Attitudes towards Healthy Eating, Fruit and Vegetable Consumption, and Health Outcomes in Scotland

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Abstract

The gap between knowledge and food consumption decisions indicates that individual attitudes towards healthy eating may play a key role in individual food choices. We investigated the link between individual attitudes towards healthy eating, eating five portions of fruit and vegetables a day, and health outcomes.

The health production function provides the theoretical basis to investigate the relationship between attitudes, diet, fruit and vegetable consumption in this case, and health outcomes. A seemingly unrelated bivariate probit model was estimated. The Scottish Health Survey (SHeS) from 2008-2011 is pooled into a single cross-section. A binary variable indicates if the individual meets the five-a-day guideline. Health outcome variables used are self-assessed health, diabetes, cardiovascular diseases, coronary obstructive pulmonary disease, and body mass index. Eight binary attitudinal variables towards healthy eating capture individual's perceived barriers to healthy eating: people, supply, information, time, price, hedonics, willpower, and other barriers.

Preliminary results indicate that meeting the five-a-day fruit and vegetable guideline is associated with positive health outcomes and the relationship is underestimated when endogeneity is not accounted for. Perceiving a lack of information, hedonics (healthy foods are too boring/do not like the taste), and a lack of willpower as barriers to healthy eating are statistically significantly associated with lower fruit and vegetable consumption. Perceiving healthy foods as too expensive was not significant. Interventions to improve dietary intakes to improve health outcomes in Scotland should focus on individual attitudes, in particular a lack of willpower, information, and hedonics

1. Introduction

Lifestyle behaviours such as diet, alcohol consumption, smoking, and exercise play a large role in explaining variations in health across populations (Fuchs, 1986). Belloc and Breslow (1972) identified the 'Alameda Seven' as lifestyle behaviours which have been associated with better health. These include: eating breakfast, not snacking between meals, maintaining proper weight, regular exercise, no/moderate alcohol consumption, and seven to eight hours sleep. Notably, four of these factors are

related to diet. The benefits of a healthy diet are widely reported within the literature (Sofi et al., 2010). A healthy diet has been associated with lower risk of non-communicable diseases, and is associated with longevity (WHO, 2004).

The economic costs of an unhealthy diet are difficult to estimate due to poor diet being one of a number of risk factors for non-communicable diseases. Using data from 2006/2007, it was estimated poor diet cost the NHS £5.8billion compared with smoking (£3.3billion), physical inactivity (£0.9billion), and alcohol (£3.3billion) (Scarborough et al., 2011).

A large proportion of Scotland's poor health among the population has been linked to their poor dietary intakes (Scottish Executive, 2012). The Scottish Government, alongside many other governments, has outlined increasing fruit and vegetable consumption to meet the WHO's recommended 400g per day (WHO, 2004), or five-a-day, as a policy target to improve population health. Higher fruit and vegetable consumption has been associated with a number of positive health outcomes such as a reduced risk of cardiovascular diseases, some cancers, diabetes, and obesity (WHO, 2004). However, more recent reviews of the literature show mixed results concerning the health benefits associated with fruit and vegetable consumption (Slavin and Lloyd, 2012). Fruit and vegetable was associated with a reduced risk of cancer (Steinmetz and Potter, 1996), cardiovascular disease (Hung et al., 2004), coronary heart disease (Oude et al., 2010) and type 2 diabetes (Wedick et al., 2012). Other studies failed to find an association between fruit and vegetable consumption and cancer (Hung et al., 2004; Smith-Warner et al.,2001), cardiovascular disease (Dauchet et al.,2006), type 2 diabetes (Carter et al., 2010), and weight gain (Ledoux et al., 2011; Vergnaud et al., 2012).

A limitation of many epidemiological studies is that they fail to account for the potential endogeneity associated with diet or fruit and vegetable consumption. Potential endogeneity is not mentioned in epidemiological reviews of fruit and vegetable benefits (Van Duyn and Pivonka,2000; Riboli and Norat, 2003; Steinmetz and Potter, 1996). Endogeneity may occur when unobservable factors are correlated with both health and diet making it difficult to disentangle the direction of the association and resulting in diet being correlated with the error term when estimating the health equation. If endogeneity is ignored, the analysis will produce inconsistent estimates. Methods such as an instrumental variable approach and recursive multivariate probit models can be used to overcome the potential endogeneity (Greene, 2012) when investigating the associations between lifestyle behaviours and health (Balia and Jones, 2008). An instrumental variable approach is not appropriate in this analysis due to the dependent variables being binary. A recursive multivariate probit model estimates a system of equations consistent with the health production function. A

seemingly unrelated bivariate probit model is utilised in this study as it allows the dependent variables to be binary. Potential endogeneity is addressed by estimating two equations simultaneously assuming the error terms are correlated to produce consistent results.

Contoyannis and Jones (2004) used the British Health and Lifestyles Survey (HALS) to examine the effect of the Alameda Seven on self-reported health status over time. Estimating a recursive multivariate probit model, they reported the diet related variable, eating breakfast, did not have a significant impact on health. Using German data and estimating a recursive multivariate probit model, health was negatively associated with smoking status, positively associated with alcohol consumption, and against expectations, no diet effect on health was observed (Schneider and Schneider, 2009). Humphreys et al., (2013) used a recursive bivariate probit model to estimate the relationship between health outcomes and physical activity. Results suggest an increase in the intensity of physical activity from moderate to high intensity appears to have diminishing marginal returns on health outcomes. The binary nature of the dependent variables used in this analysis means a seemingly unrelated bivariate probit model is most appropriate to explore the benefits of the five-a-day government policy to health.

There appears to be a gap between knowledge and consumption with respect to five-a-day policy recommendation on fruit and vegetables. In Scotland, for example, almost 90% of adults are aware of five-a-day, whilst only 24% meet the recommendation (Scottish Executive, 2012). A key objective of this paper is to understand how individual attitudes towards healthy eating may help explain this phenomenon. Positive attitudes towards healthy eating have been associated with a healthier diet and eating five-a-day (Emery, 2013). Attitudes towards healthy eating have helped explain age (Trail et al., 2011) and gender (Wardle et al., 2004) disparities in diet. Le et al., (2013) found a higher level of education was associated with a healthier diet; this is consistent with the Grossman model as a higher level of education results in a more efficient production of health which may occur through healthier lifestyle behaviours such as a healthier diet. However, given that attitudinal factors are an important component of individual dietary choices, they tend to mediate the health-diet relationship. The Seattle Obesity Study (Aggrawal et al., 2013), initially found an association between healthier diets and individuals who shopped in more expensive supermarkets. However, including attitudes towards healthy eating into their analysis eliminated this association, thereby highlighting the importance of accounting for individual attitudes in diet-health relationship.

We hypothesise attitudes towards healthy eating mediate the diet-health relationship. Utilising the health production framework (Grossman, 1972) and estimating a set of seemingly unrelated

bivariate probit models, which allowed us to examine jointly the influence of attitudes towards healthy eating on healthier diet and the effect on health outcomes.

The next section will introduce the health production function and how it connects to the econometric modelling. The data will then be described before outlining the results and discussion.

2. Methods

2.1 The Health Production Function

The health production function (Grossman, 1972) provides a theoretical underpinning to hypothesise the relationship between socioeconomic factors and lifestyle behaviours on health. The model states an individual's health stock can be increased through the consumption of health related goods. Individuals can also invest in health through health related behaviours such as eating a healthy diet. The model predicts how age, education, income and other factors impact on an individual's health stock and has been applied within studies investigating the link between health and lifestyle behaviours (Contoyannis and Jones, 2004; Balia and Jones, 2008).

