002).

Adolescent food choices tend to vary according to sex with girl's food choice deemed healthier than those of boys (de Oliveira Figueiredo et al., 2019; Savige, Ball, Worsley & Crawford, 2007; Lake et al., 2006; Cooke & Wardle, 2005). Compared to boys, girls are more likely to consume diets high in fruit and vegetables (Skardal et al., 2014; Cooke & Wardle, 2005), and to avoid high-fat foods and limit salt intake (Lake, Mathers, Rugg-Gunn & Adamson, 2006). The recent Australian National Health Survey (2018) of adolescents aged 14-18 years found that girls had a higher average daily intake of fruit compared to boys, and that boys consumed more carbonated drinks than girls (Australian Bureau of Statistics, 2018). It is therefore important to understand sex differences in understanding young people's food choices.

Psychological factors that are intrinsic to the individual are also likely to determine and be determined by young people's food choices (Fitzgerald, Heary, Kelly, Nixon & Shelvin, 2013; Story et al., 2002). Consuming a poor diet in adolescence can contribute towards poor mental wellbeing (Oddy et al., 2009; McMartin, Kuhle, Colman, Kirk & Veugelers, 2012). Mental wellbeing encompasses hedonic (happiness, life satisfaction, and affect) and eudemonic (positive functioning, sense of purpose, and self-acceptance) factors (Clarke et al., 2011; Tennant et al., 2007). Previous research on young people has also identified links between healthy eating and better mental wellbeing (Tanaka & Hasimto, 2019; Kim, Choi, Lee & Park, 2015) and between unhealthy eating practices poorer mental wellbeing (Wu, Ohinmaa & Veugelers, 2012; Zahra et al., 2014; Zahedi et al., 2014) (not measured using the sWEMWBS) Together this implies that mental wellbeing could potentially be an important driver of food choice in young people. The short-form Warwick-Edinburgh Mental Wellbeing Scale

(sWEMWBS) was developed by Tennant et al., (2007) to assess mental wellbeing in non-clinical groups. For the purpose of the sWEMWBS, wellbeing has been defined as a subjective construct that comprises positive psychological factors related to self-esteem and resilience as well as quality of life (Clarke et al., 2011). The sWEMWBS has been shown to be unidimensional in structure (Melendez-Torres et al., 2019; Hoffman et al., 2019; Ringdal et al., 2019; Clarke et al., 2011), to be reliable (Ringdal et al., 2019; Clarke et al., 2011) and appropriate for use in both adults and young people (Melendez-Torres et al., 2019; Clarke et al., 2011). Previous studies in adult samples, report an association between fruit and vegetable consumption and better mental wellbeing (as measured by the sWEMWBS) (Fat, Scholes, Boniface, Mindell & Stewart-Brown, 2017; Stranges, Samaraweera, Taggart, Kandala & Stewart-Brown, 2014; Blanchflower, Oswald & Stewart-Brown, 2012). There do not appear to be any studies that have used the sWEMWBS to assess wellbeing and diet in adolescents.

Health-related quality of life (HRQoL) is a subjective construct which evaluates the perceived health of an individual on the sub-dimensions of physical, psychological and social functioning, and wellbeing (Solans et al., 2008). Evidence for a relationship between healthier dietary practices and better HRQoL has been found using a range of measures in children and adolescents in Spain (Muros, Salvador, Zurita, Gamez & Knox, 2017), Australia (Bolton et al., 2016), Canada (Wu et al, 2012) and the UK (Boyle, Jones & Walters, 2010). A large sample study across 12 countries (Dumuid et al., 2017), and the only previous study that appears to have assessed diet as a whole (using a FFQ), found that children aged 9-11 years who were consuming healthy food choices had greater HRQoL (assessed using KS-10). A recent systematic review (Wu et al., 2019) identified seventeen studies that found associations between better diet quality and greater HRQoL in children and adolescents. HRQoL, therefore, could be important to consider when understanding food choice in young people.

Factors extrinsic to the individual can also impact upon food choice. Less healthy dietary habits are associated with more disadvantaged socioeconomic circumstances (Dowler, 2008). Family affluence is considered a marker of socioeconomic status (Hobza, Hamrik, Bucksch & De Clercy, 2017). Family affluence has been linked to the development of healthy food choices in children (Esteban-Gonzalo et al., 2019; Petrauskiene, Zaltauske & Albaviciute, 2015; Ahmadi, Black, Velazquez, Chapman & Veenstra, 2015; Elinder, Heinemans, Zeebari & Patterson, 2014). More frequent fruit and vegetable consumption has been associated with higher family affluence (scores) in young people aged 11-15 years in the UK (Simon, Owen, O'Connell & Brooks, 2018; Levin, Kirby, Currie & Inchley, 2012), Canada (Elgar, Xie, Pfortner, White & Pickett, 2016; Ahmadi et al., 2015), Greece (Yannakoulia et al., 2016), Norway (Fismen, Smith, Torsheim & Samdal, 2014; Skardal, Western, Ask & Overby, 2014), and Iran (Pourrostami et al., 2019). Higher family affluence scores have also been associated with less frequent intake of chips/fries in young people aged 10-19 years in Belgium (Rouche et al., 2019) and in 11-15 year-olds in the UK (Levin et al., 2012). Higher scores have also been associated with less frequent sugary drink consumption in young people aged 11-15 years in the UK (Simon et al., 2018). The daily experiences encountered by young people living in more economically deprived circumstances are perceived to determine less healthy eating practices (Davison et al., 2015a). Family affluence, therefore, is a potentially important socio-environmental factor to consider in constellation with other individual factors in understanding food choice in young people .

In order to design and target public health interventions appropriately, it is important to understand determinants of food choice during adolescence. Food choices are determined by an array of interacting individual psychological and socio-environmental factors (Baudry et al., 2017; Markovina et al., 2015), the relative importance of which is likely to vary by food type (Vilaro et al., 2018). Social Ecological Theory (SET), is a systems-derived model of health

behaviour developed by Stokols (1992). The theory aims to frame research that is relevant to the design and evaluation of interventions to enhance community health and wellbeing (Gregson et al., 2001). SET assumes that health and wellbeing are multifactorally determined through a 'dynamic interplay' between the individual (psychology and behaviour) and the environment/context (physical/nested structures and socio-cultural) (Stokols, 1996). Young people's food choices are driven by a complex array of interacting factors, both individual and external (Davison et al., 2015a; Share et al., 2015a; Story et al., 2002). SET, therefore, offers an appropriate model with which to understand dietary health behaviour (Golden and Earp, 2012; Bull et al., 2006). This analysis will therefore consider food choices and explore associations with mental wellbeing (individual level), a measure of family affluence (environment level) and quality of life (interaction between individual and environment) in young people.

