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Determinants of Vegetarianism and Partial Vegetarianism in the United Kingdom

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Abstract: Vegetarianism is increasing in the western world. Anecdotally, this trend can be attributed to heightened health, environmental and animal welfare concerns. In this paper we investigate the factors associated with vegetarianism among adults and children in the UK. Using the 2008 Health Survey for England, we use a logit model to assess the relationship between vegetarianism and the socioeconomic and personal characteristics of the respondents. We also analyse the factors associated with varying levels of meat consumption using an ordered logit model. This paper adds to the existing literature as it is the first paper to estimate the determinants of vegetarianism using a large dataset containing individual level consumption data.

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1. Introduction

Meat production is set to double by 2050 due to an increase in the world population and increased wealth in developing countries (FAO, 2010). At present, in less developed countries, low income levels force many people to follow vegetarian diets. In developed countries, where people are vegetarians by choice, vegetarianism is increasing (Leahy, Lyons and Tol, 2010b). The notion of partial vegetarianism is also becoming increasingly popular in developed nations. Catholics have long been urged to abstain from meat consumption on Fridays. However, the heightened interest in partial vegetarianism has been driven mainly by celebrity endorsed movements such as the Meatless Monday campaign which began in 2003. Concern for animal welfare and the environment are among the factors driving this trend. The relationship between meat consumption, especially red meat, and global environmental change has been acknowledged (FAO, 2006). Ruminant livestock are major emitters of methane, the second-most important anthropogenic greenhouse gas.

Meat consumption also has implications for an individual's health. In developed countries, excessive meat consumption can be a health concern (Giovannucci *et al.*, 2004, Drewnowski and Specter, 2004, Hu *et al.*, 2000, Rose, Boyar, and Wynder, 1986, James et al., 1997). Barnard, Nicholson and Howard (1995) studied the medical costs associated with meat consumption in the USA. The authors estimate that costs of between $30-60 billion per year result due to the higher prevalence of hypertension, heart disease, cancer, diabetes, gallstones, obesity and food-borne illness among omnivores compared with vegetarians.

Leahy, Lyons and Tol, (2010b) examined the determinants of vegetarianism at an aggregate level. The findings suggest that there is a Kuznets-like relationship between income and meat expenditure. For the poor, an increase in income results in higher meat expenditure. However, at the global average income, meat consumption levels off and at very high levels of per capita income vegetarianism increases. Higher levels of education were also associated with increased vegetarianism and, in poor countries, vegetarianism is negatively associated with the per capita level of meat production.

Leahy, Lyons and Tol (2010a) find that the proportion of vegetarians in the UK is increasing (see Figure A1). In this paper, we analyse the determinants of vegetarianism at the individual level. This study provides a much richer analysis of the characteristics of vegetarians. This should be of benefit to those forecasting future numbers of vegetarians and the associated environmental or health benefits. Because partial vegetarianism can lead to important environmental and health benefits, we also assess the personal and household characteristics associated with varying levels of meat consumption.

Previous papers which aim to establish the motivations of vegetarians have usually been carried out on small or unrepresentative samples (Beardsworth and Bryman, 1999, Fox and Ward, 2006, Jabs, Devine and Sobal, 1998). The majority of the literature instead focuses on the health advantages of following a vegetarian diet. In a study of almost 11,000 participants, with whom a follow up study was carried out 17 years later, Sanjoaquin et al. (2004) find that vegetarians showed a moderately but nonsignificantly lower risk of colorectal cancer compared with non vegetarians. Also, the risk of colorectal cancer was not seen to increase with higher meat consumption among non vegetarians. Key et al. (1999) find with the use of Poisson regression analysis that from a total sample of 76,172, of which 36.5% are vegetarian, mortality from ischemic heart disease was 24% lower in vegetarians than in non vegetarians and 26% lower in vegans. Appleby, Davey and Key (2002) find that non-meat eaters, especially vegans, are found to have a lower prevalence of hypertension and lower systolic and diastolic blood pressures than meat eaters. The differences can largely be explained by differences in body mass index, however. Key et al. (2009) studied the cancer risk among British vegetarians. In this study the sample size was 61,566 and the average follow-up took place 12.2 years after the initial interview. Results show that vegetarians face a much lower risk of stomach cancer, ovarian cancer, bladder cancer and cancer of the lymphatic and haematopoietic tissues than meat eaters.