As applied in the present study, the framework assumes individuals maximise utility through health, diet, and consumption of other goods. Individual i's utility is described by the utility function in equation 1. Individual i derives utility (U) from being healthy (H), their diet (D), and consumption of m other goods (Z_j).

(1) $U_i = U(H_{ij}, D_{i,} Z_{im})$

(2) $H_{ij} = H(D_i, X_i, G_i, V_i)$

The model assumes the individual will maximise utility subject to a number of constraints. The cross-sectional nature of the SHeS data means it is assumed that prices are fixed and income is given, therefore no income constraint is estimated in this analysis (Nyaga et al, 1999; Olajide and Ludbrook 2013). Health, where j=1,2,…j health outcomes, is determined through the health production function as shown in equation 2 where diet (D), demographic and socioeconomic factors (X), non-diet related health inputs (G) and initial health (V) determine the individual's stock of health. G and V are assumed to be given as data limitations restrict the ability to account for these factors as well as potentially intensifying the endogeneity issue. This decision is warranted further by the fact that this analysis is concerned solely with the relationship between H and D. Diet enters the utility function directly as it is assumed that individuals can derive pleasure from consuming certain foods. Diet also

enters the utility function indirectly through health as an unhealthy diet will lead to poorer health outcomes and consequently effect utility.

(3) $D_i = D(H_{ij}, X_i, A_{iK})$

Diet is determined by health (H), socio-economic factors (X) and attitudes towards healthy eating (A_k), where k=1,2,…k attitudinal variables. Health enters the diet function as an individual's health status may affect their diet. Healthier individuals may display healthier eating habits, or individuals who have experienced a health shock and now have a certain health condition may place more importance on a healthy diet as illustrated by Zhao et al, (2012). The potential endogeneity is evident as diet enters the health function (equation 2) and health enters the diet function (equation3), the next section outlines how this is addressed in a seemingly unrelated bivariate probit model.

2.2 Econometric specification

The health production function outlined above can be represented as a set of linear equations of the form:

(4) $Y^*_{hij} = \alpha_0 + \alpha_1 Y_{di} + \alpha_2 X_i + \varepsilon_{1i}$

(5) $Y^*_{di} = \beta_0 + \alpha_1 Y_{hij} + \beta_1 X_i + \beta_1 A_{2ik} + \varepsilon_{2i}$

Y^*_{hij} is the latent health stock of individual i and Y^*_{di} is the latent benefit derived from a healthy diet by individual i. Because Y^*_{hij} and Y^*_{di} are unobservable, we only observe:

(6) $Y_{hij} = 1$ if $Y^*_{hij} > 0$; 0 otherwise

(7) $Y_{di} = 1$ if $Y^*_{di} > 0$; 0 otherwise

Health is equal to the potentially endogenous diet variable (Yd), and a vector of socioeconomic characteristics (X) which are assumed to be exogenous. Diet is assumed to be endogenous because the unobserved variables which influence H and are captured within the error term (ε1i) are also correlated with diet. To account for endogeneity, equations 4 and 5 are solved in their recursive form which requires the assumption $\alpha 1 \beta 1 \neq 1$, if the model fails this restriction it cannot be identified.

(8) $Y_{hij} = \delta_0 + \delta_1 X_i + U_i$

(9) $Y_{di} = \gamma_{0+} \gamma_1 X_i + \gamma_2 A_{ik} + V_i$

Where: $\delta_0 = \alpha_0 + \alpha_1\beta_0/(1- \alpha_1 \beta_1)$; $\delta_1 = \alpha_1 \beta_2/(1- \alpha_1 \beta_1)$;

$Ui = \alpha_1 \varepsilon_{2i} + \varepsilon_{1i}/(1- \alpha_1 \beta_1)$

And: $\gamma_0 = \beta_0 + \beta_1\alpha_0/(1- \beta_1\alpha_1)$; $\gamma_1 = \alpha_1 \beta_2/(1- \beta_1\alpha_1)$; $\gamma_2 = \beta_3 /(1- \beta_1\alpha_1)$;

$V_i = \beta_1 \varepsilon_{1i} + \varepsilon_{2i}//(1- \beta_1\alpha_1)$

The seemingly unrelated regression was pioneered by Zellner (1962). This model accounts for endogeneity by estimating two probit models simultaneously allowing the error terms of both models to be correlated (Jones, 2001). This is shown above as the error terms U_i and V_i contain both ε_{1i} and ε_{2i} in their equations.

(10) $Corr(U_i , V_i) = \rho$

The error terms capture unobservable factors such as genetics and time preference which may create unobservable heterogeneity. The estimation procedure produces p-values for ρ which make it possible to observe the correlation between error terms, it can be inferred that unobservable factors which impact on diet also impact on health if $\rho \neq 0$. If no correlation is observed ($\rho=0$), the bivariate probit model is unnecessary and two independent probit models can be estimated.

Bivariate probit models generally require identification using exclusion restrictions (Maddala, 1983). To identify the model it must include a variable in the recursive equation that does not appear in the structural equation. Individual attitudes towards healthy eating fulfil this criterion as attitudes will impact on an individual's diet, but not directly on their health. Similar to other studies, falsification tests are undertaken to test the validity of the exclusion restriction (Cawley and Meyerhoefer, 2012; Humphreys et al., 2013). This is tested on mental health[1] . The diet variable is not significant ($p=0.189$) and the error terms are uncorrelated ($\rho=0$) which suggests the exclusion restriction is valid.

Equations 8 and 9 are estimated separately for five health outcomes: self-assessed health, diabetes, CVD, COPD, and healthy BMI similar to Humphreys et al, (2013). The range of health outcomes captures both subjective and objective measurements of health. The model is estimated by

[1] Mental health is measured by deriving a score from the 12-item general health questionnaire (GHQ-12) (Goldberg and Williams, 1988). A response which reports a particular feeling is being experienced 'more than usual' or much more than usual' over the past few weeks is assigned a value of one and the 12 responses are summed. An individual with a score of four or higher indicates possible psychiatric disorder and is coded as 1, 0 otherwise.

maximum likelihood methods in Stata 13 v.13 statistical package. The asterisks in table 3A, Appendix A, denote the variable used as the base category in the analysis.

2.3 The Scottish Health Survey

The SHeS was set up by the Scottish Office in 1995 and is currently commissioned by the Scottish Government Health and Care Directorates. Previous surveys were undertaken in 1995, 1998, and 2003 before changing to a rolling programme from 2008 onwards. The survey is nationally representative of people in Scotland selecting a sample from the postcode address file (PAF) using a multi-stage stratified design. This excludes individuals living in institutions and a small proportion of households not on the PAF (Scottish Government, 2012).

The SHeS is designed to monitor the health of the population and risk factors associated with health outcomes. It allows trends over time and progression towards health targets to be monitored. Topics in the survey include questions about general health and wellbeing, alcohol consumption, smoking, fruit and vegetable consumption, and physical activity. All respondents answer the core modules outlined above (n=36,922). A subsample answers the Eating Habits module (n=3,362) or the Knowledge, Attitudes and Motivations (KAM) module (n=8,404), thus, an individual does not complete both the Eating Habits and KAM module. This study uses a pooled dataset from 2008, 2009, 2010, and 2011 SHeS.