The purpose of this study therefore has been to identify the food choices of adolescents assessed at age 13-14 years and again at age 15-16 years, and then to explore their relationship with mental wellbeing, HRQoL, family affluence and sex. This study has also assessed the degree to which dietary choices at age 13-14 years (as a mediating variable) indirectly affected choices at age 15-16 years. Very few existing studies on food choice in young people appear to have assessed the whole diet, instead analysing single items (Winpenny, Penney, Corder, White & van Slujis, 2017). This study in contrast has assessed the diet as a whole by means of a food frequency questionnaire (FFQ). This also appears to be the first study of its kind conducted on Northern Irish adolescents. This research is also novel in that no previous studies have considered wellbeing, HRQoL and family affluence together as determinants of food choice. Whereas the sWEMWBS assesses wellbeing as a specific, single construct focused on positive hedonic factors (Clarke et al., 2011), the KS-10 measures wellbeing as part of the more general HRQoL construct (Solans et al., 2008). Given these differences, both measures have

been included in the analysis. Based on previous research, it is predicted that food choices at age 13-14 years will be associated with those at 15-16 years of age and that more healthy food choices will be associated with greater mental wellbeing, HRQoL and family affluence.

1. Method

2.1 Design and Procedure

Ethical approval was obtained from the School of Education Research Ethics Committee at Queens University Belfast (reference number 100314 and 111217). Data were gathered in two waves (2016 & 2018) as part of the Wellbeing in Schools (WiSe) study, which is a longitudinal survey exploring the role of schools on the health and wellbeing of 13-16 year-old school children in Northern Ireland (NI) (UK). Data were collected from pupils in clusters (each comprising one form class) within each school. A list of all post-primary schools in NI was obtained from the Department of Education NI (DENI) website. A letter detailing the aims, objectives and procedures of the study, along with an invitation to participate, was posted to the head teacher in each of the selected schools. Of the 203 schools contacted, 94 replied with 89 agreeing to participate. At each school, one form class was randomly selected from each year group to participate. Schools that provided written consent for their school to participate were sent information sheets and consent forms for parents and pupils. While parents were provided with an opportunity of opt-out consent for their child's participation, all pupils were required to provide full written consent prior to completing the questionnaire. At time two, all 89 schools were re-contacted and re-invited to continue their school's participation in the study. Of the 89 schools, 79 schools participated again at time two (response rate of 89%). The same consent procedures described above were completed at time two.

The fieldwork at time one and time two was carried out in schools either on a study iPad or a school computer, hosted by LimeSurvey, with a researcher (JD) present to address any issues/questions arising. Data were captured from the same pupils when they were in Year 10 (2016) and Year 12 (2018). The resultant sample (participants with data available at both time points) comprised 1,237 adolescents (51% male and 49% female), aged 13-14 years at time one and aged 15-16 years at time two and attending 79 post-primary schools across Northern Ireland (UK).

2.2 Measures

2.2.1 Family Affluence Scale (FAS)

The FAS (Boyce, Torsheim, Currie and Zambon, 2006) has been shown to be a valid measure of socio-economic inequality in young people aged 14-17 years from across Europe (N=10,900) (Moor et al., 2019). The FAS comprises four items: 'Do you have your own bedroom at home where you normally live?' for which responses are dichotomous (yes/no); 'Does your family own a car, van or truck?' for which responses are yes-one, yes-two or more, or no; 'During the past 12 months how many times did you travel away on holiday with your family?' for which responses are on a four-point scale -not at all, once, twice, more than twice; and. 'How many computers, laptops, tablets or iPads do your family own?' for which responses are none, one, two, and three or more. Principal component analysis was used to optimise the relationship between the items and the underlying component under evaluation (family affluence). From this emergent model a component weight was obtained for each individual using SPSS v25. These were then used within the statistical analyses. This use of a linear composite of indicators is in keeping with measurement recommendations suggested by Bollen and Lennox (1991).

2.2.2 Short-form Warwick-Edinburgh Mental Wellbeing Scale (sWEMWBS)

The sWEMWBS (Tennant et al., 2007) comprises seven items and measures mental wellbeing, and accounts for both hedonic elements of positive wellbeing (e.g. I've been feeling cheerful) and eudemonic elements (e.g. I've been thinking clearly). The scale gathers responses on a five-point scale (none of the time; rarely; some of the time; often; all of the time) to: 'feeling optimistic about the future'; 'feeling useful'; 'feeling relaxed'; 'dealing with problems well'; 'thinking clearly'; 'feeling closer to other people'; 'able to make my own mind about things'. Responses to the seven items were summed to create total raw scores, these raw scores where then transformed to metric scores using the sWEMWBS conversion table provided by WARWICK (Warwick Medical School, 2020). Reliability estimates (Cronbach's Alpha) for the sWEMWBS were good at both time-1 (α=0.76) and time-2 (α=0.80). The seven-item sWEMWBS has been found to be highly reliable for the assessment of wellbeing in young people (Ringdal, Bradley and Bjornsen, 2018; Hunter, Houghton and Wood, 2015; Clarke et al., 2011) and unidimensional in structure (Melendez-Torres et al., 2019; Hoffman, Rueda and Lambert, 2019; Ringdal et al., 2018; Clarke et al., 2011). The sWEMWBS has also been shown to be valid and effective for the assessment of wellbeing in young people in Wales (N=103,971) (Melendez-Torres et al., 2019) and in Australia (N=829) (Hunter et al., 2015).

2.2.3 KIDSCREEN-10 (KS-10)

The KS-10 (The KIDSCREEN Group Europe, 2006) is a 10-item measure of HRQoL designed for use with children aged between 8 and 18 years. Items scored on a five-point scale - not at all, slightly, moderately, very, extremely – are: 'thinking about the last week, have you': 'felt fit and well'; 'felt full of energy'; 'got on well at school'; 'been able to pay attention'. Items

scored on a five-point scale - never; seldom; quite often; very often; always - are: ‘‘felt sad’; ‘felt lonely’; ‘been able to do the things you want to do in free time’; ‘had enough time for yourself’; ‘had fun with friends’; ‘parents treated you fairly’. Reliability for the KS-10 was good at time one (α=0.84) but only moderate at time two (α=0.64). The KS-10 has been shown to be reliable with Cronbach’s alpha of 0.82 in adolescents aged 8-18 years (N=22,830) across 13 European countries (Ravens-Seiberer et al., 2010) and α 0.80 in Iranian adolescents (N=551) (Nik-Azin, Shairi, Naeinian and Sadeghpour, 2014). The KS-10 has been shown to function as a good indicator of HRQoL (Erhart et al., 2009), and has a unidimensional structure (Nik-Azin et al., 2014; Ravens-Seiberer et al., 2010;). The item responses for KS-10 scale were coded so that higher values indicate better wellbeing. Scores were added together and then transformed into Rasch person parameters (PP). The PPs were transformed into values with a mean of 50 and a standard deviation of 10 using the syntax provided on a CD accompanying the purchase of the KIDSCREEN manual (Ravens-Seiberer et al., 2010; Erhart et al., 2009; The KIDSCREEN Group Europe, 2006).