In his summation of the literature on the health effects of vegetarianism, Panebianco (2007) concluded that the merits of meat avoidance include a lower incidence of obesity, a reduced risk of chronic diseases such as heart disease, hypertension, and type 2 diabetes, a lower death rate from ischemic heart disease, lower blood cholesterol levels, a lower incidence of certain cancers including prostate and colon cancer, and greater longevity. Some authors for example, Worsley and

Skrzypiec, (1997) have suggested, however, that there is a link between teenage vegetarianism and eating disorders, especially among females,

While literature on the determinants of vegetarianism is lacking, research into meat consumption has been extensive. The factors affecting meat demand have been studied at a micro level for example in Ireland by Newman et al. (2001), in the USA by Nayga (1995), in the UK by Burton et al. (1994), in Japan by Chern et al. (2002) and in Mexico by Gould et al. (2002). Results suggest that the demand for meat is affected by factors such as income, household size, education level and professional status. Changing socio economic patterns have also resulted in changing the pattern of meat demand. Meat products which are seen as being convenient and versatile have become popular in developed countries (Newman et al., 2002, Meat and Livestock Commission, 1996). During the 1990s in the UK it was found that price and income were declining in importance and the demand for meat was dominated by preferences and tastes (Burton et al., 1996, 1999). Various health scares such as the BSE crisis have resulted in a noticeable demand shift away from red meat towards white meat (Burton et al., 1999). A recent analysis of the role of the media on the demand for meat shows that animal welfare advertising has a small but statistically significant effect on pork and poultry demand (Tonser and Olynk, 2010).

The majority of meat demand studies to date have used household expenditure surveys with which it is difficult to predict individual consumption patterns because data is collected at the household level. Also, such surveys do not usually contain detailed information about eating out. Expenditure does not necessary equal consumption (e.g., someone may buy meat for her dog). Expenditure surveys cannot distinguish between people who eat a lot of cheap meat and people who eat a little bit of expensive meat. There can also be problems with the accuracy of purchase recall, and the frequency of purchase. All this makes expenditures surveys less suitable for studying the patterns of vegetarianism. The advantage of this paper is that the data we use is collected at the individual level and respondents are asked about general eating patterns as opposed to expenditure at a point in time. To our knowledge, this is the first empirical analysis of the determinants of vegetarianism and partial vegetarianism using a large micro dataset.

The paper continues as follows. Section 2 describes the data and methods used and section 3 discusses the results. Section 4 provides a discussion and conclusion.

2. Data and Methods

We use the 2008 Health Survey for England in which 15,102 adults and 7,521 children took part. 3,473 children were from the core sample and 4,048 were from a later boost sample (Department of Health, 2010). A response rate of 64% was achieved for the core sample and 73% for the boost sample. The Health Survey for England specialises in different topics each year. The 2008 survey focuses on physical activity and fitness levels. Participants were interviewed, and for those in the core sample this was followed by a nurse visit. Adults and children were asked a range of questions about general health, fruit and vegetable consumption, alcohol consumption, smoking, and physical activity. Respondents aged 16 and over were asked to self- complete a section on eating habits while an interviewer completed the section on children's eating habits. Adults and children were asked how often they consume both red and white meat; 6 or more times a week, 3-5 times a week, 1-2 times a week, less than once a week, or rarely or never. We classify those who identify themselves as consuming both red and white meat "rarely or never" as vegetarians. While this is not perfect, it is the best measure available to identify vegetarians.

The Health Survey for England also contains information on income and other socio-economic variables which we use as explanatory variables in our models. The analysis is made up of two parts. In the first we use logit regression models to analyse the factors associated with vegetarianism. The dependent variable is a binary variable, equalling 1 if the respondent eats red meat or white meat "rarely or never" and 0 if he/she eats any type of meat more often. We carry out separate analyses for adults and children.

The independent variables are a series of individual and household characteristics. The household income level is included as an explanatory variable and enables us to establish whether vegetarians are more likely to be found in higher income or lower income households. The income variable is not continuous; rather it is divided into 12 binary categories. A graph of the relationship between household income and the percentage of vegetarians aged between 2 and 16 is shown in Figure A2 of the Appendix. At the micro level, there is no evidence of a Kuznets-like relationship as is the case at the aggregated level across nations (Leahy, Lyons and Tol, 2010b). Instead, vegetarianism appears to increase with income but for adults, at extremely

high income levels, the proportion of the population that is vegetarian falls (see Figure A3 of the Appendix).