Five binary health outcome variables were included in the analysis. Self-assessed health indicates if the individual reports "very good" health. Doctor diagnosed diabetes, cardiovascular disease (CVD), chronic obstructive pulmonary disease (COPD), and healthy weight (body mass index (BMI) validated by a nurse within the recommend range 18.5-25.0kg.m^{-2}) are also health outcomes. The Fruit and Vegetable Consumption module asks individuals to report each type of fruit and vegetable, and portion size consumed the previous day. This includes composites which are dishes made mainly of fruit or vegetables. Total fruit and vegetables consumed was derived and recoded to indicate whether individual meets the five-a-day recommendation. The Dietary Quality Index (DQI), which is constructed using data from the Eating Habits module, was used to explore the relationship between diet quality and fruit and vegetable consumption (Armstrong et al., 2009). DQI was positively correlated with the individual eating five-a-day (ρ=0.65) implying meeting the five-a-day recommendation may be a proxy for a healthy diet.

The KAM module captures the individual's perceived barriers to healthy eating for a subsample of the survey. Individuals are presented with a list of 13 possible barriers to healthy eating and asked to select up to three that apply to them. There is also a 'none of these – nothing prevents me from eating healthier' option. The barriers have been grouped into people (family, friends, people at work being discouraging or unsupportive), information (not knowing what changes to make, or not

knowing how to cook more healthy foods), supply (lack of choice of healthy foods in canteen or restaurants, or where you do your main shop), price (healthy foods are too expensive), time (healthy foods take too long to prepare), hedonics (healthy foods are too boring, or don't like the taste/don't enjoy healthy foods), willpower (lack of willpower), and other barriers. The listed barriers were grouped into eight binary variables.

Demographic variables include gender, age, marital status, and an urban/rural indicator. Age is grouped into ten year age bands. Marital status categorises individuals as married, living as married, single, separated, divorced, or widowed. The urban/rural indicator is categorised as primary city (population above 250,000), urban town (population above 10,000), small accessible town (population above 3,000), small remote town (population above 3,000), accessible rural village, or remote rural village.

Socioeconomic variables include equivalised income, highest attained educational qualification, and economic activity. Equivalised income is divided into quintiles. Education identifies the individual's highest reported level of education: degree or higher, HNC/D or equivalent, higher grade or equivalent, standard grade or equivalent, other, and none. Economic activity was categorised as in education, in paid employment, permanently unable to work, looking for work, retired, looking after family, or 'doing something else'.

The most recent SHeS (2008, 2009, 2010, and 2011), which includes the KAM module, was used in this study. Individuals under the age of 16 years were excluded from the sample as they did not complete the KAM module.

3. Results

3.1 Descriptive statistics

Table 1A (see Appendix A) show the descriptive statistics for, health outcomes (Y_{hj}), fruit and vegetable consumption (Y_d), and attitudinal factors (A_{ik}). Over 32% of individuals report self-assessed health as very good. Diabetes is reported by 6.3% of the sample, COPD by 4.7% and CVD by 38.7%. Thirty one percent have a healthy BMI. The number of observations is lower for BMI as some did not want to have this measured. Eating five or more portions of fruit and vegetable the previous day is reported by 23.6%. A lack of willpower was stated by almost a third of the sample as a barrier to healthy eating. Healthy foods being too expensive (16.3%) was the second most common barrier followed by hedonics (12.8%) and a lack of information (11.3%).

Table 2A presents the number and proportion of individuals who report each health outcome and whether or not they eat five or more portions of fruit and vegetables. 2,718 individuals report very good self-assessed health, of which 29.3% report meeting the five-a-day recommendation. The cross-sectional nature of these data fails to detect the impact of a health shock on the objective health outcomes, for example, we cannot determine if 26.2% of diabetics eating five-a-day were meeting the recommendation before being diagnosed with diabetes.

Almost 42% of the sample is male (Table 3A). Over 25% of individuals have a third level degree or higher. The SHeS captures different income groups, with the number of individuals in each income quintile represented equally. Almost half of individuals are in paid employment. Over 40% of the sample is married and 35.45% live in a primary city in Scotland.

The main focus of this study is to investigate the association between individual attitudes, eating five portions of fruit and vegetables, and health outcomes. Table 1 presents the average marginal effects (M.E) of each variable on five health outcomes described in the previous section.

3.2 Health outcomes

Table 1 shows eating five portions of fruit and vegetable each day is statistically significantly associated with each health outcome. An individual who meets the five-a-day recommendation is 31% more likely to report very good health, 17% less likely to have diabetes, 29% less likely to have a CVD, 13% less likely to suffer from COPD and 42% more likely to have a healthy BMI

As predicted by the Grossman model, age has a strong impact on health outcomes as the health stock deteriorates with age. Education has a statistically significant impact on reporting very good self-assessed health but no other health outcomes. Income has a positive relationship with self-assessed health. Individuals permanently unable to work, looking for work, or retired, are associated with being less likely to report very good self-assessed health compared to those employed. An individual in education is also associated with a higher probability of having a healthy BMI. Married individuals are associated with a higher probability of reporting very good self-assessed health, but they are more likely to have an unhealthy BMI. Marital status has no significant effect on probability of being diabetic or suffering from CVD or COPD conditions. Living in a rural area is associated with a higher probability of reporting very good self-assessed health compared to a primary city.

3.3 Fruit and Vegetable Consumption

Table 2 shows the results from the second equation in the bivariate probit model. Similar results are expected across models because they are estimating the same diet equation, the relationship

between demographic variables, socioeconomic variables, attitudes towards healthy eating and whether or not the individual eats five-a-day. In the first model being male is associated with 3.3% decrease in probability of eating five-a-day. A clear relationship between education and fruit and vegetable consumption is observed. As education increases, the probability of eating five-a-day increases significantly. Income is positively associated with probability of eating five-a-day. Individuals in education are more likely to eat five-a-day than those in employment, unable to work or looking for work. Married individuals are more likely to eat five-a-day than those who report being separated. Living in remote rural areas is associated with a higher probability of eating five-a-day than living in any other areas.

3.4 Attitudes

Table 3 shows the average marginal effect of each attitudinal variable on consuming five-a-day. Lack of information, lack of willpower, and hedonics are attitudinal variables which are significant at the 99% level across all models. However supply, people and price were not significant in any of the models. Time was significant at the 10% level in all models except CVD. In the self-assessed health model, an individual who reports a lack of information as a barrier to healthy eating is 6.3% less likely to eat five-a-day than someone who does not consider a lack of information a barrier. Those who perceive hedonics, as a barrier, are 9.5% less likely to eat five-a-day than those who do not. Individuals who perceive a lack of willpower a barrier to healthy eating are 4.2% less likely to reach the five-a-day recommendation.

The correlation coefficient is statistically significant at the 95% level in each model, except the falsification test model, and is reported in table 4A. This result reinforces are decision to estimate the models within a seemingly unrelated bivariate probit framework. Full results from the analysis are reported in tables 5A – 7A in Appendix A.

4. Discussion

This study aimed to increase understanding of the relationship between fruit and vegetable consumption and health outcomes in Scotland, and observe the impact of individual attitudes towards healthy eating on fruit and vegetable consumption. In summary, it showed that people who perceive a lack of information, willpower or hedonics to be a barrier to healthy eating are significantly less likely to eat five-a-day, which is associated with positive health outcomes. An important contribution of this paper is treating diet as potentially endogenous.