2.2.4 Food Frequency Questionnaire (FFQ)

Dietary habits were assessed using a 17-item FFQ previously employed in the Young Persons Behaviour and Attitudes (YPBAS) Survey (Central Survey Unit, 2013). Responses were on a five-point scale: more than once a day; once a day; most days; once or twice a week; less often or never. Items related to the frequency of consumption of: sweets/chocolate/biscuits; buns/cakes/pastries; fizzy/sugary drinks; diet drinks; crisps; chips/fried potatoes; boiled/baked potatoes; fried foods (sausage eggs, bacon); meat products; meat/meat dishes’; fish (not fried); beans/pulses; fruit; vegetables/salads (except potatoes); bread; rice/pasta; milk (to drink; on cereal; puddings) cheese/yoghurt. The 17-item FFQ has been found to be a reliable and valid

264 measure for assessing dietary intake in adolescents aged 11-15 years (Inchley, Mokogwu,
265 Mabelis and Currie, 2020) and adults aged 18-64 years (Weir et al., 2016).

266

267 **2.3 Analysis**

268 All analyses were conducted using Mplus V8.4 Muthén & Muthén. Where there were missing
269 cases (n=29) present on the exogenous measures, these were excluded from the analysis. One
270 case was removed as responses appeared anomalous. Where there were missing responses,
271 these were assigned -999 or 99. The eventual sample comprised 1208 cases.

272 The scoring metric for the KS-10 and the sWEMWBS on both occasions were based
273 on a Rasch model, and hence the variables were continuous, as were the principal component
274 scores for the FAS measure. Responses to the FFQ were scored on a Likert scale, and this was
275 treated as an ordinal measure. Following from these measurement properties a weighted least
276 square mean and variance estimator was used for the analysis.

277 Since data were obtained from respondents in 79 schools, adjusted standard errors and
278 model fit statistics were computed to account for the non-independence of the respondents
279 owing to clustering. The statistical calculations were consequently based on a weighted least
280 square mean and variance adjusted (WLSMV) model. The clustering effect of pupils within
281 school (non-independence) was taken into account using the complex modelling
282 TYPE=COMPLEX option in Mplus. This uses a sandwich estimator to compute appropriate
283 standard errors and a chi-square test of model fit taking into account stratification, non-
284 independence of observations owing to cluster sampling, and/or unequal probability of
285 selection. The model parameters were estimated using robust maximum likelihood. School
286 therefore was entered into the analysis as a clustered variable. Sex was entered as an

independent variable, coded as 1 for females and 2 for males, and assumed to have an effect at time two via time one.

2.3.1 Identification of Food Choice Factors

Data were obtained at two points in time (at age 13-14 years and age 15-16 years). The dimensional structure representing the food choices assessed using FFQ was determined in two steps. First, exploratory factor analysis was conducted on the 17 FFQ items at time one using a geomin (oblique) solution, using a chi-square testing of model fit. Since the variables were on a five-point Likert scale, they were treated as ordinal. Results indicated a five-factor solution. Second, all factor loadings that were statistically significant at the 0.05 level in the exploratory factor model were then included within a five-factor solution modelled within a confirmatory framework. Confirmatory factor analysis at time two confirmed the same five factors (Table 1), with the same statistically significant factor loadings.

2.3.2 Predictors of Food Choice Factors

Three further parallel exogenous measures were introduced into the time sequence of the FFQ, i.e., at both points in time, as continuous, independent/explanatory variables. These measures were: (1) FAS; (2) sWEMWBS; and (3) KS-10. There was consistency between both time-points for scores on the KS-10 ($P<0.001$), sWEMWBS ($P<0.001$), and the FAS ($P<0.001$). The five factors for the FFQ at time two were regressed onto the same factor at time one, as were the three other parallel measures (FAS; sWEMWBS; and KS-10). These latter three measures were used as predictors of the five FFQ food choice factors. This was done by having the five food choice factors on the first occasion as mediating variables in the model, and

regressed onto these three predictor measures (FAS, sWEMWBS and KS-10). Sex was also introduced as a predictor for the five FFQ food choice factors on the first occasion.

Insert Diagram 1 here

3. Results

Data were obtained from 1,208 young people of whom 607 were males and 601 females, aged 13-14 years at time one of survey completion (2016), and aged 15-16 years at time two (2018). At time of data collection 58.4% (n=706) were attending a secondary school, and 41.6% (n=502) were attending a grammar school. Of these, 69.5% (n=840) were attending mixed sex schools, 16.6% (n=200) an all-boys school and 13.9% (n=168) an all-girls school. Nearly half (48%) reported that their general health was 'very good', 21% reported 'excellent' and over a quarter (26%) reported it as 'good'. Only 4% reported their general health to be 'fair' and less than 1% (n=7) 'poor'. Over three quarters (80%) of the sample reported 'high' family affluence, 17% 'average' and 3% reported 'low' family affluence

3.1 Food Choice Factors

Standardised factor loadings (see Table 1) indicated: Factor 1 'Junk Food' comprised six items – sweets/biscuits, buns/cakes, fizzy sugary drinks, diet drinks, crisps, chips/fried potatoes; Factor 2 'Meat' comprised three items - fried foods (sausage/egg/bacon), meat products, meat and meat dishes; Factor 3 'Healthy Protein' comprised four items - fish, beans/pulses, meat/meat dishes; Factor 4 'Fruit and Vegetables' comprised two items - fruit and vegetables; Factor 5 'Bread/Dairy' comprised two items – bread and milk/yoghurt. FFQ item 7 – potatoes,

had a relatively low factor loading across four of the five factors, and a negative factor loading on junk food. FFQ item 10 – Meat and Meat Dishes cross-loaded onto both the Meat factor and that for Healthy Protein. The FFQ relating to Rice /Pasta loaded onto the Health Protein factor with much lower cross-factor loadings on to both the Meat and, Fruit and Vegetables factors.