For the analysis of vegetarianism among children we also control for the social class of the household reference person (HRP)[1] as we expect to find a positive relationship between vegetarianism and higher social classes. As the presence of other vegetarians in a household may increase the likelihood that a child will be vegetarian, we control for the number of other vegetarians in the household. We expect to find that vegetarians are more prevalent in urban areas (and in particular big cities) than in rural areas or small towns. Therefore we control for the region in which the child lives and the degree of urbanisation. Also included is the age and gender of the child. Anecdotally, vegetarianism is becoming more prevalent among young adults and females in particular. We wish to ascertain whether there is a link between vegetarians and the health conscious. The child's body mass index (bmi) is measured and the number of portions of fruit and vegetables consumed daily are counted. Children are also asked whether they get the recommended amount of physical activity or not. The recommended amount of exercise for children is a minimum of 60 minutes of moderate[2] to vigorous exercise every day of the week. Children are also asked if they are trying to lose weight. We expect to find a positive relationship between being on a diet and vegetarianism. Other control variables include having a long term illness, because this may mean respondents are obliged to follow restricted diets, and ethnic origin because this may influence meat eating patterns, particularly those of red meat.

We then do the same analysis for adults. The questions asked to adults and children vary slightly. With regard to adults, we control for all of the above except we do not know if adults are trying to lose weight and, instead of controlling for the social class of the HRP, we control for the social class of the respondent. In addition, we include the education level and economic status of the individual because those educated to higher levels and those in professional occupations may have a higher probability of being a vegetarian. The explanatory variables also include smoking and alcohol intake. We expect to find that vegetarians are more health conscious and so, alcohol intake might be lower than that of non vegetarians. Similarly, we expect to find that

[1] The HRP is the highest earner in the household. If household members cannot be separated by income, the oldest person is chosen.

[2] Moderate activity is defined as an activity that makes one out of breath or sweaty, indicating that one is doing cardiovascular activity.

non smokers are more likely to be vegetarians than smokers. Finally, we control for the marital status of the individual. Pribis, Sabate and Fraser (1999) find no differences in martial status between vegetarians and non vegetarians. However, the sample used was small (158 adults) and unrepresentative of the population. A list of the variables included in our models and some descriptive statistics on them is set out in Table 1.

[Table 1 about here]

In the second part of the analysis we examine the factors associated with varying levels of meat consumption. We construct an ordered logit model in which the dependent variable is the level meat consumption. First we construct a red meat consumption scale. 0 indicates that red meat is consumed rarely or never, 1 indicates that red meat is consumed less than once a week, 2 indicates that red meat is consumed 1-2 times a week, 3 indicates a consumption level of 3-5 times a week and 6 means that red meat is consumed at least 6 times per week. We do the same for white meat and then combine the two scales in order to rank total meat consumption. Thus, the dependent variable takes a value of 0 if the consumption level is rarely or never in both of the red and white meat categories, 1 if it is less than once a week in one of the categories and 0 in the other, 2 if it is less than once a week for both red and white meat consumption or 1-2 times a week in one of the categories and zero in the other and so on until we have a variable which takes a value of 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, or 12. We run separate models for children and adults.

For both the logit and ordered logit models we include all of the explanatory variables we believe may influence meat consumption. We then test for joint significance of the insignificant variables. Due to the large number of explanatory variables in our models, only the results of the more parsimonious models are presented. Full regression results are available on request from the authors.

3. Results

3.1 Vegetarianism

The dependent variable equals 1 if the respondent is a vegetarian, 0 otherwise. For each categorical explanatory variable there is a reference category which acts as a

baseline against which the characteristics of respondents, or their households, are compared. The results are presented in terms of odds ratios which reflect the odds that a respondent with a given characteristic will be a vegetarian, relative to those in the reference category. An odds ratio of 1 indicates that respondents with that characteristic are equally likely to be vegetarians as those in the reference category. An odds ratio greater than 1 indicates a higher probability that the respondent will be a vegetarian, while a ratio below 1 indicates that the probability is lower.

Table 2 displays the results of the model which investigates the factors associated with vegetarianism among children.

[Table 2 about here]

The odds ratio for fruitveg indicates that as daily fruit and vegetable consumption increases so too does the probability that a child will be a vegetarian. However, we cannot exclude reverse causality. It could be the case that vegetarians just consume more fruit and vegetables as part of their daily calorie intake. Unfortunately, we do not have an instrumental variable with which we can solve this problem of simultaneity. Thus, the results on the fruitveg variable should be interpreted with caution.

Results also show that children that are trying to lose weight are one and a half times more likely to be vegetarians than their counterparts who are not on a diet. Consistent with anecdotal evidence is the fact that girls are 3 times more likely to be vegetarians than boys. Children of Asian origin (excluding China) are 3 times more likely to be vegetarians than White children, most of whom are of British origin. Given that non-Chinese Asians in Britain are primarily from the Indian subcontinent where vegetarianism and veganism is widespread for religious regions, this result is not surprising.