Table 1: Average Marginal Effects of Five-a-day, Demographic, and Socioeconomic Variables on Health Outcomes

	Self-Assessed health		Diabetes		CVD		COPD		Healthy BMI	
	M.E	P value	M.E	P value	M.E	P value	M.E	P value	M.E	P value
Five-a-day	31.13%*	0.000	-17.56%*	0.000	-29.75%*	0.000	-13.14%*	0.017	42.40%*	0.000
Male	-0.39%	0.689	2.56%*	0.000	0.94%	0.344	-1.58%*	0.03	-3.13%*	0.001
Age Group										
25-34	-3.19%	0.166	2.14%	0.084	4.72%*	0.015	-0.01%	0.994	-2.99%	0.208
35-44	-6.15%*	0.009	3.68%*	0.006	13.16%*	0.000	3.50%*	0.01	-10.59%*	0.000
45-54	-11.49%*	0.000	9.11%*	0.000	23.34%*	0.000	6.09%*	0.001	-11.88%*	0.000
55-64	-13.02%*	0.000	12.48%*	0.000	36.55%*	0.000	8.71%*	0.000	-18.79%*	0.000
65-74	-10.11%*	0.001	13.20%*	0.000	43.82%*	0.000	9.06%*	0.000	-17.41%*	0.000
75+	-13.44%*	0.000	13.18%*	0.000	51.36%*	0.000	7.69%*	0.001	-14.93%*	0.000
Highest education										
HNC/D or equivalent	-0.74%	0.677	-1.73%	0.286	0.26%	0.893	0.94%	0.538	-0.90%	0.596
Higher grade at school	0.41%	0.799	-2.25%	0.118	-1.51%	0.379	-1.45%	0.307	1.57%	0.31
Standard grade at school	-2.15%	0.201	-2.07%	0.168	-1.89%	0.283	-1.35%	0.355	0.32%	0.831
Other qualifications	-1.55%	0.465	-3.00%	0.055	0.83%	0.698	-1.08%	0.489	-0.61%	0.759
No qualifications	-4.98%*	0.01	-3.14%	0.053	-1.42%	0.464	-0.28%	0.869	2.12%	0.175
Income Quintile										
2nd income quintile	-2.95%	0.055	-0.32%	0.806	0.53%	0.736	1.81%	0.12	-1.24%	0.396
3rd income quintile	-5.23%*	0.002	0.35%	0.795	-1.29%	0.434	2.43%*	0.036	1.26%	0.417
4th income quintile	-9.10%*	0.000	-0.47%	0.735	0.51%	0.775	2.57%*	0.031	-0.86%	0.608
Bottom quintile	-7.58%*	0.000	-1.62%	0.265	0.26%	0.891	1.14%	0.357	3.80%*	0.036
No income reported	-1.90%	0.314	-0.90%	0.53	-3.72%*	0.04	0.68%	0.575	4.15%*	0.027
Economic Activity										
In paid employment	-1.28%	0.671	-2.30%	0.54	-1.96%	0.582	-1.68%	0.601	-9.84%*	0.001
Permanently unable to work	-35.11%*	0.000	6.87%	0.095	15.52%*	0.000	6.03%	0.087	-10.50%*	0.004
Looking for work	-12.73%*	0.001	-1.00%	0.808	2.94%	0.501	-0.13%	0.972	-4.47%	0.236
Retired	-10.45%*	0.003	3.07%	0.437	5.70%	0.156	0.84%	0.8	-9.27%*	0.009
Homemaker	-3.74%	0.283	-2.60%	0.513	-0.79%	0.842	0.23%	0.947	-6.13%	0.075
"Doing something else"	-2.88%	0.624	9.08%	0.131	5.36%	0.39	3.92%	0.455	-11.80%*	0.044
Marital Status										
Living as married	-4.45%*	0.01	2.50%	0.139	0.62%	0.743	-1.21%	0.383	4.52%*	0.011
Single	-4.49%*	0.001	0.04%	0.97	-0.93%	0.505	-0.19%	0.838	5.06%*	0.000
Separated	-4.08%	0.076	-1.91%	0.214	-3.79%	0.081	0.41%	0.776	3.05%	0.178
Divorced	-3.91%*	0.017	1.17%	0.31	1.86%	0.24	0.58%	0.565	4.53%*	0.006
Widowed	-2.13%	0.204	0.76%	0.461	3.06%	0.057	1.77%	0.074	4.93%*	0.005
Urban/Rural Indicator										
Urban town	1.64%	0.148	0.36%	0.664	-0.42%	0.715	-0.87%	0.259	-1.66%	0.153
Small accessible town	1.39%	0.411	2.46%	0.058	1.14%	0.505	-2.51%*	0.018	-2.10%	0.222
Small remote town	5.44%	0.006	0.00%	0.998	-1.08%	0.575	-2.03%	0.095	-3.17%	0.105
Accessible rural	3.39%*	0.028	-1.32%	0.238	-1.02%	0.514	-1.92%	0.066	-2.60%	0.092
Remote rural	3.09%*	0.048	0.76%	0.521	0.74%	0.636	-3.27%*	0.001	-4.09%*	0.007

*denotes significance at 95% level

Table 2: Average Marginal Effects of Demographic and Socioeconomic Factors on Fruit and Vegetable Consumption