Insert table 1 here

The five dietary factors were equivalent across time one and two (Table 1) and therefore were restricted at time two, before being fitted to the five-factor model. Intercepts (Factorial Invariance - VI) on the FFQ were then restricted. The five dietary factors (Junk; Meat; Healthy Protein; Fruit and Vegetables; Dairy/Bread) were the dependent/outcome variables. The observed measures relating to the five factors were treated as ordinal. The factor loadings and item thresholds were restricted to be equal across the points in time. The residual variances of the respective observed measures were correlated with the same item at a later point in time. This latter step was taken after an examination of the modification indices. Restricting the factor loadings and the thresholds to be equivalent on both occasions indicated, especially after an examination of the modification's indices, that a number of correlated residuals could be usefully introduced across the same measures on each occasion. Before the introduction of the correlated residuals the model did not provide an adequate description of data: Comparative Fit Index (CFI)=0.90; Tucker-Lewis Index (TLI)=0.90; Root Mean Square Error of Approximation (RMSEA)=0.04: confidence interval (CI)= 0.3 – 0.4; Standardised Root Mean Square Residual (SRMR)=0.05, and the chi-square test of model fit (X^2=1478.83, df=572, P<0.0001). With the introduction of correlated residuals, an improved model resulted. With

the exception of one, all correlated residuals were statistically significant (0.05 level). The fit indices also indicated a much improved model with a reduction in the chi-Square value of 485.29 for the loss of 17 degrees of freedom (CFI=0.95; TLI=0.95; RMSEA=0.03: CI= 0.2 – 0.3; SRMR=0.04) and the chi-square test of model fit (X^2=993.54, df=555, p<0.001).

In this analysis the identical food choice factor on the second occasion of measurement was regressed onto the same measure taken at time one.

3.2 Intercorrelations between food choice factors at time one (aged 13-14) and two (aged 15-16)

There was some intercorrelation between dietary factors (Table 2). Frequent consumption of the Junk Food factor was significantly and positively associated with consumption of the Meat factor at both time one and two and with the Healthy Protein factor at time two. The Junk Food factor was associated with less frequent consumption of the Fruit and Vegetable factor at time point one but not time two. The Meat factor was positively associated with the Healthy Protein factor at both time points. The Fruit and Vegetable factor was related to more frequent intake of the Healthy Protein food factor at both time points and with more frequent choice of the Meat factor at time two. The Bread/Dairy factor was significantly and positively correlated with all of the other four dietary factors at both time points (Table 2).

Insert table 2 here

3.3 Predictors of the Food Frequency Questionnaire (FFQ) factors at time one and two

The correlations between the four exogenous measures at time one (KS-10, sWEMWBS, FAS and Sex) were all below 0.25 with the exception of the relationship between KS-10 and sWEMWBS where the correlation was -0.63. The FFQ food choice factors on occasion two were regressed onto the three predictors obtained on the second occasions (FAS, sWEMWBS and KS-10), which had been regressed onto the same measure at time one. This model provided an adequate description for the data (CFI=0.95; TLI=0.95; RMSEA=0.02: CI= 0.02 – 0.03; SRMR=0.07; chi-square = 1184.40, df = 769, p<0.001).

There was then a direct and indirect effect from these four exogenous measures onto the five FFQ factors at both points in time. In addition, the measures for FAS, sWEMWBS, KS-10 at time two had a direct effect onto the five FFQ factors at the second point in time (see Heuristic diagram 1).

Insert Table 3 here

3.3.1 Sex, mental wellbeing, HRQoL, and family affluence.

Sex had a direct effect onto the five FFQ food choice factors at time one. Males had a statistically significant higher score than females (p<0.05) on F1 (Junk Food), F2 (Meat) and F5 (Bread/Dairy), and a lower score on F4 (Fruit and Vegetables). The result for F3 (Healthy Protein) did not statistically significantly differ by sex. In the model this pattern of effects carried over the five-factors on the second occasion, some two years later (see Table 3).

The children's HRQoL (KS-10) measure was moderately stable over the two-year period of the study (standardised effect = 0.50). In relation to the model, the KS-10 at time one had a statistically significant direct effect on two FFQ factors. There was a negative relationship between KS-10 and F2 (Meat), and a positive effect with F4 (Fruit and Vegetables).

405 The measure of mental wellbeing (sWEMWBS) had a negative relationship with the
406 FFQ F1 (Junk Food), i.e., a higher score on the eating of junk food indicated worse mental
407 wellbeing on average. There were also two positive associations between the measure of
408 wellbeing and FFQ. These were with factors 4 (Fruit and Vegetables) and 5 (Bread/Diary),
409 thus indicating that a diet of frequent fruit, vegetables, bread and dairy product intake were
410 associated with more positive mental wellbeing.

411 The affluence measure (FAS) had a statistically significant negative association with
412 F4 (Fruit and Vegetables), F5 (Bread/Dairy) and a significant, but weaker, positive association
413 with F2 (Meat) (see Table 3). The association between affluence and meat indicated that on
414 average the more affluent tended to eat less meat. On the other hand, greater affluence was
415 associated with more frequent consumption of fruit, vegetables, bread and dairy products, at
416 time two. These were effects that remained stable over the two-year period of the study, as
417 indicated by the indirect effect of affluence on the respective factors on the FFQ measures at
418 time two.

419

420 **3.3.2 Food Factors (mediating and outcome factors)**

421 *Junk food*

422 The sum of the specific indirect effect of sex on the Junk food factor at time two is the
423 multiplicative effect of sex on Junk food factor at time one, multiplied by the effect of Junk
424 food from time one to time two conditioned on the specific exogenous measures (sex). The
425 test statistic for the indirect effect of sex on Junk Food at the second point in time was:
426 estimate/standard error (est/se)=4.05. Based on the test statistic for the direct effect (4.20) there
427 was little added value in the effect of sex on Junk food on the second occasion i.e., implying
428 no change in junk food consumption across the two-year period.

The respective direct and indirect effects for the remaining exogenous measures were as follows: KS-10 (-1.255; 1.301); sWEMWBS (-4.983; -2.27); and FAS (-0.443; -0.44). Values of the test statistic below ±1.96 indicate values that are not statistically significant at the 0.05 level. Where the direct and indirect effects are close this indicates that the effect of the respective exogenous measure had little impact on the food factor on the second occasion.

Meat factor

The indirect effect of sex in the second factor (Meat) produced a test statistic of 4.81, close to the direct effect of gender on the Meat factor on occasion one (5.26). The direct and indirect effects relating to the remaining exogenous measures were as follows: KS-10 (-2.36; -2.35); sWEMWBS (0.57; -0.43); and FAS (-1.98; -1.98).

Healthy Protein

The effect (indirect) from factor three (Healthy Protein) at time one to time two, conditioned on the exogenous measures was not statistically significant (test statistic 1.61), as neither was the direct effect (1.62) for the effect of sex at time one. The direct and indirect effects for the remaining variables in the model were as follows: KS-10 (0.63; 0.64), sWEMWBS (0.94; 0.92); and FAS (1.42; 1.43).