Interestingly, one of each of the income and social class variables is significant. Children from households that earn between £41,601 and £52,000 a year are 1.8 times more likely to be vegetarians than children who live in households earning between £10,000 and £20,000. One may suspect that because we do not control for the education level of the HRP, the income variable may be picking up some education effect. While the survey did ask adult respondents to state their level of education, the survey did not include a specific question about the education level of the HRP. Creating this variable by finding all of the HRPs who responded to the survey reduces

the number of observations to 469.[3] Children living in households where the HRP is a semi-skilled manual worker are 1.6 times more likely to be vegetarians than children living with reference persons who are managerial or technical workers. Since we do not control for the education level of the HRP, we would have expected that the reference group, managerial and technical workers, who achieve relatively high levels of education (30% of this group have a degree or higher) would be more likely to be vegetarians than the less well educated semi-skilled manual workers (6% have a degree or higher). Thus, there is some factor, other than education, that we don't observe that would explain this result. Finally, children living in the East Midlands are significantly more likely to be vegetarians compared to those living in the South East. This result must be explained by some factor we do not observe.

Table 3 shows the results of the model which investigates the factors associated with vegetarianism among adults. The number of observations is much higher than is the case for children, as is the number of significant variables. The results of the parsimonious model are presented. The omitted variables prove individually and jointly insignificant.

[Table 3 about here]

Results show that there is a positive correlation between vegetarianism and the consumption of fruit and vegetables. However, as stated previously, we cannot draw any causal inferences between the two variables using this data. Similarly, adults getting the recommended amount of physical activity per week are 23% more likely to be vegetarians than adults who do not meet the criteria.4 The odds ratio for bmi indicates that the lower a person's bmi, the higher the probability that the person is a vegetarian. This suggests that people chose to become vegetarians for health reasons. However, it could be the case that the non-consumption of meat reduces the bmi. Thus, we interpret the odds ratios on these variables with caution. We know only that the variables are positively correlated but we cannot say that one causes the other.

[3] A total of 17,684 respondents from 9,870 households took part in the survey but over 60% of households did not provide an interview from the HRP. This, along with the exclusion of a child's interview in other households, reduces the total number of observations dramatically. The education level of the HRP was not significant in an earlier version of the model. Thus, we decided to omit it.

[4] For adults, the recommended amount is at least 30 minutes of moderate activity 5 days a week or at least 30 minutes of vigorous activity 3 days a week.

The results of this model show that smokers are 39% more likely to be vegetarians than non smokers. Simple cross tabulations show, however, that smoking levels are lower among vegetarians than meat eaters. It is thus surprising that the odds ratio on smoker is greater than one. A more thorough investigation of this result shows that the addition to the model of age, living in London, working in a 1 or 2 person organisation or belonging to an ethnic minority increases the odds ratio on smoking so much so that its effect changes from negative to positive. This happens because the correlation between Asians and smoking is negative while the correlation between Asians and vegetarianism is positive. The same correlations hold for living in London or working in a very small organisation. Vegetarianism is negatively correlated with both smoking and age but younger adults are more likely to be vegetarians and older adults are more likely to be smokers.

As was the case in the previous model, the odds of being a vegetarian are increased for non-Chinese Asians. The probability of being a vegetarian is 4 times higher if an adult is Asian compared to White. Also as expected are the odds ratios on female and age. Adult females are twice as likely to be vegetarians as males and the younger the adult, the higher the probability that he/she is a vegetarian.

An interesting result is that of the number of employees in the respondent's workplace. People working in organisations that employ only one or two people are almost 1.7 times as likely to be vegetarians as those working in organisations with between 25 and 500 employees. This is probably because becoming a vegetarian is not only a diet choice but also a lifestyle choice. We do not observe the reason why vegetarians choose to work in very small organisations but it may be that they do not want to work for large multi-national corporations, government offices or state funded agencies. This result may also be driven by the fact that non-Chinese Asians are over represented in workplaces containing one or two employees. These may be small, family run businesses such as food stores, but we cannot explore this possibility further using the available data.

The region in which a person lives is also an important variable in our model. Living in London significantly increases the odds that a person is a vegetarian compared to the reference group, the South East, while the same is the case for residents of the East Midlands. The population of London is more culturally diverse, better educated and younger on average than the UK in general, so, this result is not surprising. However, descriptive statistics on the East Midlands show that its

population achieves lower levels of education and the average age of respondents is older than that of the UK in general. Descriptive statistics also show there are fewer Asians living in the East Midlands (as a percentage of all of those living in the East Midlands) than there are in other parts of the UK. Thus, there must be some unobservable characteristic associated with the East Midlands that explains the higher percentage of vegetarians there. Living in Yorkshire and Humber, however, has the opposite effect. Residents of this region are significantly less likely to be vegetarians than those in the reference group. In the South East of England, the reference category in this group, the weighted percentage of vegetarian adults is 3.4% whereas for the UK in general it is 4%. In the East Midlands, 4.6% of adults are vegetarians while in London the figure is much higher at 9.7%. In Yorkshire and Humber it is lower at 2.5%.