	Self-Assessed health		Diabetes		CVD		COPD		Healthy BMI	
	M.E	P value	M.E	P value	M.E	P value	M.E	P value	M.E	P value
Male	-3.39%*	0	-3.31%*	0.001	-3.49%*	0.000	-3.31%*	0.001	-4.23%*	0.000
25-34	6.19%*	0.002	6.29%*	0.001	6.22%*	0.002	6.30%*	0.002	5.18%*	0.013
35-44*	5.47%*	0.007	5.61%*	0.005	5.83%*	0.004	5.68%*	0.005	4.56%*	0.031
45-54*	9.20%*	0.000	9.61%*	0.000	9.75%*	0.000	9.38%*	0.000	8.97%*	0.000
55-64*	11.91%*	0.000	12.53%*	0.000	12.62%*	0.000	12.56%*	0.000	11.51%*	0.000
65-74*	10.19%*	0.000	11.14%*	0.000	10.95%*	0.000	11.00%*	0.000	10.20%*	0.000
75+*	8.56%*	0.004	9.76%*	0.001	9.69%*	0.001	9.57%*	0.001	9.05%*	0.004
Highest education										
HNC/D or equivalent	-8.60%*	0.000	-8.78%*	0.000	-8.79%*	0.000	-8.73%*	0.000	-8.15%*	0.000
Higher grade at school	-9.29%*	0.000	-9.40%*	0.000	-9.53%*	0.000	-9.40%*	0.000	-9.07%*	0.000
Standard grade at school	-12.11%*	0.000	-12.45%*	0.000	-12.45%*	0.000	-12.43%*	0.000	-11.22%*	0.000
Other qualifications	-13.77%*	0.000	-13.84%*	0.000	-13.88%*	0.000	-13.75%*	0.000	-13.73%*	0.000
No qualifications	-18.65%*	0.000	-18.99%*	0.000	-18.68%*	0.000	-18.80%*	0.000	-18.00%*	0.000
Income Quintile										
2nd income quintile	-4.16%*	0.008	-4.17%*	0.007	-4.36%*	0.005	-4.22%*	0.007	-5.06%*	0.002
3rd income quintile	-5.64%*	0.001	-5.97%*	0.000	-5.70%*	0.001	-5.72%*	0.001	-5.57%*	0.001
4th income quintile	-6.50%*	0.000	-6.40%*	0.000	-6.53%*	0.000	-6.52%*	0.000	-6.70%*	0.000
Bottom quintile	-8.63%*	0.000	-8.84%*	0.000	-8.87%*	0.000	-8.73%*	0.000	-10.25%*	0.000
No income reported	-6.80%*	0.000	-6.74%*	0.000	-6.58%*	0.000	-6.62%*	0.000	-6.63%*	0.001
Economic Activity										
In paid employment	-6.64%*	0.044	-6.79%*	0.041	-6.90%*	0.038	-6.77%*	0.042	-5.45%*	0.112
Permanent unable to work	-11.48%*	0.003	-11.63%*	0.002	-11.32%*	0.003	-11.65%*	0.002	-9.86%*	0.014
Looking for work	-10.39%*	0.011	-11.18%*	0.006	-11.78%*	0.004	-11.54%*	0.005	-7.26%*	0.089
Retired	-7.10%	0.059	-7.25%	0.055	-7.37%	0.051	-7.43%	0.05	-6.22%	0.111
Homemaker	-9.10%*	0.013	-9.00%*	0.015	-8.96%*	0.016	-9.00%*	0.016	-7.05%	0.067
"Doing something else"	-1.45%	0.817	-1.15%	0.854	-1.22%	0.846	-1.35%	0.829	-7.01%	0.271
Marital Status										
Living as married	-1.82%	0.303	-1.98%	0.267	-1.93%	0.276	-1.74%	0.327	-2.52%	0.175
Single	-0.17%	0.905	-0.18%	0.894	-0.02%	0.991	-0.10%	0.945	-0.77%	0.606
Separated	-4.38%*	0.04	-4.94%*	0.019	-4.71%*	0.025	-4.96%*	0.02	-4.48%*	0.048
Divorced	1.06%	0.527	1.20%	0.473	1.07%	0.523	1.24%	0.46	0.51%	0.772
Widowed	-0.13%	0.937	-0.27%	0.871	-0.22%	0.894	-0.09%	0.954	-1.25%	0.487
Urban/Rural Indicator										
Urban town	-0.22%	0.849	-0.20%	0.859	-0.07%	0.952	-0.13%	0.907	0.48%	0.696
Small accessible town	1.00%	0.56	1.16%	0.504	1.07%	0.535	1.05%	0.542	0.91%	0.62
Small remote town	0.48%	0.807	0.58%	0.766	0.47%	0.811	0.39%	0.841	-0.46%	0.823
Accessible rural	1.47%	0.348	1.59%	0.308	1.77%	0.258	1.69%	0.281	1.25%	0.445
Remote rural	3.86%*	0.016	4.40%*	0.006	4.28%*	0.007	4.34%*	0.007	4.30%*	0.011

*denotes significance at 95% level

Table 3: Average Marginal Effects of Attitudinal Variables on Fruit and Vegetable consumption

	Self-Assessed health		Diabetes		CVD		COPD		Healthy BMI	
	M.E	P value	M.E	P value	M.E	P value	M.E	P value	M.E	P value
Attitudes										
People	1.60%	0.491	-0.38%	0.869	-0.89%	0.692	0.22%	0.925	1.16%	0.6
Information	-6.39%*	0.000	-5.53%*	0.000	-5.83%*	0.000	-5.22%*	0.001	-4.80%*	0.001
Supply	0.32%	0.821	2.08%	0.135	1.46%	0.293	1.32%	0.36	1.41%	0.292
Hedonics	-9.55%*	0.000	-9.33%*	0.000	-9.48%*	0.000	-9.48%*	0.000	-7.57%*	0.000
Price	-0.92%	0.477	0.19%	0.879	0.01%	0.992	-0.39%	0.768	-1.25%	0.321
Time	-3.72%*	0.03	-3.26%	0.057	-2.25%	0.189	-3.62%*	0.039	-3.03%	0.077
Willpower	-4.23%*	0.000	-3.35%*	0.000	-4.02%*	0.000	-3.10%*	0.001	-7.21%*	0.000
Other Barrier	-1.23%	0.562	-0.32%	0.879	-0.34%	0.87	-0.72%	0.736	-0.22%	0.916

*denotes significance at 95% level

By using the seemingly unrelated bivariate probit model, equations 8 and 9 are jointly estimated. This approach produces estimates which are not biased downwards (Jones et al., 2007).

Jointly estimating equations 8 and 9 allows the error terms to be correlated which captures unobserved heterogeneity. Factors such as genetics and time preference may be responsible for unobservable heterogeneity. A statistically significant correlation coefficient indicates unobservable factors which affect eating five-a-day also affect the health outcome. The negative, statistically significant correlation coefficient indicates the unobservable factors which increase the probability of eating five-a-day, decrease the probability of reporting very good self-assessed health. This is also true for BMI. In relation to diabetes, CVD, and COPD, there is a positive, statistically significant correlation coefficient which indicates the unobservable factors which increase the probability of eating five-a-day, increase the probability of these health outcomes. The sign of the correlation coefficient is opposite to what we would expect. However, one possible unobservable factor is a health shock, which impacts fruit and vegetable consumption after being diagnosed with diabetes, CVD, or COPD (Zhao et al., 2013). This effect cannot be investigated in cross-sectional data.

Meeting the five-a-day government recommendation was associated with positive health outcomes in all models. An individual who eats five-a-day is more likely to report very good health and have a healthy BMI. One is also less likely to have diabetes, CVD, or COPD. The analysis also highlights the significance of individual attitudes towards healthy eating. Hedonics is associated with the largest reduction in probability of eating five-a-day. Individuals who perceive healthy foods, not just fruit and vegetables, to be too boring, or to not like the taste are almost 10% less likely to eat five-a-day. This association is almost as strong as educational and socioeconomic factors implying individual attitudes are an important factor.

Individuals who perceive a lack of information as a barrier to healthy eating are around 6% less likely to eat five-a-day. This variable captures individuals who feel they do not have adequate knowledge

to improve their diet or cook more healthy foods. This suggests information campaigns need to go beyond just informing people the amount of each food to eat. A lack of willpower was reported by almost a third of individuals as a perceived barrier to healthy eating and decreases the probability of eating five-a-day by about 4%.

Interestingly, the attitudinal variable associated with price was not significant despite 16% of individuals perceiving price to be a barrier to healthy eating. This result was consistent with Dibsdall et al., (2002) which report affordability as only a small part of improving diets.

These results are relevant to policy makers as eating five-a-day is associated with health benefits and highlights the importance of continuing to encourage fruit and vegetable consumption. Information campaigns appear to increase knowledge but not motivate action as almost 90% of Scottish adults are aware of five-a-day while only 24% meet the recommendation (Scottish Government, 2012). The significance of the attitudinal factors suggests an intervention which focuses on changing attitudes towards healthy eating may be fruitful. First, a greater understanding of these individual attitudes is required to recognise why people lack willpower and what information is needed to make better food choices. This may help explain the knowledge-action gap. Also, these findings regarding attitudes suggest tools from behavioural economics may provide a suitable approach to increasing fruit and vegetable consumption as price appear to be an insignificant factor.