Fruit and Vegetables

The fourth factor (Fruit and Vegetables) had an indirect effect of sex on the measure on the final occasion of (-5.27). This was little changed from the direct effect of sex differences on this factor on the first occasion (-5.51). The direct and indirect t-statistics for the remaining exogenous measures were as follows: KS-10 (2.43; 2.42); sWEMWBS (2.14; 2.11); and FAS (3.49; 3.40).

454

455 *Bread and Diary*

456 The final factor was (Bread/Dairy) products and the indirect effect of sex on this factor of
457 (2.35). This was little changed from the direct effect value on the first occasion (2.43). For
458 the other exogenous measures, the test statistics were as follows: KS-10 (-0.36; -0.36);
459 sWEMWBS (3.26; 2.69); and FAS (3.25; 2.75).

460

461 **4. Discussion**

462 This analysis sought to identify food choice factors in adolescents, to explore the degree to
463 which the frequency with which foods were consumed were associated with mental wellbeing,
464 HRQoL, family affluence and sex, and to assess any indirect effects on dietary choices
465 longitudinally. Dietary assessment identified five food choice factors in the young people
466 surveyed at both time points (Junk Food; Meat; Fruit and Vegetables; Healthy Protein;
467 Bread/Dairy). Similar dietary factors have been observed previously in Greek adolescents: junk
468 food; red meat; fruit and veg; dairy; rice, potatoes, fish, poultry; legumes; bread (Kourlaba et
469 al., 2009) and in Brazilian youth aged 11-17 years: junk food; healthy; traditional (de Pinho,
470 Silveira, Botelho & Caldeira, 2014). The finding that there were five food choice factors,
471 however, contrasts with other previous research on Irish school children aged 13-18 years
472 (N=483) which implied only two factors (healthy/unhealthy) (Fitzgerald et al., 2013). That the
473 five food choice factors were found to be similar across the two time points, agrees with
474 previous results in children aged 5-13 years in the UK (Fremeaux et al., 2011) and suggests
475 that young peoples' food choices are consistent over time. This finding, however, contrasts
476 with previous research which found differences in food choices over time in Hawaiian girls (9-
477 14 years) (Mosley et al., 2018), Brazilian young people (15-18 years) (Schneider et al., 2016)
478 and in Swedish young people (15-18 years) (Post-Skagegard et al., 2002).

Social Ecological Theory (SET) (Stokols, 1995) postulates that health behaviour occurs within a given context and is driven by multiple factors, both individual and environmental. Consistent with SET, therefore, at the individual level, there were sex differences. Males consumed junk food, bread and dairy foods more frequently, and fruit and vegetables less frequently than females at both time points. Again, at the individual level, higher mental wellbeing was associated with less frequent intake of junk food and more frequent consumption of fruit and vegetables, bread, and dairy foods at both time points. Also at both time points, those who frequently consumed fruit and vegetables had higher HRQoL while those who consumed meat frequently had lower HRQoL. At the environmental level, greater family affluence was associated with more frequent intake of fruit and vegetables, bread, and dairy foods and less frequent intake of meat. Comparison of the direct and indirect effects indicated that once the direct effect was taken into account, there was little if any change in the effect of the independent measures upon the final five outcome measures (dietary factors), at time two. To enable comparison with previous research the results have been discussed taking each food choice factor (DV) in turn.

Previous studies have also identified frequent junk food intake among young people (Davison et al., 2015b; de Pinho et al., 2014; Kourlaba et al., 2009). As many as 17% of 12-16 year-olds in the UK consume junk food daily (Zahra et al., 2014). Previous qualitative research has suggested a possible reason for this is that young people express autonomy through choice of junk food (Lems, Hilverda, Broerse & Dedding, 2019; Davison et al., 2015a). The current analysis implied that more frequent consumption of junk food was associated with lower mental wellbeing (sWEMWBS) and being male. Other studies have also found an association between the frequency with which junk food was consumed and poorer mental health in young people aged 6-18 years in Iran (Zahedi et al., 2014), and in 12-16 year-olds in the UK (Zahra et al., 2014). Although, given that this is a survey study it is not possible to establish cause and

effect from our analysis, a possible explanation for this association between wellbeing and frequent junk food intake could be that frequent consumption of junk food is detrimental to wellbeing. Alternatively, poor mental wellbeing may drive choice of junk food. Further research is required to determine the direction of association between mental wellbeing and food choice. Another explanation is that young people feel bad about eating junk food (IImoisili, Park, Lundeen, Yaroch & Blanck, 2020) which could be detrimental to wellbeing.

The finding that family affluence was unrelated to the junk food factor contrasts with those from other studies in adolescents, and which have found lower affluence to be associated with more frequent junk food consumption (Rouche et al., 2019; Levin et al., 2012). This also contradicts results of a Brazilian study of youth aged 11-17 years (N=474) which showed that those from lower income families were more likely to consume junk food (de Pinho et al., 2014). One possible explanation for lack of association between family affluence and junk food consumption observed in the present study is that school-based public health initiatives implemented over the past decade, for example the health promoting schools approach (Langford et al., 2016), have been successful in reducing junk food consumption (Dudley, Cotton & Peralta, 2015; Wang & Stewart, 2013).

HRQoL was also unrelated to the junk food factor, a finding that is difficult to compare with those of previous studies of HRQoL in adolescents, the majority of which have taken BMI and not diet as the outcome. Such studies have been consistent in finding that higher BMI was associated with lower HRQoL (Cordero & Cesani, 2019; Wynne, Comiskey & McGilloway, 2016; Gouveia, Frontini, Canavarro & Moreira, 2014; Buttitta, Iliescu, Rousseau & Guerrien, 2014; Ottova, Erhart, Rajmil, Dettenborn-Betz & Ravens-Sieberer, 2012; Boyle et al., 2010). Our result implies that lower HRQoL is not related to junk food intake.

Sex was an important indirect determinant of the frequency with which junk food was consumed. Being male led to more frequent choice of junk food. This is consistent with previous research (Australian Bureau of Statistics, 2018; Skardal et al., 2014; Savige et al., 2007; Lake et al., 2006; Cooke & Waddle, 2005) suggesting that girls' food choices are healthier than those of boys. Little if any change occurred in the differences between the sexes in terms of the five dietary factors across a period of two years. Sex differences in the frequency with which the junk food and fruit and vegetables were consumed may be partly explained by differences in taste preferences, for example, girls have been found to like fruit and vegetables more than boys, whereas boys seem to prefer junk foods (Cooke & Wardle, 2005). Another explanation could be that boys have higher energy requirements, which drives their food preferences towards more energy-dense foods (Cooke & Wardle, 2005). Another factor could be that girls have a greater awareness of their health and as such have stronger beliefs in the importance of healthy eating (Wardle et al., 2004). Previous qualitative research in 12-18 year-old boys residing in disadvantaged neighbourhoods in the Netherlands (Lems et al., 2019) has implied that junk food consumption is an important part of adolescent boys' social identity and behaviour and to fit with friends. To deter choice of junk foods therefore, dietary health promotion will need to target males, particularly those in less affluent homes and to engage with them on matters of social identity. Taken together, these findings emphasise the need for the creation of sex-specific health promotion interventions (Lombardo et al., 2019).

