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DERIVING AND INTERPRETING DIETARY PATTERNS IN THE SCOTTISH DIET: FURTHER ANALYSIS OF THE SCOTTISH HEALTH SURVEY AND THE EXPENDITURE AND FOOD SURVEY

Executive Summary

Dr Julie Armstrong[1]
Dr Andrea Sherriff[2]
Dr Wendy L Wrieden[4]
Dr Yvonne Brogan[1]
Ms Karen L Barton[3]

[1] School of Life Sciences, Glasgow Caledonian University
[2] Department of Dentistry and Medicine, University of Glasgow
[3] Centre for Public Health Nutrition Research, University of Dundee
[4] Health Services Research Unit, University of Aberdeen

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Introduction

An adequate diet is central to achieving and sustaining good health and supporting prosperous development at an individual and population level. In 1996, dietary guidelines for the Scottish population- the Scottish Dietary Targets- were established in *Eating for Health: A Diet Action Plan for Scotland*[1]. The Scottish Government has recently reiterated that the underlying principles and goals established in the Scottish Diet Action Plan remain valid and that the impact of current dietary improvement activity should continue to be monitored (*Healthy Eating: Active Living, 2008*[2]).

In 2004 the Working Group on Monitoring Scottish Dietary Targets acknowledged the lack of formal surveillance of the Scottish diet to assess progress towards the dietary targets[3]. The Working Group concluded that the *Expenditure and Food Survey*[4] and *Scottish Health Survey*[5] could be used to inform progress towards the targets[3]. The *Scottish Health Survey* provides information on the health and health–related behaviours of children and adults living in private households. In contrast, the *Expenditure and Food Survey* provides information on food purchases, nutrients and expenditure on food for households in Scotland. Whilst there is no information on health outcomes in the *Expenditure and Food Survey*, socio-demographic information is available.

As a result of the conclusions of the 2004 Working Group, FSAS commissioned work to monitor progress towards the dietary targets. The first phase of this work was published in 2006[6]. The results indicated that there had been little change in overall diet since 1996. Whilst some improvement has been made towards reducing total fat, there had been no change in the intake of saturated fat, fruit and vegetables, bread, oil-rich fish and breakfast cereals. The data also indicated an increase in the consumption of added sugars.

A second phase of this work is now underway, encompassing data from both the *Expenditure and Food Survey* (EFS) and the *Scottish Health Survey* (SHS). This second phase began in March 2007 and comprises two parts. The first part continues using the established methodology to examine food and nutrient intakes from the EFS (2001-2006), comparing these with the Scottish Dietary Targets and examining differences in diet, food groups and nutrients by quintile of socioeconomic group and area of residence. This work is due for completion in September 2009.

The present report incorporates the second part of the second phase and aims to advance the work already being undertaken by the Food Standards Agency on monitoring the diet in Scotland. Until now, dietary monitoring had focused on intakes of individual nutrients and foods or food groups. This additional analysis was designed to provide both a measure of the whole diet by deriving dietary patterns as well as measuring how well the diet meets current dietary guidelines, by developing and using a Dietary Quality Index.

Studying dietary patterns rather than single nutrients or single foods, acknowledges that foods are eaten together and not in isolation and accounts for the complex interactions of foods and nutrients in the context of the effect of the overall diet.

This allows an exploration of the demographic and social patterning of different types of diets within the population and comparison of the patterns revealed from the individual food intake data collected in the SHS and the household purchase data collected in the EFS.

The main aims of this project were:

- to derive dietary patterns using **Principal Component Analysis**;
- to establish a **Dietary Quality Index** based on dietary guidelines.

The dietary patterns and Dietary Quality Index were then used to assess the relationships between the diet and socio-economic status, lifestyle factors and health outcomes in sub-groups of the Scottish population and in Scottish households.

The information provided by this work aims to inform future dietary monitoring in Scotland and supply additional information on the relationship between dietary patterns and demographic, socio-economic, lifestyle and health measures. This information should help to inform policy for future dietary interventions in specific subgroups of the population.

Full details are presented in the main Technical report (web address)

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Methods

Datasets

Two surveys which generate very different information were used as sources of data in this project; both provide valuable and complementary data (Table 1).