The cross sectional nature of the data allows us to observe associations but we are unable to infer causality. Panel data which allowed the observation of fruit and vegetable consumption, health outcomes, and attitudes over time would be required to determine the health benefits of fruit and vegetable consumption and the role of individual attitudes. The self-reported nature of fruit and vegetable consumption is another limitation. Individuals are asked to report how many portions of fruit and vegetables were consumed is problematic as individuals may not be familiar with what constitutes a portion (Guthrie, 1984). Misreporting by people of what they actually eat is an issue well documented in dietary assessment (Macdiarmid and Blundell, 1998). However, when individuals report fruit and vegetable consumption, over-reporting may be an issue as most individuals are aware they should consume fruit and vegetables (Bogers et al., 2003). The binary variable used in this analysis indicates whether the individual reported eating five-a-day. It does not capture the entire diet and it is possible an individual who eats five-a-day may also consume high levels of saturated fats and salt resulting in an overall unhealthy diet. The positive correlation of DQI and fruit and vegetable consumption discussed earlier assumes that an individual who eats five-a-day may be eating a healthier diet. Finally, the exclusion restriction used in our analysis is difficult to prove to be valid. The falsification tests discussed earlier shows confidence in the exclusion

restriction. However, one may argue attitudes towards healthy eating are related to general health attitudes and therefore are directly related to health outcomes.

Further work on this paper will involve running a multivariate probit model to overcome the strong assumption that health outcomes are unrelated in this analysis. Factor analysis may be used to investigate the possibility of a latent attitudinal variable. Also, structural modelling has been suggested as an alternative approach to modelling this work. To conclude, our analysis has added to the literature which supports the government's strategy to increase fruit and vegetable consumption but future interventions need to consider the attitudinal barriers highlighted in this analysis.

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Appendix A

Table 1A: Descriptive Statistics – Attitudinal, Diet, and Health Outcome Variables

Variables	**Analysis Sample**	
	n	*Mean/%*
Health Outcomes		
Self-Assessed Health (very good)	8407	32.33%
Diabetes	8408	6.35%
CVD	8398	38.72%
COPD	8407	4.70%
BMI (18.5-24.9kg.m^{-2})	7224	31.09%
Meet Five-a-day Recommendation	8407	23.67%
People: Family, friends, people at work being unsupportive	8408	3.68%
Information: Not knowing what changes to make, or how to cook healthy	8408	11.33%
Supply: Lack of choice of healthy foods in canteen ,restaurants, or shops	8408	10.99%
Price: Healthy foods are too expensive	8408	16.37%
Time: Healthy foods take too long to prepare	8408	7.33%
Willpower: Lack of willpower	8408	32.81%
Hedonics: Healthy foods are too boring, don't like the taste/don't enjoy	8408	12.84%
Other barriers	8408	4.26%

Table 2A: Individuals with Health Outcome (Y_{hj}) by fruit and vegetable consumption (Y_d)

Health Outcome		*Eat five-a-day* *n*	*%*	*Total* *n*
Report very good health	Yes	797	29.32%	2,718
	No	1,193	20.97%	5,388
Diabetes	Yes	140	26.22%	534
	No	1,850	23.50%	7,873
CVD	Yes	759	23.35%	3,251
	No	1,229	23.88%	5,146
COPD	Yes	82	20.76%	395
	No	1,908	23.82%	8,011
Healthy BMI	Yes	547	24.35%	2,246
	No	1,175	23.61%	4,977

Table 3A: Independent Variables – Descriptive Statistics

Variable	n	Mean/%
Male	8408	41.83%
16-24*	8408	7.21%
25-34	8408	13.19%
35-44	8408	16.48%
45-54	8408	16.78%
55-64	8408	17.60%
65-74	8408	15.69%
75+	8408	13.05%
Highest educational qualification		
Degree or higher*	8399	25.51%
HNC/D or equivalent	8399	9.49%
Higher grade at school	8399	13.39%
Standard grade at school	8399	17.42%
Other qualifications	8399	9.07%
No qualifications	8399	25.11%
Income Quintile		
Top income quintile*	8408	18.20%
2nd income quintile	8408	17.89%
3rd income quintile	8408	17.50%
4th income quintile	8408	16.65%
Bottom quintile	8408	18.27%
No income reported	8408	11.50%
Economic Activity		
In Education*	8407	3.24%
In paid employment	8407	48.83%
Permanently unable to work	8407	6.08%
Looking for work	8407	3.53%
Retired	8407	31.14%
Homemaker	8407	6.40%
"Doing something else"	8407	0.79%
Marital Status		
Married*	8407	40.91%
Living as married	8407	8.43%
Single	8407	22.17%
Separated	8407	4.60%
Divorced	8407	10.00%
Widowed	8407	13.88%
Urban/Rural Indicator		
Primary city (pop.>250,000)*	8408	35.45%
Urban (pop. >10,000)	8408	27.49%
Small accessible towns (pop.>3,000)	8408	8.58%
Small remote towns (pop.>3,000)	8408	6.20%
Accessible rural	8408	10.99%
Remote rural	8408	11.30%

*denotes variable is base category in analysis.

Table 4A: Correlation Coefficients

Health Outcome	Coefficient	P-Value
Report very good health	-0.5732315*	0.000
Diabetes	0.9621922*	0.000
CVD	0.6924556*	0.000
COPD	0.7625438*	0.004
Healthy BMI	-1.12039*	0.000
GHQ	-0.4767509	0.209

*denotes significance at 95% level

Table 5A: Bivariate Probit Results – Five-a-day, Demographic, and Socioeconomic Variables on Health Outcomes