As expected, adults who have completed higher education are significantly more likely to be vegetarians than those in the reference category (no educational qualifications). Having a third-level degree (or higher) increases the odds of being a vegetarian by 95%. The probability of being a vegetarian is 46% higher for those with higher education below degree level. It is likely that the well educated are better informed about the health, ethical and environmental benefits associated with vegetarianism. They may also find it easier to source high quality alternatives to meat compared to those with no educational qualifications.

Divorced respondents are 1.4 times more likely to be vegetarians than their married counterparts. Unfortunately, we cannot tell how long people have been following vegetarian diets, however, it may be that divorce triggers lifestyle changes such as the adoption of a meat free diet – but we cannot exclude the possibility that vegetarianism somehow increases the probability of divorce. Being part of a cohabiting couple increases the odds of being a vegetarian by about 1.5 compared to that of being married. The preference for cohabitation over marriage represents a lifestyle choice that may be correlated with vegetarianism.

Finally, as the number of people living in a household increases; the probability of being a vegetarian is reduced. This result is expected as almost 60% of all vegetarian adults live in one or two person households.

3.2. Meat consumption

Table 4 shows the results of an ordered logit model with which we investigate the factors associated with varying levels of meat consumption among children. The dependent variable represents the level of meat consumption in an average week and varies between 0 and 12. As stated previously, we do not observe every stage between 0 and 12. For this reason, we use an ordered logit as opposed to a count model. We employ the same explanatory variables as was the case in the vegetarian analysis. Again, we test for joint significance of the insignificant variables and the results of the parsimonious model are presented.

[Table 4 about here]

Asian children are seen to consume meat significantly fewer times per week than children of English origin whereas Black children and children of Chinese origin, especially, consume meat significantly more often. As expected, the odds ratio on female is significant and indicates that girls consume meat fewer times per week than boys. The odds ratio on age shows that for children, meat consumption, increases with age, which is to be expected. This is likely to be the case for any food group.

Children who get the required amount of physical activity per week eat meat more often than children who do not exercise enough. It may be that active children have a bigger appetite for meat products or, by exercising often, they can afford to incorporate a greater amount of relatively high fat foods into their diet (for a given weight), or that meat consumption provides the drive to exercise. Since we do not know the causal relationship between these two variables, we can only say for definite that there is a positive relationship between the two. Results also show that there is a negative correlation between weekly meat consumption and daily fruit and vegetable consumption.

Children living in London eat less meat than those in the reference category. These children are probably influenced, if not dictated, by their relatively well educated parents who realise the health concerns that are associated with eating large quantities of meat. Income also plays a role in the frequency of meat consumption. Children living in relatively high income households, earning between £70,001 and £80,000 a year, tend to eat significantly less meat than the children who live in households that earn £10,400 - £20,400 annually. As stated earlier, at extremely high income levels

excessive meat consumption can be a health concern. This finding is reinforced in this model by the odds ratio for the highest income earners. Children living in households that earn over £150,000 a year eat almost 60% more meat (if we are to believe that portions sizes are roughly the same in each sitting) than their counterparts in the reference category. A graph showing the relationship between household income and meat consumption among children can be seen in Figure A4 of the Appendix. From this graph it appears that the frequency of meat consumption is fairly stable across income levels.

Children living in households in which the reference person is a skilled manual worker eat meat more often than do the children of managerial/technical workers. It is possible that the social class variables are picking up some income effect here or it may be to do with tastes and preferences of these workers who, in turn, influence the eating habits of their children.

Finally, as household size increases so too does the frequency with which children consume meat. This may be due to the economies of scale associated with buying meat for big households. While the use-by date might be an issue for small households, this is less likely to be the case in bigger households and, thus, they may be inclined to buy meat more often. Also, it may be a characteristic of larger households that they are more prepared to take the time and effort to prepare a meal including meat when there are a larger number of people to share it with. Alternatively, family size may reflect aspects of social class not captured by other explanatory variables.

Table 5 shows the results of the model which investigates the factors associated with varying levels of meat consumption for adults.