Table 1.   The Scottish Health Survey and Expenditure and Food Survey

	SHS	EFS
Sample size	2003 survey 10,439 individuals	2001-2004 combined 1750 households
Dietary data	Limited dietary data Limited food inventory from the Eating Habits module, frequency of consumption of some foods and food groups with additional 24-hour recall on fruit and vegetable intake Questionnaire also providing info on health and health-related behaviour of individuals	Full household dietary data Food and drink purchase data in household for 14 days. Includes foods eaten in and out Uses assumptions on varieties and composition of food groups, cooking losses and waste to calculate nutrient intakes
Variables included in the present analysis	sex level of deprivation household income social class education screen viewing physical activity smoking obesity diabetes total:HDL cholesterol blood pressure	level of deprivation household income social class smoking purchases alcohol purchases

In this project data from the 2003 *Scottish Health Survey* were used to describe dietary patterns and dietary quality in *sub-groups* of the Scottish population. Dietary information was taken from the *Eating Habits* module which included a limited food inventory questionnaire and a 24-hour recall of fruit and vegetable intake. Information on alcohol intake was obtained from the *Scottish Health Survey Drinking Habits* module.

Data on *Household and Eaten Out food* (based on purchase data) was taken from the 2001/02, 2002/03 and 2003/04 *Expenditure and Food Survey* and used to describe dietary patterns and quality of the diet in Scottish households.

Dietary patterns

Dietary patterns were derived using **Principal Component Analysis,** a data-driven technique used to identify foods or food groups which are commonly consumed together- the **principal components** of a dietary pattern. This analysis provides

information on key food patterns in the population. The principal components of each dietary pattern were grouped together as a single exposure or 'type of diet'. Each dietary pattern identified was assessed for associations with socio-economic status, lifestyle factors and health outcomes from the surveys to characterise the factors most associated with each dietary pattern.

Dietary Quality Index

A Dietary Quality Index was specifically designed for this project. The Dietary Quality Index was generated by scoring each individual according to whether or not their reported diet met specific dietary guidelines. The total number of points scored was termed the Dietary Quality Index and this was used as a summary measure of the diet overall.

The main dietary guidelines which comprised the Dietary Quality Index were from the Scottish Dietary Targets (Table 2), together with other dietary recommendations from the Food Standards Agency, the Scientific Advisory Committee on Nutrition (SACN), the World Cancer Research Fund (WCRF) and the World Health Organisation (WHO). These recommendations informed which foods and nutrients contributed to the Dietary Quality Index score. In addition, for the *Expenditure and Food Survey* the UK Dietary Reference Values were used to inform the scores for nutrients[7].

The Dietary Quality Index gauges the extent to which an individual's or household's diet conforms to collective food and nutrient indicators. Final scores were converted to percentage scores to enable comparisons between groups.

Table 2.   The Scottish Dietary Targets[1]

Fruit & vegetables	Intake to double to more than 400 grams per day.
Bread	Intake to increase by 45 % from present daily intake of 106 grams, mainly using wholemeal and brown breads.
Breakfast Cereals	Average intake to double from the present intake of 17 grams per day.
Fats	Average intake of **total** fat to reduce from 40.7% to no more than 35% of food energy. Average intake of **saturated** fatty acids to reduce from 16.6% to no more than 11% of food energy.
Salt	Average intake to reduce from 163 mmol per day to 100 mmol per day
Sugar	Average intake of non-milk extrinsic (NME) sugars in adults not to increase. Average intake of NME sugars in children to reduce by half i.e. to less than 10% of total energy.
Breastfeeding	The proportion of mothers breastfeeding their babies for the first 5 weeks of life should increase to more than 50% from the present incidence of around 30%.
Total complex carbohydrates	Increase average non-sugar carbohydrates intake by 25% from 124 grams per day, through increased consumption of fruit and vegetables, bread, breakfast cereals, rice and pasta and through an increase of 25% in potato consumption.
Fish	**White fish** consumption to be maintained at current levels. **Oily fish** consumption to double from 44 grams per week to 88 grams per week.