	Self-Assessed Health (n=8,396)			Diabetes (n=8,397)			CVD (n=8,387)			COPD (n=8,396)			Healthy BMI (n=7,214)		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Five-a-day	1.022*	(0.156)	0.000	-1.070*	(0.147)	0.000	-0.971*	(0.163)	0.000	-1.024*	(0.246)	0.000	1.391*	(0.078)	0.000
Male	-0.013	(0.032)	0.688	0.156*	(0.048)	0.001	0.031	(0.032)	0.344	-0.123*	(0.049)	0.013	-0.103*	(0.032)	0.001
25-34	-0.097	(0.070)	0.166	0.323	(0.195)	0.098	0.213*	(0.090)	0.018	-0.002	(0.223)	0.994	-0.089	(0.070)	0.208
35-44	-0.190*	(0.072)	0.008	0.481*	(0.190)	0.011	0.520*	(0.087)	0.000	0.501*	(0.190)	0.008	-0.323*	(0.072)	0.000
45-54	-0.363*	(0.075)	0.000	0.862*	(0.190)	0.000	0.833*	(0.089)	0.000	0.718*	(0.192)	0.000	-0.364*	(0.075)	0.000
55-64	-0.415*	(0.080)	0.000	1.035*	(0.192)	0.000	1.202*	(0.092)	0.000	0.888*	(0.194)	0.000	-0.599*	(0.080)	0.000
65-74	-0.317*	(0.095)	0.001	1.068*	(0.204)	0.000	1.404*	(0.107)	0.000	0.909*	(0.206)	0.000	-0.550*	(0.096)	0.000
75+	-0.430*	(0.103)	0.000	1.068*	(0.208)	0.000	1.621*	(0.115)	0.000	0.826*	(0.211)	0.000	-0.465*	(0.104)	0.000
HNC/D or equivalent	-0.024	(0.057)	0.676	-0.099	(0.091)	0.278	0.008	(0.062)	0.893	0.067	(0.114)	0.554	-0.030	(0.057)	0.597
Higher grade at school	0.013	(0.052)	0.800	-0.130	(0.080)	0.103	-0.049	(0.056)	0.380	-0.115	(0.102)	0.257	0.051	(0.051)	0.310
Standard grade at school	-0.069	(0.054)	0.195	-0.119	(0.080)	0.138	-0.062	(0.058)	0.284	-0.107	(0.102)	0.293	0.011	(0.049)	0.831
Other qualifications	-0.050	(0.068)	0.463	-0.177*	(0.084)	0.035	0.027	(0.069)	0.698	-0.084	(0.111)	0.447	-0.020	(0.066)	0.759
No qualifications	-0.163*	(0.061)	0.007	-0.186*	(0.082)	0.023	-0.046	(0.064)	0.466	-0.021	(0.123)	0.865	0.069	(0.051)	0.178
Income Quintile															
2nd income quintile	-0.093	(0.048)	0.052	-0.019	(0.078)	0.805	0.017	(0.051)	0.736	0.150	(0.103)	0.144	-0.042	(0.049)	0.395
3rd income quintile	-0.166*	(0.052)	0.001	0.020	(0.079)	0.797	-0.042	(0.054)	0.435	0.195	(0.105)	0.064	0.041	(0.051)	0.418
4th income quintile	-0.296*	(0.058)	0.000	-0.028	(0.082)	0.732	0.017	(0.058)	0.775	0.206	(0.109)	0.060	-0.029	(0.056)	0.607
Bottom quintile	-0.244*	(0.062)	0.000	-0.101	(0.087)	0.246	0.009	(0.062)	0.891	0.098	(0.115)	0.395	0.123	(0.059)	0.036
No income reported	-0.059	(0.058)	0.312	-0.055	(0.086)	0.524	-0.123*	(0.060)	0.042	0.060	(0.111)	0.587	0.134*	(0.061)	0.027
Economic Activity															
In paid employment	-0.038	(0.088)	0.669	-0.154	(0.229)	0.500	-0.063	(0.113)	0.579	-0.143	(0.246)	0.562	-0.309*	(0.091)	0.001
Perm. unable to work	-1.636*	(0.180)	0.000	0.351	(0.247)	0.156	0.478*	(0.133)	0.000	0.373	(0.268)	0.164	-0.331*	(0.113)	0.003
Looking for work	-0.402*	(0.120)	0.001	-0.064	(0.257)	0.803	0.092	(0.138)	0.502	-0.010	(0.280)	0.972	-0.137	(0.115)	0.235
Retired	-0.324*	(0.106)	0.002	0.172	(0.241)	0.477	0.178	(0.126)	0.157	0.063	(0.258)	0.807	-0.290*	(0.108)	0.007
Homemaker	-0.112	(0.103)	0.278	-0.177	(0.250)	0.479	-0.025	(0.126)	0.842	0.017	(0.261)	0.947	-0.189	(0.105)	0.071
"Doing something else"	-0.086	(0.176)	0.626	0.444	(0.299)	0.138	0.167	(0.194)	0.388	0.259	(0.340)	0.445	-0.375	(0.193)	0.052
Marital Status															
Living as married	-0.146*	(0.057)	0.010	0.144	(0.094)	0.126	0.020	(0.061)	0.743	-0.103	(0.123)	0.402	0.149*	(0.058)	0.010
Single	-0.147*	(0.045)	0.001	0.002	(0.066)	0.970	-0.030	(0.045)	0.505	-0.016	(0.077)	0.838	0.166*	(0.045)	0.000
Separated	-0.134	(0.076)	0.081	-0.127	(0.106)	0.231	-0.124	(0.072)	0.085	0.032	(0.112)	0.775	0.101	(0.074)	0.171
Divorced	-0.128*	(0.055)	0.019	0.070	(0.068)	0.300	0.060	(0.051)	0.238	0.045	(0.077)	0.556	0.149*	(0.053)	0.005
Widowed	-0.069	(0.055)	0.206	0.046	(0.062)	0.457	0.098	(0.051)	0.055	0.130	(0.070)	0.064	0.162	(0.056)	0.004
Urban/Rural															
Urban town	0.054	(0.038)	0.148	0.022	(0.051)	0.664	-0.014	(0.037)	0.715	-0.063	(0.056)	0.261	-0.054	(0.038)	0.153
Small accessible town	0.046	(0.056)	0.409	0.142*	(0.072)	0.049	0.037	(0.055)	0.505	-0.198*	(0.094)	0.035	-0.068	(0.056)	0.225
Small remote town	0.176*	(0.063)	0.005	0.000	(0.086)	0.998	-0.035	(0.063)	0.576	-0.156	(0.101)	0.123	-0.104	(0.065)	0.109
Accessible rural	0.111*	(0.050)	0.026	-0.085	(0.075)	0.256	-0.033	(0.051)	0.515	-0.146	(0.086)	0.089	-0.085	(0.051)	0.095
Remote rural	0.101*	(0.050)	0.044	0.046	(0.070)	0.510	0.024	(0.051)	0.636	-0.269*	(0.100)	0.007	-0.135*	(0.051)	0.008
Constant	-0.001*	(0.120)	0.991	-1.902*	(0.333)	0.000	-1.027*	(0.171)	0.000	-1.957*	(0.395)	0.000	-0.129	(0.107)	0.225

Table 6A: Bivariate Probit Results - Demographic and Socioeconomic Factors on Fruit and Vegetable Consumption