Frequent consumption of meat was directly associated with lower HRQoL at time one and indirectly at time two. More frequent meat intake was also associated with being male. Unfortunately, there do not appear to have been any previous studies that have considered adolescent HRQoL and meat intake with which to compare this result. That males consumed meat more frequently than females, however, concurs with previous research indicating that boys eat more meat than girls (Lombardo et al., 2019; Daniuseviciute-Brazaite &

552 Abromaitiene, 2018; Rothgerber, 2013; Post-Skagegard et al., 2002). A possible reason for this
553 sex difference could be that boys seek to express masculinity though eating meat (Lems et al.,
554 2019). This implies a need to target males in seeking to encourage less frequent meat intake.
555 Mental wellbeing and family affluence were unrelated to the frequency with which meat was
556 consumed.

557 Approximately 12-18% of young people consume a diet low in fruit and vegetables (de
558 Oliveira Figueiredo et al., 2019; McKeown & Nelson, 2018; Zahra et al., 2014). Fruit and
559 vegetable consumption appear consistent between different populations of young people
560 (Howe et al., 2016; Davison et al., 2015b; Kourlaba et al., 2009). As predicted, frequent fruit
561 and vegetable intake was directly associated with higher mental wellbeing (sWEMWBS),
562 higher HRQoL (KS-10), and greater family affluence (FAS) at time one and indirectly at time
563 two. The finding that frequent fruit and vegetable intake was associated with higher wellbeing
564 is consistent with previous research which has found that young people who frequently eat
565 vegetables (Tanaka & Hashimto, 2019) and/or fruit and vegetables (Kim et al., 2015) report
566 fewer symptoms of depression. Given this is a survey study, albeit at two points in time, it is
567 difficult to establish whether frequent fruit and vegetable intake is a cause or effect of enhanced
568 mental wellbeing in young people.

569 As indicated by previous studies of children and adolescents in Spain (Muros et al.,
570 2017), Australia (Bolton et al., 2016), Canada (Wu et al., 2012) and the UK (Boyle et al., 2010),
571 HRQoL was an important determinant of food choices in this group of young people. Again,
572 although it is not possible to determine the degree to which HRQoL is a cause or effect of more
573 frequent fruit and vegetable intake, these data corroborate previous research suggesting that
574 enhancing young people's HRQoL may be the key to promoting healthy food choices in young
575 people (Wu et al., 2019; Dumuid et al., 2017; Boyle et al., 2010). Further, more controlled

576 research is required to establish the direction of causation between mental HRQoL and choice
577 of fruit and vegetables.

578 Greater family affluence was also directly associated with more frequent fruit and
579 vegetable intake at time one and indirectly at time two. This agrees with previous research on
580 young people indicating that those in higher socio-economic groups make healthier food
581 choices (Ahmadi et al., 2015) and more frequently consume fruit and vegetables (Pourrostami
582 et al., 2019; Yannakoulia et al., 2015; Skardal et al., 2014). This finding is also in keeping with
583 previous research that has found an association between fruit and vegetable intake and family
584 affluence also using the FAS (Simon et al., 2019; Elgar et al., 2016; Yannakoulia et al., 2016;
585 Fismen et al., 2014; Levin et al., 2012). Affluence has also been found to influence the
586 availability of healthy foods within the home, with less availability in lower affluent groups
587 (Aggarwal, Monsivais, Cook & Drewnowski, 2011). Availability of healthy foods may also be
588 mediated by dietary knowledge and awareness (Wardle, Parmenter & Waller, 2000) and their
589 cost (Shepherd et al., 2006). This implies that intervention to promote fruit and vegetable
590 intake should target those in less affluent circumstances.

591 Frequent choice of fruit and vegetables was also associated with being female. That
592 girls consumed fruit and vegetables more often than males agrees with previous research (de
593 Oliveira Figueiredo et al., 2019; Skardal et al., 2014) and that boys reduce fruit and vegetable
594 intake during adolescence (Post-Skagegard et al., 2002). Previous research has shown that
595 regular consumption of fruit and vegetables in adolescence leads to improved physical health
596 outcomes (Vereecken et al., 2015). This implies that intervention to encourage consumption of
597 fruit and vegetables will need to target boys, particularly those in less affluent groups.

598 The healthy protein factor was unusual and does not appear to have arisen out of other
599 studies that have characterized diet in young people and could represent an emerging trend.
600 The healthy protein factor was unrelated to mental well-being, HRQoL, family affluence or

601 sex suggesting that the frequency with which foods high in protein were consumed was driven
602 by other factors.

603 Adolescents who eat bread and grains tend to have better overall dietary quality
604 (Papanikolaou, Jones & Fulgoni, 2017) and dairy foods are considered important for general
605 health (Spence, 2013; Rangan et al., 2012). The current study found that bread/dairy factor was
606 directly associated with higher mental wellbeing at time one and indirectly at time two.
607 Although difficult to establish whether the frequency with which bread/dairy foods were
608 consumed was a cause or an effect of higher mental wellbeing, this finding implies that to
609 enhance wellbeing, young people should be encouraged to include dairy and wholegrains as
610 part of their diet. The bread/dairy factor was also associated with greater family affluence
611 (FAS) corroborating previous research conducted in young people in Iran (Pourrostami et al.,
612 2019), Greece (Yannakoulia et al., 2015) and Norway (Skardal et al., 2014) and indicating
613 more frequent bread/dairy intake among those of higher socio-economic status. The
614 bread/dairy factor was more common among males. Together, these findings imply that
615 intervention to increase diary and wholegrain intake will need to target females and those in
616 less affluent families. As Social Ecological Theory (SET) (Stokols, 1995) would imply, dietary
617 factors derived from the FFQ varied in the individual and environmental context associated
618 with their expression and this has implications for dietary health promotion. Frequent junk food
619 consumption was associated with individual characteristics ie. being male and lower mental
620 wellbeing (sWEMWBS) implying that intervention to reduce junk food intake may need to
621 focus on raising wellbeing among young people and to target males. Frequent intake of meat
622 was also associated with being male but with lower HRQoL (KS-10), implying that
623 intervention to discourage meat intake would need to focus on young people's quality of life
624 and how it relates to the food choice environment. Although also associated with being male,
625 the bread/dairy factor was associated with higher mental wellbeing (sWEMWBS) at the

626 individual level and with greater affluence (FAS) at the environmental level. The
627 fruit/vegetable food choice factor was also associated with both individual and environmental
628 factors. Those who reported frequent intake of fruit and vegetables were more likely to be
629 female and to have higher HRQoL (KS-10), higher wellbeing (sWEMWBS) and greater family
630 affluence (FAS). Intervention to increase fruit and vegetable intake among young people,
631 therefore, should seek to enhance mental wellbeing and health related quality of life and at the
632 contextual level and target those in less affluent circumstances, particularly males.