Comparison of dietary patterns and Dietary Quality Index with health outcomes, socio-economic and lifestyle factors

Dietary patterns illustrate the variety of types of diets that predominate in a population or a sub-group. The Dietary Quality Index provides a composite measure of the quality of the Scottish diet compared to dietary guidelines. As such they are two different, but complementary, measures of the composition of the diet. In this study the association between the dietary patterns/Dietary Quality Index and health outcomes, socio-economic and lifestyle factors were assessed. This was done in quintiles such that, individuals or households in the **highest** quintile group were those that followed the **dietary pattern most closely**. Those in the **highest** quintile % Dietary Quality Index followed **dietary guidelines more closely**. The variables compared across quintiles of dietary patterns/Dietary Quality Index are listed in Table 1.

6

Results: Dietary patterns

Dietary Patterns from the Scottish Health Survey
The sample size for the *Scottish Health Survey* was 10,439 (4,743 males; 5,696 females; 10,507 weighted). Dietary patterns were derived for five different age groups: 5-10 years, 11-15 years, 16-24 years, 25-64 years and >64 years. Three patterns emerged in each group except 5-10 year olds where the analysis produced only two patterns. In total, the dietary patterns generated by the analysis of *Scottish Health Survey* data accounted for 19% of the variation in overall diet, with individual patterns accounting for between 4.5-9.6% of variation in diet.

> **In all age groups, Principal Component Analysis identified at least one healthy dietary pattern:**
> - ***Healthy;***
> - ***Healthy with Fish;***
>
> **and one energy dense dietary pattern:**
> - ***Energy dense;***
> - ***Energy dense/Snacking.***

Foods which represented the ***Healthy*** patterns varied between age groups. The ***Energy dense*** and/or ***Energy dense/Snacking*** type patterns emerged in each age group and this was the predominant pattern in children aged 5-10 and 11-15 years. Sweets and chocolates, crisps and savoury snacks, meat products, soft drinks and biscuits featured heavily in the ***Energy dense/snacking*** pattern. Table 3 describes the dietary patterns and the foods which best represented these in each age group.

Table 3. Dietary patterns emerging from Scottish Health Survey 2003 Eating Habits module, according to age group

Dietary Patterns	Foods which were positively associated with the dietary pattern[3] Foods which were negatively associated with the dietary pattern
Children	
5-10 years	
Energy Dense/Snacking	Sweets and chocolates, crisps and savoury snacks, meat products, biscuits, soft drinks, ice-cream, cheese, cakes, scones sweet pies and pastries, red meat, chips
Healthy with Fish	Vegetables, fresh fruit, potatoes, rice or pasta, oily fish, tinned tuna, fruit juice, salad Soft drinks
11-15 years	
Energy Dense/ Snacking	Sweets and chocolates, meat products, crisps and savoury snacks, soft drinks, biscuits, ice cream, cakes, scones sweet pies or pastries, chips, cheese Lower fat milks
Healthy with Fish	White fish, salad, oily fish, potatoes, rice and pasta, fresh fruit, wholegrain/brown breads Soft drinks, chips
Healthy	Vegetables, pulses, chips, frozen and canned fruit, fruit juice, tinned tuna, fresh fruit
Adults	
16-24 years	
Healthy with Fish	Salad, fresh fruit, vegetables, fruit juice, poultry, oily fish, vegetables in composite dishes, potatoes, rice and pasta, tinned tuna
Energy Dense/ Snacking	Biscuits, cakes, scones sweet pies and pastries, crisps and savoury snacks, soft drinks, sweets and chocolates, meat products, ice-cream
Healthy	Lower fat milks, spreads, higher fibre breakfast cereals, wholegrain and brown breads, Crisps and savoury snacks, soft drinks, meat products, salt, chips
25-64 years	
Energy Dense	Meat products, chips, red meat, soft drinks, alcohol, salt Wholegrain and brown breads, low fat spread, lower fat milks
Healthy with Fish	Vegetables, fresh fruit, oily fish, higher fibre breakfast cereals, salad, white fish, Crisps and savoury snacks
Energy Dense/ Snacking	Biscuits , cakes, scones sweet pies and pastries, sweets and chocolates, ice-cream, crisps
>64 years	
Healthy	Fresh fruit, spread, lower fat milks, wholegrain and brown breads, tinned tuna Meat products, soft drinks, salt
Energy Dense/ Snacking	Cakes, scones sweet pies and pastries, sweets and chocolates, ice-cream, biscuits Alcohol
Traditional	Red meat, potatoes, rice and pasta, white fish

Dietary patterns from the Expenditure and Food Survey

Combining three years of the *Expenditure and Food Survey* provided data on 1750 households. In total, the dietary patterns produced by the *Expenditure and Food Survey* analysis accounted for 12% of the variation in overall diet, with individual patterns accounting for between 2.0-4.1% of variation in diet.