[Table 5 about here]

Both the number of days per week an adult consumes alcohol as well as the number of units consumed on the adults heaviest drinking day in the last 7 days are positively associated with meat consumption. This may be partly due to the fact that those who eat large quantities of meat are less health conscious and enjoy consuming more alcohol than those who are concerned about their health. Again, the direction of causation is not known. This problem arises again with the bmi variable. The higher a respondent's bmi, the more meat that respondent is likely to consume and vice versa, as was the case in the vegetarian analysis.

As expected, ethnicity is strongly correlated with levels of meat consumption. Asians consume over 60% less meat than Whites while Blacks and respondents of mixed ethnic backgrounds consume significantly more. The odds ratio on female is consistent with that of the previous model while respondents who live in the South West of England consume meat on fewer occasions than those living in the South East. Since we control for income, education, social class and employment status, this result must be explained by some factor that we do not observe.

As was the case in the model looking at meat consumption among children, a high level of income proves statistically significant. This time we see that adults who live in households earning between £100,001 and £150,000 a year eat meat more often than those in the reference category. Not only can these people afford to buy meat for home consumption more often, it may also be the case that residents of these high income households eat in restaurants offering a large number of meat dishes more often than their poorer counterparts. This may also partly explain the positive association with alcohol consumption. Figure A5 in the Appendix shows the relationship between household income and meat consumption frequency among adults. Again, it is stable across income levels.

The education variables show that adults with any level of education above O level eat meat significantly more often than those with no educational qualifications. Marital status also plays a role in explaining varying levels of meat consumption. Single people eat less meat than married people, probably because they cannot avail of economies of scale in food expenditure and they may be less inclined to buy a lot of meat in case it reaches its use-by date before being consumed. Being divorced is also associated with a lower level of meat consumption. As stated previously, reducing or eliminating meat from the diet may be one of a number of lifestyle changes associated with divorce. Cohabiting couples also consume meat on fewer occasions than married people. Again, this could be explained by different lifestyle choices of those who opt to cohabit as oppose to marry. Individuals living in rented accommodation eat meat less often than mortgage holders. While this result may be explained simply by preferences, it is likely that adults who rent are likely to be younger and have a lower level of disposable income than those who opt to buy their own home. Finally, the odds ratio for household size is consistent with that of the previous model except the effect is even stronger for adults than it is for children.

Discussion and Conclusion

In this paper, we investigate the factors associated with vegetarianism at the individual level. We find that gender, ethnic origin, the region in which a person lives, their level of education and other lifestyle choices are all significantly associated with vegetarianism. Consistent across both the adult and child analyses are the findings that vegetarians are more likely to be female as opposed to male and Asian as opposed to White. The identification of causal relationships between some of the variables in our models and vegetarianism is constrained by the data. We are unable to correct for problems of simultaneity due to the lack of suitable instrumental variables and because the data are cross sectional. Also, due to data limitations, we cannot test the hypotheses that people become vegetarians for heath, environmental or animal welfare reasons.

We also investigate the factors driving the frequency of meat consumption. Only a few variables are found to be significant in the meat consumption analysis for both children and adults; being female and being Asian both negatively affect the level of meat consumed while Blacks are found to consume meat significantly more often than Whites. The household size variable is important for the level of meat consumed by both adults and children. The larger the household, the more often meat is consumed. It thus appears that there are economies of scale in food consumption and small households may be deterred from consuming meat as often because of the associated cost, limited life span of meat, or the effort required in preparation.

The U-shaped relationship between income and vegetarianism at the aggregate level does not exist at the micro level. It is neither the richest nor the poorest of households that have the highest levels of vegetarianism. Nevertheless, most adult vegetarians belong to households earning between £80,001 and £90,000 a year while most children live in households earning between £90,001 and £100,000, both well above the national average. We see that there is much more variation in the level of vegetarianism across income levels than there is in meat consumption frequency.

As expected, vegetarianism increases with education (37% of vegetarians are educated to degree level or higher) while for those that do eat meat, respondents who discontinued education after A levels are the most frequent consumers. This is probably because the well educated are aware of the health and environmental benefits that are associated with a low meat, if not a meat free, diet.