633 Consistent with SET associations between the frequency with which foods were
634 consumed were associated with interacting individual and environmental level factors. That
635 the dietary factors were not mutually exclusive implies that the young people may make
636 different food choices in different contexts. Frequent consumption of junk food appeared to
637 occur along with frequent intake of meat at both time points indicating that those who
638 frequently choose junk foods also frequently choose meat. Both the junk food and meat factors
639 were also more common in males suggesting that dietary health promotion should target efforts
640 at reducing both junk and meat intake together and focus upon males. Frequent intake of the
641 meat factor was also associated with frequent consumption of the healthy protein factor at both
642 time points, implying that some young people eat meat along with healthier sources of protein
643 and which could suggest that young people may be open to reducing meat intake by substituting
644 it with other sources of protein. Also of interest, was that choice of fruit and vegetables was
645 associated with the healthy protein factor at both time points, again indicating a broader healthy
646 food choice tendency. Another finding was that junk food consumption was associated with
647 less frequent fruit and vegetable choice at time point one when the respondents were younger,
648 but not at time two when they were older. This could be because either the frequency with
649 which junk food was consumed reduced, or fruit and vegetable intake increased over time. That

650 the bread/dairy factor overlapped with all other patterns at both time points is unsurprising
651 given bread is a staple food.

652

653 **4.1 Limitations and Strengths**

654 Although the present study represents an advance in our understanding of the association of
655 established adolescent food choices with HRQoL, mental wellbeing, sex and family affluence,
656 it is not without certain limitations. While the FFQ, FAS, KS-10 and sWEMWBS are valid
657 and reliable measures of assessment for use in large-scale samples, and are appropriate for
658 evaluating adolescents' dietary intake (Inchley, Mokogwu, Mabelis and Currie, 2020; Weir et
659 al., 2016), family affluence (Hobza et al., 2017), HRQoL (Ravens-Seiberer et al., 2010) and
660 mental wellbeing (Ringdal et al., 2018; Hunter et al., 2015; Clarke et al., 2011), our findings
661 may be subject to limitations inherent in self-reported data such as inaccurate recall and bias
662 toward what is perceived to be socially acceptable (Rosenman, Tennekoon and Hill, 2011). A
663 further potential limitation relates to the FFQ employed which would be subject to inaccuracies
664 inherent in any dietary assessment method (MacDiarmid & Blundell, 1998) and which did not
665 assess quantity of food consumed, only how often a food was chosen. Nevertheless, FFQs are
666 characterised by low participant burden (Winpenny et al., 2017) and are designed to give an
667 indication of 'usual' intake (Subar et al., 2015; Burrows, Martin & Collins, 2010). Given our
668 research question related to food choice rather than how much was eaten this has not adversely
669 impacted upon the ability of these results to inform our understanding of food choice in
670 adolescents. Another potential limitation is that although reducing dietary intake data to
671 factors, has enabled us to characterise the total diet, we have not considered the prevalence
672 with which certain foods are chosen. People seldom eat foods in isolation and more often as
673 meals as part of a diet, therefore, to analyse individual food items for prevalence would tell us

674 little about how people choose and combine foods. Another strength is that in using factor
675 analysis as opposed to PCA, on the assumption that food choices vary by context, we have
676 been able to determine overlap between food choice factors. Meanwhile, psychometric
677 assessment of the FFQ confirmed stability of the measure for use in longitudinal surveys across
678 time, given the five food choice factors replicated at both time points. Future studies are
679 required that use a selection of other suitable dietary assessment tools for this age range
680 including, for example, 24-hour recalls and App-delivered diaries (Rankin, Hanekom, Wright
681 & MacIntyre, 2010; Burrows et al., 2010).

682 Despite these potential drawbacks, the current study achieved a large sample size
683 representative and including nearly half of the post-primary schools in Northern Ireland, and
684 the analysis has taken into account the clustered nature of these data at school level. Unlike
685 previous research into food choice in young people this study included the sWEMWBS which
686 measures mental wellbeing, therefore, accounting for both hedonic and eudemonic elements of
687 positive wellbeing. Unlike many previous studies that have considered single food items
688 (Winpenny et al., 2017) our study has taken young peoples' diet as a whole. This study is
689 novel, therefore, in that it is one of very few that have looked at the whole diet rather than
690 individual food items and considered how food choices are constructed. This study also serves
691 to provide a detailed analysis of individual and contextual factors associated with food choice
692 factors to enable comparison with other research studies.

693 Unlike previous research into food choice in young people (Dumuid et al., 2017; Muros
694 et al., 2017; Bolton et al., 2016; Cooke et al., 2014; Wu et al., 2012; Boyle et al., 2010), this
695 study encompasses longitudinal data (at two time points), which addresses limitations often
696 levied at the over-use of cross-sectional surveys (Ferrer-Cascales et al., 2019) and the paucity
697 of longitudinal data (Winpenny et al., 2017). Building on this, future research should aim to
698 assess food choices over several time-points throughout adolescence and into early adulthood

699 to understand trajectories in food choice across the life stage, and in particular during the
700 transitional period to adulthood. Repeated longitudinal assessments at three time points (or
701 more) could achieve this.
702
703 **4.2 Conclusion**

704 In summary, young people with better mental wellbeing tended to make healthier food
705 choices characterized by less frequent junk food consumption and more frequent fruit and
706 vegetable and bread and dairy intake. Evidence from previous longitudinal research (Wu et al.,
707 2019) and qualitative enquiry (Davison et al., 2015a), both in young people, has implied a
708 reciprocal relationship between wellbeing and healthy eating. It may therefore be possible to
709 encourage healthier food choices in young people by enhancing mental wellbeing and in doing
710 so, further improve overall wellbeing. Those with better HRQoL also tended to choose meat
711 less frequently and fruit and vegetables more frequently. This could suggest that by improving
712 HRQoL in young people that healthier food choices may develop. There were marked sex
713 differences in food choices such that boys were more likely than girls to choose junk food,
714 meat and bread/dairy more frequently than girls and to choose fruit and vegetables less
715 frequently than girls. Those in more affluent homes were more likely to make healthier food
716 choice characterized by frequent intake of fruit and vegetables and bread and dairy foods.
717 Together, results of the present study imply that adolescents growing up in more affluent
718 families make better food choices, and more frequently consume fruit and vegetables,
719 bread/dairy, and meat.