There were four dietary patterns identified from Principal Component Analysis of household purchasing data:

- ***Takeaway/Eaten Out;***
- ***Healthy with fruit and vegetables;***
- ***Cakes, pastries, buns, scones, cereals and bread;***
- ***Traditional.***

The ***Takeaway/Eaten Out*** pattern was characteristic of a diet highly dependent on foods and drinks as takeaway foods such as chips and ethnic meals (eaten wherever) and foods eaten out of the home. The ***Takeaway/Eaten Out*** pattern also included sandwiches and oily fish and, therefore, may encompass a wide range of different eating out behaviours. Alcoholic drinks (wine, lager and beer) consumed outside the home also featured heavily in this pattern. The ***Healthy with fruit and vegetables*** pattern was characteristic of a health-conscious dietary pattern. The ***Cakes, pastries, buns, scones, cereals and bread*** pattern was characterised by starchy carbohydrate cereal (wheat) based foods and was distinctly lacking in processed type snacks and fast food. The final pattern was named as a ***Traditional*** dietary pattern characterised by a 'meat and two veg' home cooking pattern. Table 4 shows the foods which best represented the different dietary patterns.

Table 4. Dietary patterns emerging from Expenditure and Food Survey

Dietary Patterns	**Foods which were positively associated with the dietary pattern** **Foods which were negatively associated with the dietary pattern**
Households	
Takeaway/ Eaten out	Takeaway and Eaten Out Chips, Meat Dishes Traditional Eaten Out, Ethnic Main Meal Dishes Takeaway/Eaten Out, Processed Meat Products Takeaway / Eaten Out, Wine Consumed Outside the Home, Oily Fish Dishes Eaten Out, White Fish Dishes Eaten Out, Sauces Eaten Out, Prepared Sandwiches/Filled Rolls, Meat Pies/Pasties Takeaway/Eaten Out, Lager/Beer/Cider Consumed Outside the Home, Salad Main Meal Eaten Out
Healthy with fruit and vegetables	Fruit Other Fresh Vegetables Lettuce and Cucumber Yoghurt/Fromage Frais, Vegetables Other Fresh and Frozen, Fruit and Vegetable Juice, Other Bread, Mineral Water, Fruit Citrus Fresh Milk Whole, Bread White
Cakes, pastries, buns, scones, cereals, bread	Cakes and Pastries Pasta, Pizza, Soft Drinks Not Low Calorie, Processed Meat Products, Takeaway/Eaten Out, Salad Dressings, Sauces, Pickles and Mayonnaise, Crisps and Savoury Snacks
Traditional	Onions, Tomatoes, Fresh Potatoes, Wine, Vegetables Root Fresh, Red Meat, Vegetables Green, Vegetables Other Fresh and Frozen

10

Dietary patterns and socio-economic status, lifestyle factors and health outcomes

In both surveys there was evidence of a significant influence of socio-economic status and lifestyle factors on dietary patterns. A lower level of deprivation, higher household incomes and no smoking/tobacco purchases were associated with diets which more closely matched the ***Healthy*** patterns.

Scottish Health Survey

There were statistically significant but minor gender differences in dietary patterns. In young people (16-24 years) and adults (25-64 years), for example, males followed the ***Energy dense*** and ***Energy dense/snacking*** patterns more closely than females.

Increased screen viewing was positively associated with the ***Energy dense*** patterns, whereas increased screen viewing was negatively associated with the ***Healthy with fish*** pattern. The ***Healthy with fish*** pattern was also negatively associated with increased smoking and indicators of deprivation.

Table 5. **Summary of key findings for dietary patterns from the *Scottish Health Survey* (adults aged 25-64 years) for socio-economic and lifestyle factors[a]**

	Energy Dense	Healthy with Fish	Energy Dense/Snacking
Male gender	↑	NS	↑
Increasing deprivation	↑	↓	NS
Lower household income	↑	↓	↑
Lower social class	↑	↓	↑
Lower level of education	↑	↓	↑
More screen viewing	↑	↓	↑
Lower physical activity	↑	↓	NS
More smoking	↑	↓	↓

[a] ↓ indicates a decreasing factor score, ↑ indicates an increasing factor score, NS indicates non-significant findings.