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Table 1. Descriptive Statistics

Dependent variables	Description	Obs	Mean	Std. Dev.	Min	Max
vegetarian	1 if vegetarian, 0 if not	17,684	0.04	0.19	0	1
meatlevel	level of meat consumption	17,684	4.46	1.73	0	12
Explanatory Variables						
hhsize	Size of household in which respondent lives	17,684	3.19	1.44	1	12
otherveg	The number of other vegetarians living in the household	17,684	0.02	0.19	0	4
age	Age of respondent	17,684	33.21	24.80	2	97
bmi	Body mass index (kg/m^2) of respondent	15,667	23.89	6.33	9.88	65.83
fruitveg	The number of portions of fruit and vegetables consumed per day	16,189	4.12	2.21	0	9
daysdrink	The number of days a week respondent consumes alcohol	10,578	2.14	2.33	0	7
unitsday	The number of units of alcohol consumed on the heaviest drinking day in previous week	6,896	6.31	6.11	0	73.50
smoker	1 if respondent smokes cigarettes or a pipe daily, 0 if not	10,605	0.27	0.44	0	1
adequateactivity	1 if respondent gets adequate exercise, 0 if not	17,684	0.32	0.47	0	1
ondiet	1 if child is trying to lose weight, 0 if not	4,138	0.24	0.43	0	1
illness	1 if respondent suffers from at least one long term illness, 0 if not	17,684	0.36	0.48	0	1
female	1 if female, 0 if male	17,684	0.53	0.50	0	1

Variable	Description	Freq	%
Geo type of dwelling unit			
urban_1 (reference category)	Urban	14,141	79.96
urban_2	Town & fringe	1,691	9.56
urban_3	Village, hamlet and isolated dwellings	1,852	10.47
Tenure			
tenure_1	Owned outright	4,180	23.69
tenure_2 (reference category)	Mortgage holder	8,224	46.61
tenure_3	Share ownership scheme	97	0.55
tenure_4	Renting	5,007	28.38
tenure_5	Rent free	136	0.77
Region			
region_1	North East	1,101	6.23
region_2	North West	2,552	14.43
region_3	Yorkshire and Humber	1,920	10.86
region_4	East Midlands	1,656	9.36
region_5	West Midlands	1,702	9.62
region_6	East of England	1,986	11.23
region_7	London	2,056	11.63
region_8 (reference category)	South East	2,872	16.24
region_9	South West	1,839	10.4

Variable	Description	Freq	%
Education level			
educlevel_1	Degree or higher	2,105	19.86
educlevel_2	Higher education below degree	1,216	11.47
educlevel_3	A level	1,534	14.47
educlevel_4	O level	2,300	21.7
educlevel_5	Other	535	5.05
educlevel_6	Foreign educational qualifications	193	1.82
educlevel_7 (reference category)	No educational qualifications	2,718	25.64
Economic status			
econstat_1 (reference category)	In employment	5,770	54.45
econstat_2	Unemployed	463	4.37
econstat_3	Retired	2,756	26.01
econstat_4	Other	1,607	15.17
Marital status			
maritalstat_1	Single	1,870	17.63
maritastat_2 (reference category)	Married	5,749	54.21
maritalstat_3	Civil Partnership	3	0.03
maritalstat_4	Separated	228	2.15
maritalstat_5	Divorced	744	7.02
maritalstat_6	Widowed	858	8.09
maritalstat_7	Cohabiting	1,153	10.87
Social status of the respondent			
socialstat_1	Professional	546	5.15
socialstat_2 (reference category)	Managerial/technical	3,216	30.36
socialstat_3	Skilled non-manual	2,348	22.17
socialstat_4	Skilled-manual	1,684	15.9
socialstat_5	Semi-skilled manual	1,708	16.12
socialstat_6	Unskilled manual	518	4.89
socialstat_7	Armed forces	22	0.21
socialstat_9	Full time student	259	2.45
socialstat_10	Other	292	2.76
Social status of the household reference person			
socialHRP_1	Professional	1,247	7.08
socialHRP_2 (reference category)	Managerial/technical	6,383	36.22
socialHRP_3	Skilled non-manual	2,630	14.92
socialHRP_4	Skilled-manual	3,713	21.07
socialHRP_5	Semi-skilled manual	2,306	13.08
socialHRP_6	Unskilled manual	744	4.22
socialHRP_7	Armed forces	86	0.49
socialHRP_9	Full time student	67	0.38
socialHRP_10	Other	449	2.55
Number of employees in workplace			
workplace_1	1 or 2	448	4.94
workplace_2	3-24	2,971	32.75
workplace_3	25-499	4,028	44.41
workplace_4	500+	1,624	17.9
Ethnicity			
White (reference category)	White British, Irish or other	15,582	88.27