720 Although difficult to establish cause and effect, our findings imply that interventions
721 aimed at improving dietary health in young people, should target males in less affluent
722 households, seek to reduce the consumption of low nutrient (junk) foods, and promote
723 consumption of fruit and vegetables, whilst taking mental wellbeing and HRQoL into account.

A next step would be to conduct more in-depth qualitative research to probe how young people conceive of the five dietary factors, the reasons behind consumption and how and why they are consumed in practice and in different contexts. Meanwhile, the present study has provided a first step in assessing food choice during adolescence and identifying determinants, both individual and contextual, which should be of use to key stakeholders in the areas of public health and nutrition interested in promoting healthy dietary habits in young people.

Conflicts of Interest

The authors have no conflict of interests to declare.

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Author Contributions

PC and KL were responsible for the conception of the research idea. PC, KL, LD and JD contributed to the study design and management. JD lead data collection and preparation of the project dataset. JD, BSK and BB formulated the research questions and contributed to the design of the analysis. BB undertook the analysis. JD, BSK and BB were involved in drafting the paper. All authors reviewed the manuscript and approved the final version submitted for publication.

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Table 1

Standardised factor loadings for food frequency questionnaire items at time-point 1 and 2 (N=1208)

Food Frequency Questionnaire Items	**Factor 1 Junk**		**Factor 2 Meat**		**Factor 3 Healthy Protein**		**Factor 4 Fruit and Vegetables**		**Factor 5 Bread/Dairy**	
	T 1	*T 2*	*T 1*	*T 2*	*T 1*	*T 2*	*T 1*	*T 2*	*T 1*	*T 2*
1. Sweets/chocs/biscuits	**0.461**	**0.462**							0.105	0.106
2. Buns/cake/pastries	**0.470**	**0.472**			0.265	0.267				
3. Fizzy/sugary drinks	**0.707**	**0.714**								
4. Diet drinks	**0.525**	**0.528**								
5. Crisps	**0.640**	**0.645**								
6. Chips/fried potatoes	**0.438**	**0.442**	0.314	0.316						
7. Boiled/baked potatoes	-0.260	-0.262	0.219	0.219	0.298	0.299	0.159	0.156		
8. Fried food (sausage/bacon/egg)			**0.770**	**0.774**						
9. Meat products			**0.722**	**0.725**						
10. Meat dishes			**0.579**	**0.580**	**0.453**	**0.458**				
11. Fish (not fried)					**0.649**	**0.651**				
12. Beans/pulses					**0.585**	**0.587**				
13. Fruit							**0.712**	**0.706**		
14. Vegetables/salad (not potatoes)							**0.902**	**0.898**		
15. Bread									**0.764**	**0.789**
16. Rice/pasta			0.149	0.149	**0.450**	**0.451**	0.204	0.200		
17. Milk/cheese/yoghurt									**0.596**	**0.606**

Note. T=time. Analysis conducted in Mplus; Item loadings shown $p<0.001$; Factor loadings on unstandardised scores were equal.

Table 2

Intercorrelations (standardised) between dietary factors – times one and two (N=1208)

	Est		*SE*		*Est/SE*		*P Value*	
	T1	*T2*	*T1*	*T2*	*T1*	*T2*	*T1*	*T2*
F1 Junk + F2 Meat	0.574	0.551	0.030	0.044	19.127	12.499	0.000**	0.000**
F1 Junk + F3 Protein	0.051	0.153	0.037	0.057	1.376	2.688	0.169	0.007**
F1 Junk + F4 Fruit/Veg	-0.171	-0.084	0.036	0.045	-4.805	-1.852	0.000**	0.064
F1 Junk + F5 Bread/Dairy	0.126	0.112	0.044	0.055	2.829	2.033	0.005**	0.042*
F2 Meat + F3 Protein	0.249	0.279	0.042	0.051	5.905	5.468	0.000**	0.000**
F2 Meat + F4 Fruit/Veg	-0.037	0.139	0.040	0.040	-0.920	3.472	0.358	0.001**
F2 Meat + F5 Bread/Dairy	0.295	0.390	0.042	0.044	6.976	8.923	0.000**	0.000**
F3 Protein + F4 Fruit/Veg	0.533	0.537	0.031	0.050	16.973	10.671	0.000**	0.000**
F3 Protein + F5 Bread/Dairy	0.405	0.427	0.036	0.051	11.253	8.325	0.000**	0.000**
F4 Fruit/Veg + F5 Bread/Dairy	0.506	0.558	0.030	0.043	16.864	13.043	0.000**	0.000**

Note. F=factor; T=time; Est=estimate; SE=standard error; Est/SE= estimate divided by standard error; **$p < .001$; *$p < .005$.

Table 3

Associations between KS-10, sWEMWBS and FAS scores, sex and dietary patterns at time two (N=1208)

	Variables	*Est*	*SE*	*Est/SE*	*P*
Factor 1 – Junk Food					
	Sex	0.165	0.039	4.244	0.000**
	KS-10	-0.003	0.002	-1.258	0.208
	sWEMWBS	-0.027	0.005	-4.976	0.000**
	FAS	-0.008	0.017	-0.441	0.659
Factor 2 - Meat					
	Sex	0.134	0.025	5.290	0.000**
	KS-10	-0.003	0.001	-2.357	0.018*
	sWEMWBS	0.002	0.004	0.542	0.588
	FAS	-0.018	0.009	-1.941	0.052*
Factor 3 – Healthy Protein					
	Sex	0.065	0.041	1.589	0.112
	KS-10	0.001	0.002	0.637	0.524
	sWEMWBS	0.005	0.006	0.900	0.368
	FAS	0.026	0.018	1.417	0.156
Factor 4 – Fruit and Vegetables					
	Sex	-0.356	0.064	-5.579	0.000**
	KS-10	0.008	0.003	2.442	0.015*
	sWEMWBS	0.017	0.008	2.113	0.035*
	FAS	0.087	0.025	3.485	0.000**
Factor 5 – Bread/Dairy					
	Sex	0.167	0.068	2.453	0.014**
	KS-10	-0.001	0.003	-0.411	0.681
	sWEMWBS	0.037	0.011	3.337	0.001**
	FAS	0.077	0.024	3.278	0.001**

Note. KS-10=KIDSCREEN-10; sWEMWBS=short-form Warwick Edinburgh Mental Wellbeing Scale; FAS=Family Affluence Scale. Est=estimate; SE=standard error; Est/SE=estimate divided by standard error; **$p < .001$; *$p < .005$.