Data from the *Scottish Health Survey* did not show a clear relationship between obesity and dietary patterns. However, adults (aged 25-64 years) who closely followed a ***Healthy with fish*** pattern were **more likely** to have diabetes than those who did not. Adults aged >64 years who closely followed the ***Healthy*** pattern were also **more likely** to have diabetes. This finding may relate to individuals with diabetes following the healthy eating advice prescribed to those diagnosed with diabetes.

For adults aged 25-64 years, total cholesterol:HDL ratio results showed that individuals who scored **highest** for the ***Energy dense*** patterns were **at greater risk** of having a high ratio. A high ratio is an important cardiovascular disease risk factor.

11

Expenditure and Food Survey

Households with the highest equivalised income followed the ***Takeaway/Eaten Out*** pattern most closely (Figure 1). Households which most closely followed the ***Healthy with fruit and vegetables*** pattern also had higher equivalised income (defined as a measure of household income which is adjusted for the number of people living in the household) and greater level of education.

Figure 1. Dietary patterns from EFS in all Scottish households according to Equivalised Income
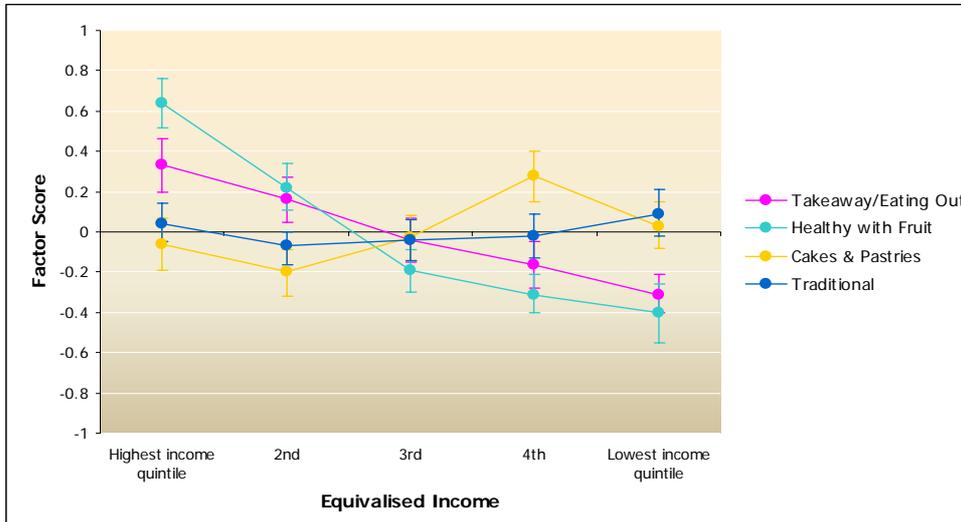
The highest tertile of alcohol purchases in the household was strongly associated with a diet based on the ***Takeaway/Eaten Out*** pattern. Smoking purchases were decreased in households which most closely followed the ***Healthy with fruit and vegetables*** and the ***Cakes, pastries, buns, scones, cereals and bread*** patterns.

Table 6 shows the correlation of Dietary Patterns with nutrient intakes. The ***Healthy with fruit and vegetables*** pattern was positively correlated with intake of vitamin C and folate and had a weak negative correlation with saturated fat and NMES. The ***Takeaway/Eaten Out*** pattern showed weak correlation with nutrient intakes; correlation was negative for saturated fat and NMES. This suggests that this pattern is not simply characterised by poor nutritional quality fast foods high in fat and NMES.