	Self-Assessed Health (n=8,396)			Diabetes (n=8,397)			CVD (n=8,387)			COPD (n=8,396)			Healthy BMI (n=7,214)		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Male	-0.117*	(0.033)	0.000	-0.114*	(0.033)	0.001	-0.120*	(0.033)	0.000	-0.114*	(0.033)	0.001	-0.145*	(0.035)	0.000
25-34	0.244*	(0.083)	0.003	0.253*	(0.084)	0.003	0.250*	(0.084)	0.003	0.253*	(0.084)	0.003	0.203*	(0.085)	0.017
35-44	0.218*	(0.085)	0.010	0.228*	(0.086)	0.008	0.236*	(0.086)	0.006	0.230*	(0.086)	0.007	0.180*	(0.087)	0.039
45-54	0.348*	(0.087)	0.000	0.369*	(0.088)	0.000	0.373*	(0.088)	0.000	0.360*	(0.088)	0.000	0.334*	(0.089)	0.000
55-64	0.436*	(0.091)	0.000	0.465*	(0.092)	0.000	0.467*	(0.091)	0.000	0.464*	(0.092)	0.000	0.416*	(0.093)	0.000
65-74	0.381*	(0.107)	0.000	0.420*	(0.108)	0.000	0.413*	(0.107)	0.000	0.414*	(0.107)	0.000	0.374*	(0.110)	0.001
75+	0.327*	(0.114)	0.004	0.374*	(0.115)	0.001	0.371*	(0.114)	0.001	0.367*	(0.114)	0.001	0.337*	(0.119)	0.005
HNC/D or equivalent	-0.258*	(0.058)	0.000	-0.264*	(0.058)	0.000	-0.264*	(0.058)	0.000	-0.262*	(0.058)	0.000	-0.245*	(0.060)	0.000
Higher grade at school	-0.281*	(0.052)	0.000	-0.284*	(0.052)	0.000	-0.288*	(0.052)	0.000	-0.284*	(0.052)	0.000	-0.275*	(0.054)	0.000
Standard grade at school	-0.376*	(0.050)	0.000	-0.387*	(0.050)	0.000	-0.388*	(0.050)	0.000	-0.387*	(0.050)	0.000	-0.348*	(0.053)	0.000
Other qualifications	-0.436*	(0.064)	0.000	-0.437*	(0.064)	0.000	-0.439*	(0.064)	0.000	-0.435*	(0.064)	0.000	-0.437*	(0.068)	0.000
No qualifications	-0.631*	(0.050)	0.000	-0.645*	(0.050)	0.000	-0.631*	(0.050)	0.000	-0.637*	(0.050)	0.000	-0.608*	(0.053)	0.000
Income Quintile															
2nd income quintile	-0.133*	(0.050)	0.007	-0.134*	(0.050)	0.007	-0.140*	(0.050)	0.005	-0.135*	(0.050)	0.007	-0.161*	(0.052)	0.002
3rd income quintile	-0.183*	(0.053)	0.001	-0.195*	(0.053)	0.000	-0.185*	(0.053)	0.000	-0.186*	(0.053)	0.000	-0.178*	(0.056)	0.001
4th income quintile	-0.213*	(0.058)	0.000	-0.210*	(0.058)	0.000	-0.214*	(0.058)	0.000	-0.214*	(0.058)	0.000	-0.217*	(0.061)	0.000
Bottom quintile	-0.290*	(0.063)	0.000	-0.299*	(0.063)	0.000	-0.299*	(0.063)	0.000	-0.295*	(0.063)	0.000	-0.347*	(0.067)	0.000
No income reported	-0.224*	(0.061)	0.000	-0.222*	(0.062)	0.000	-0.216*	(0.061)	0.000	-0.218*	(0.062)	0.000	-0.214*	(0.067)	0.001
Economic Activity															
In paid employment	-0.212*	(0.100)	0.035	-0.217*	(0.101)	0.032	-0.220*	(0.100)	0.029	-0.216*	(0.101)	0.033	-0.175	(0.105)	0.097
Perm. unable to work	-0.386*	(0.124)	0.002	-0.392*	(0.125)	0.002	-0.379*	(0.124)	0.002	-0.392*	(0.125)	0.002	-0.332*	(0.132)	0.012
Looking for work	-0.345*	(0.135)	0.011	-0.375*	(0.137)	0.006	-0.396*	(0.137)	0.004	-0.388*	(0.139)	0.005	-0.237	(0.139)	0.088
Retired	-0.227	(0.116)	0.050	-0.233*	(0.117)	0.047	-0.236*	(0.116)	0.043	-0.238*	(0.117)	0.042	-0.201	(0.122)	0.101
Homemaker	-0.298*	(0.116)	0.011	-0.294*	(0.117)	0.012	-0.292*	(0.117)	0.012	-0.293*	(0.117)	0.012	-0.230	(0.122)	0.061
"Doing something else"	-0.044	(0.193)	0.818	-0.035	(0.191)	0.855	-0.037	(0.190)	0.846	-0.041	(0.191)	0.829	-0.228	(0.216)	0.290
Marital Status															
Living as married	-0.063	(0.062)	0.310	-0.069	(0.063)	0.274	-0.067	(0.063)	0.284	-0.061	(0.063)	0.334	-0.087	(0.066)	0.183
Single	-0.006	(0.047)	0.905	-0.006	(0.047)	0.894	-0.001	(0.047)	0.991	-0.003	(0.048)	0.945	-0.026	(0.051)	0.607
Separated	-0.158	(0.081)	0.050	-0.180*	(0.081)	0.027	-0.171*	(0.081)	0.034	-0.181*	(0.082)	0.028	-0.159	(0.084)	0.059
Divorced	0.036	(0.056)	0.524	0.041	(0.056)	0.469	0.036	(0.056)	0.520	0.042	(0.056)	0.456	0.017	(0.059)	0.771
Widowed	-0.004	(0.056)	0.937	-0.009	(0.057)	0.871	-0.007	(0.056)	0.894	-0.003	(0.057)	0.954	-0.042	(0.062)	0.491
Urban/Rural															
Urban town	-0.008	(0.040)	0.849	-0.007	(0.040)	0.859	-0.002	(0.040)	0.952	-0.005	(0.040)	0.907	0.017	(0.042)	0.696
Small accessible town	0.035	(0.059)	0.558	0.040	(0.060)	0.500	0.037	(0.059)	0.532	0.036	(0.059)	0.539	0.031	(0.063)	0.618
Small remote town	0.017	(0.068)	0.806	0.020	(0.068)	0.765	0.016	(0.068)	0.811	0.014	(0.068)	0.841	-0.016	(0.072)	0.823
Accessible rural	0.050	(0.053)	0.344	0.055	(0.053)	0.303	0.061	(0.053)	0.253	0.058	(0.053)	0.276	0.043	(0.056)	0.442
Remote rural	0.129*	(0.052)	0.014	0.147*	(0.052)	0.005	0.143*	(0.052)	0.006	0.145*	(0.052)	0.005	0.143*	(0.055)	0.009

*denotes significance at 95% level

Table 7A: Bivariate Probit Results –Attitudes towards Healthy Eating Factors on Fruit and Vegetable Consumption

	Self-Assessed Health (n=8,396)			Diabetes (n=8,397)			CVD (n=8,387)			COPD (n=8,396)			Healthy BMI (n=7,214)		
	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z	Coef.	Std. Err.	P>z
Attitudes															
People	-0.055	(0.080)	0.490	-0.013	(0.080)	0.869	-0.031	(0.078)	0.692	-0.008	(0.082)	0.925	0.040	(0.076)	0.600
Information	-0.220*	(0.052)	0.000	-0.191*	(0.052)	0.000	-0.201*	(0.052)	0.000	-0.180*	(0.054)	0.001	-0.164*	(0.051)	0.001
Supply	0.011	(0.049)	0.821	0.072	(0.048)	0.136	0.050	(0.048)	0.293	0.046	(0.050)	0.360	0.048	(0.046)	0.292
Hedonics	-0.329*	(0.050)	0.000	-0.322*	(0.050)	0.000	-0.327*	(0.050)	0.000	-0.327*	(0.051)	0.000	-0.259*	(0.050)	0.000
Price	-0.032	(0.045)	0.476	0.007	(0.043)	0.879	0.000	(0.043)	0.992	-0.014	(0.046)	0.768	-0.043	(0.043)	0.321
Time	-0.128*	(0.059)	0.030	-0.113	(0.059)	0.057	-0.078	(0.059)	0.189	-0.125*	(0.061)	0.040	-0.103	(0.058)	0.077
Willpower	-0.146*	(0.033)	0.000	-0.116*	(0.033)	0.000	-0.138*	(0.033)	0.000	-0.107*	(0.034)	0.001	-0.246*	(0.032)	0.000
Other Barriers	-0.042	(0.073)	0.562	-0.011	(0.072)	0.879	-0.012	(0.071)	0.870	-0.025	(0.074)	0.736	-0.008	(0.072)	0.916
Constant	-0.171	(0.113)	0.131	-0.218	(0.113)	0.054	-0.206	(0.113)	0.067	-0.215	(0.113)	0.058	-0.153	(0.119)	0.200
Correlation Coefficient	-0.573*	(0.126)	0.000	0.962*	(0.197)	0.000	0.692*	(0.155)	0.000	0.763*	(0.264)	0.004	-1.120*	(0.121)	0.000

*denotes significance at 95% level

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