Table 6.   Correlation coefficients for Dietary Patterns from the EFS with nutrients

Nutrients	Saturated fat	NMES	Vitamin C	Folate
Takeaway/Eaten Out	-0.10	-0.18	0.004	0.05
Healthy with fruit and vegetables	-0.15	-0.11	0.50	0.30
Cakes, pastries, buns, scones, cereal and bread	0.22	0.008	0.05	0.15
Traditional	-0.08	-0.29	0.14	0.28

12

Table 7. **Summary of key findings for dietary patterns from the *Expenditure and Food Survey* for socio-economic and lifestyle factors[a]**

Dietary patterns	Takeaway / Eaten Out	Healthy with Fruit and Vegetables	Cakes, Pastries, Buns, Scones, Cereals, Bread	Traditional
Increasing deprivation	↓	↓	↓	NS
Lower household income	↓	↓	↑	NS
Lower social class	NS	↓	NS	NS
Higher alcohol purchases	↑	↑	↓	↑
Smoking purchases	↑	↓	↓	NS

[a] ↓ indicates a decreasing factor score, ↑ indicates an increasing factor score, NS indicates non-significant findings.

13

Results: Dietary Quality Index

Scottish Health Survey

The scores for each age group ranged from 5-100%. Dietary quality scores were generally similar in males and females, although adult females (25-64 years) had statistically significant marginally higher scores.

Mean Dietary Quality Index increased more dramatically with age with the lowest mean in the 11-15 year olds and highest in individuals aged >64 years.

Table 8. **Mean, standard deviation (SD), minimum and maximum DQI % in each age group (years) for males and females in the 2003 *Scottish Health Survey***

	n[a]	Mean DQI %	SD	MIN	MAX
Males					
5-10	630	44.3	12.8	5.0	83.3
11-15	595	42.7	13.1	8.3	81.1
16-24	570	44.9	14.7	15.4	84.6
25-64	2583	52.0	15.6	6.2	100
>64	659	56.6	13.9	21.5	100
Females					
5-10	619	42.9	12.8	8.3	75.8
11-15	547	40.9	13.9	0	83.3
16-24	566	46.1	15.1	7.7	92.3
25-64	2747	54.8	15.9	14.6	100
>64	956	57.9	14.3	15.4	100

[a] Weighted n

The Dietary Quality Index was similar to the dietary patterns in that a better quality of diet using the index was associated with **higher** socio-economic status and equivalised income in children and adults (see figure 2).

Dietary Quality Index was **higher** in non-smokers compared to smokers (56.5% versus. 44.2%). There was also a consistent association between levels of physical activity and screen viewing and Dietary Quality Index, such that individuals who were less active had poorer dietary quality scores.

Table 9 provides a summary of the key findings for Dietary Quality Index in each age group according to socio-economic and lifestyle factors.

Table 9. **Summary of the key findings for DQI in each age group according to socio-economic status and lifestyle factors.**

	5-10 years	11-15 years	16-24 years	25-64 years	>65 years
Female gender	NS	NS	NS	↑	↑
Increasing deprivation (SIMD)	↓	↓	↓	↓	↓
Higher SES (NS-SEC)	↑	↑	↑	↑	↑
Higher income	↑	↑	↑	↑	↑
More education	N/A	N/A	N/A	↑	↑
More screen viewing	↓	↓	↓	↓	↓
Higher level of activity	NS	↑	↑	↑	↑
More smoking	N/A	N/A	↓	↓	↓

↑ indicates a higher DQI and ↓ indicates lower DQI e.g. in 5-10 year olds there is a higher DQI% with less deprivation with a linear trend suggesting those in the least deprived group have a better quality diet, NS indicates non-significant findings.

Data did not show a clear relationship between obesity and Dietary Quality Index. Adults in the highest quintile for Dietary Quality Index were **more likely** to have diabetes than those in the lowest quintile. A **high** Dietary Quality Index in 25-64 year olds was associated with lower total cholesterol:HDL ratio.

Figure 2. **% Dietary Quality Index in all age groups according to Equivalised Income pattern**

15
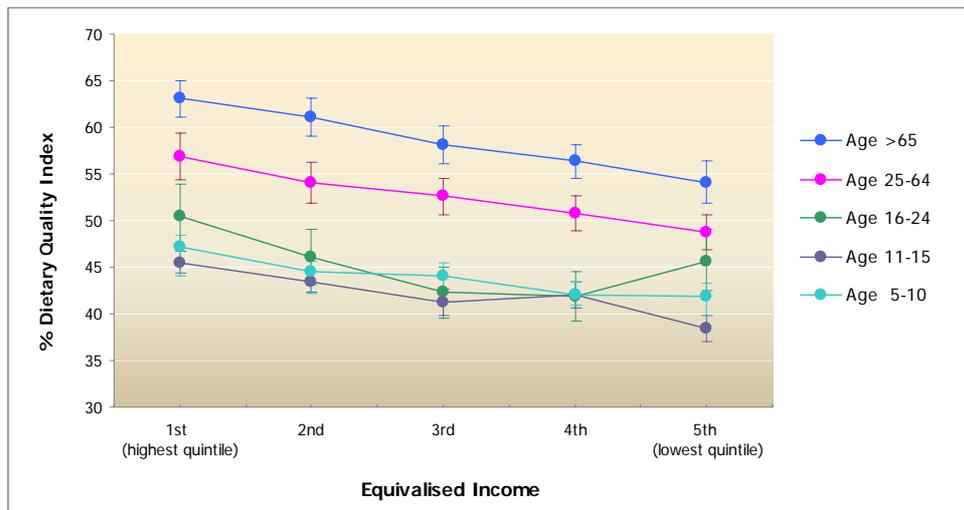
Expenditure and Food Survey

There was a linear reduction in Dietary Quality Index with increasing deprivation (p<0.001 for trend). The score in the least deprived (first quintile) of Scottish Index of Multiple Deprivation (SIMD) was 35.4% versus 30.0%. A weaker relationship in the same direction also existed with the level of equivalised income.

There was a significant drop in Dietary Quality Index with household smoking purchases. The mean score for Dietary Quality Index dropped from 34.9% for no purchase to 29.3% for any cigarette purchase (p<0.001 for trend).

The correlation coefficients for the Dietary Quality Index and nutrients were in the direction expected with a high correlation between the Dietary Quality Index and vitamin C (0.35) and folate (0.47) and a weaker negative correlation with saturated fat (-0.35) and added sugar (NMES) intakes (-0.18).

Conclusion

In both surveys there was evidence to suggest a significant influence of socio-economic status, in particular, an effect of equivilised income on dietary patterns and diet quality. Increasing deprivation, decreasing equivilised income and decreasing social class were all linked to following the **Energy Dense** eating patterns more closely, following the **Healthy** patterns less closely and having a lower % Dietary Quality Index.

The results also suggested a significant effect of age on dietary patterns and diet quality. Diet quality clearly increased with age; younger age groups were more likely to have a poorer diet.

The results from the *Scottish Health Survey* have also confirmed the findings of other investigators for a relationship between diet and lifestyle behaviour in relation to smoking and screen viewing[8,9,10], and the results reported here provide more details about the dietary patterns associated with these behaviours.

Dietary patterns and diet quality have been explored for the first time in Scottish households using the *Expenditure and Food Survey*. However, the four dietary patterns which emerged explain only a small amount of the variance in diet. The labels chosen for these food patterns were subjective and may be controversial, but this was necessary for ease of interpretation.

The pattern which explained most of the variance in the diet (4.1%) from the *Expenditure and Food Survey* was highly dependent on foods and alcoholic drinks eaten out of the home (**Takeaway/Eaten Out**). In addition, there was a health-conscious dietary pattern (**Healthy with fruit and vegetables**) and two more traditional patterns; one characterised by starchy cereal based foods which was distinctly lacking in contemporary processed snacks and fast foods (**Cakes, pastries, buns, scones, cereals and bread**) and a **Traditional** pattern based more on food to be cooked at home such as red meat, onions and root vegetables. It may be useful to explore the relationship between these patterns and the age profile of the households.

There was little to suggest that the **Takeaway/Eaten Out pattern** was correlated with poorer nutrient intakes as might have been expected. Both **Takeaway/Eaten Out** and **Healthy with fruit and vegetables** patterns were associated with higher equivalised income. It may be valuable to examine the **Takeaway/Eaten Out** pattern further. Results suggest that this pattern encompasses a range of different eating out behaviours with potentially different consequences in terms of overall diet quality and nutrient intakes.

The relationship between the household dietary patterns, smoking and alcohol purchases suggested a complex picture. Lower tobacco purchases were associated

with diets which more closely matched the **Healthy with fruit and vegetables** pattern and also the starchy cereal based pattern (**Cakes, pastries, buns, scones, cereals and bread**). Higher alcohol consumption was related to the **Takeaway/Eaten Out** pattern as might be expected, but was also associated with the **Healthy with fruit and vegetables** and the **Traditional** home cooking patterns. There is a complex relationship between dietary patterns and alcohol consumption which may be mediated by age, income and social class.

The Dietary Quality Index was a useful indicator of how closely the diet met current recommendations. Given that there is information in the *Expenditure and Food Survey* on household income, expenditure and household composition, it may be useful to further explore the relationships between diet quality, household profile and expenditure on food.

It is important to recognise that certain components of the Dietary Quality Index may not be independent and that effects might be cumulative in a diet score. For example, the contribution to the fruit and vegetable component would also impact on the fibre component of the diet score. Furthermore, any suggestion of a link between Dietary Quality Index and alcohol intake must be treated with extreme caution as alcohol intake formed part of the Dietary Quality Index.

The lack of association between poor diet and obesity in the *Scottish Health Survey* echoes a common phenomenon when exploring diet and health outcomes. Data collected in the *Scottish Health Survey* and *Expenditure and Food Survey* is cross-sectional. With this type of data, it is not unusual to find inconsistent relationships between diet and other outcomes and it is important that cross-sectional data is not used to imply causation. In particular, the relationships between diet and disease are better explored using prospective studies with time ordering of behaviours and health outcomes. The lack of relationship between poor diet and obesity in this report may be partly explained by dietary restraint in obese individuals or differential reporting bias between the obese and non-obese individuals.

Furthermore, the association between risk of diabetes and healthy diet should not be taken as evidence that a healthy diet is a *cause* of diabetes. This association may be due to healthy eating advice given to individuals as a result of diagnosis of diabetes, or may be explained by the reasons given above in relation to obese individuals.

There were similarities in the dietary patterns and Dietary Quality Index results from the *Expenditure and Food Survey* and the *Scottish Health Survey* despite the fact that the surveys are different. Similarities existed particularly in the relationship between diet and socioeconomic indicators.

Implications of the project and recommendations
Dietary patterns can overcome some of the limitations of using one particular food group (e.g. fruit and vegetables only) or nutrient (e.g. saturated fat) to evaluate the

diet of population groups. Different types of dietary pattern present in different socio-demographic groups may warrant different approaches to improving diet.

Detailed analysis of the patterns can reveal differences in diet which can help inform the provision of targeted nutrition advice. For example, in the analysis for adults in Scotland aged 16-25 The *Healthy* pattern, which heavily featured healthy starchy foods, did not feature as many fruit and vegetables in comparison with other age groups. This implies that increasing fruit and vegetable intake is an important target in this age group. If the analyses are repeated then changes in these dietary patterns can be tracked over time.

The link between the *Take-away/Eating Out* pattern, alcohol consumption and socio-economic status may require further investigation to identify whether a *Take-away/Eating Out* pattern is associated with poorer nutrient intakes in addition to higher alcohol intakes.

The Dietary Quality Index summarises the extent to which an individual's or household's diet meets specific dietary guidelines. The Dietary Quality Index may be useful as it takes all targets together rather than each one in isolation. The Dietary Quality Index could track changes over time in different subgroups of the population and gauge progress towards the Scottish Dietary Targets at both national and local levels.

Considering the importance of obesity and diabetes for health in Scotland and lack of a relationship between diet and obesity found in this and other similar cross-sectional studies, it may be useful in future to consider the potential cost/benefit of dietary surveillance with longitudinal follow-up.

The overall findings from this report emphasise the relationship between the quality of the diet, socio-economic factors and age and highlights the importance of improving nutritional intakes in both lower income and younger age groups. The results suggest that in order to improve the nutritional intake of all population groups, continued promotion of the balance of foods is required to encourage a healthy diet, in line with the advice provided as part of the eatwell plate.

Our results indicate that the particular groups who may benefit most from initiatives to improve dietary intake include children (who are already the target of nutrition policy interventions, for example, in schools), young people, adult males, smokers and those with high levels of screen viewing, particularly those from the lower socio-economic groups.

The results support the need for the promotion of dietary messages within the context of healthy lifestyle as advocated in the Scottish Government Healthy Eating, Active Living Action Plan[2] document which outlines the Scottish Government's joint action on diet, physical activity and maintaining a healthy weight. Advice should be

integrated into current healthy lifestyle messages such as the Take Life On campaign and could bring about improvements in the wellbeing of the Scottish population.

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