Variable	Description	Freq	%
Black	Black	489	2.77
Asian	Asian excluding Chinese	1,031	5.84
Chinese	Chinese	54	0.31
Mixed	Mixed ethnic backgrounds	398	2.25
Other	Any other ethnic origin	98	0.56
Household income			
hhinc_1	< £10,400	2,135	14.72
hhinc_2 (reference category)	£10,400 - £20,400	3,401	23.45
hhinc_3	£20,401 - £31,200	2,538	17.50
hhinc_4	£31,201 - £41,600	1,897	13.08
hhinc_5	£41,601 - £52,000	1,611	11.11
hhinc_6	£52,001 - £60,000	764	5.27
hhinc_7	£60,001 - £70,000	566	3.90
hhinc_8	£70,001 - £80,000	487	3.36
hhinc_9	£80,001 - £90,000	200	1.38
hhinc_10	£90,001 - £100,000	231	1.59
hhinc_11	£100,001 - £150,000	463	3.19
hhinc_12	> £150,000	210	1.45

Table 2: Determinants of vegetarianism among children

	Odds Ratio	Std. Err.	z	P>|z|
fruitveg	1.17	0.06	3.11	0.002***
ondiet	1.53	0.36	1.83	0.067*
female	3.02	0.77	4.33	0***
asian	3.02	0.93	3.59	0***
socialHRP_5	1.64	0.47	1.74	0.082*
hhinc_5	1.83	0.56	1.96	0.05**
region_4	2.15	0.67	2.44	0.015**
Number of obs	3394			
LR chi2(7)	58.76			
Prob > chi2	0			
Pseudo R2	0.072			
Pearson chi2(254)	231.37			
Prob > chi2	0.8427			

Table 3. Determinants of vegetarianism among adults

	Odds Ratio	Std. Err.	z	P>|z|
fruitveg	1.18	0.03	6.38	0***
adequateactivity	1.23	0.15	1.7	0.089*
bmi	0.95	0.01	-3.85	0***
smoker	1.39	0.19	2.37	0.018**
age	0.98	0	-3.72	0***
female	2.12	0.28	5.8	0***
asian	4.24	0.81	7.55	0***
workplace_2	1.66	0.37	2.25	0.024**
region_3	0.6	0.15	-2.01	0.044**
region_4	1.63	0.29	2.76	0.006***
region_7	1.98	0.31	4.41	0***
educlevel_1	1.95	0.26	5.04	0***
educlevel_2	1.46	0.27	2.01	0.044**
maritalstat_5	1.42	0.3	1.66	0.097*
maritalstat_7	1.48	0.25	2.37	0.018**
hhsize	0.83	0.04	-3.53	0***
Number of obs	8163			
LR chi2(16)	327.97			
Prob > chi2	0			
Pseudo R2	0.1192			
Pearson chi2(8146)	8254.36			
Prob > chi2	0.1975			

Table 4. Factors influencing levels of meat consumption among children

	Odds Ratio	Std. Err.	z	P>|z|
asian	0.54	0.07	-5.06	0***
black	1.66	0.27	3.12	0.002***
chinese	3.56	1.73	2.62	0.009***
female	0.82	0.04	-3.68	0***
age	1.02	0.01	1.78	0.076*
adequateactivity	1.14	0.07	2.2	0.028**
fruitveg	0.98	0.01	-1.58	0.114
region_7	0.82	0.07	-2.17	0.03**
hhinc_8	0.73	0.1	-2.17	0.03**
hhinc_12	1.58	0.3	2.39	0.017**
socialHRP_4	1.16	0.08	2.26	0.024**
hhsize	1.06	0.03	2.19	0.029**
Number of obs	4597			
LR chi2(12)	95.61			
Prob > chi2	0			
Pseudo R2	0.0059			
AIC	16104.8 1			
BIC	6246.32			

Table 5. Factors influencing levels of meat consumption among adults

	Odds Ratio	Std. Err.	z	P>|z|
unitsday	1.02	0	4.23	0***
daysdrink	1.03	0.01	2.48	0.013**
bmi	1.02	0.01	4.06	0***
asian	0.36	0.09	-4.32	0***
black	1.5	0.35	1.72	0.086*
mixedrace	1.92	0.51	2.45	0.014**
female	0.87	0.05	-2.7	0.007***
region_9	0.84	0.07	-2.25	0.025**
hhinc_11	1.27	0.18	1.72	0.085*
educlevel_1	1.15	0.08	1.93	0.054*
educlevel_2	1.3	0.11	3.05	0.002***
educlevel_3	1.46	0.12	4.47	0***
educlevel_4	1.28	0.1	3.32	0.001***
maritalstat_1	0.77	0.06	-3.3	0.001***
maritalstat_5	0.67	0.07	-3.86	0***
maritalstat_7	0.87	0.07	-1.82	0.069*
tenure_4	0.84	0.06	-2.62	0.009***
hhsize	1.17	0.03	7.34	0***
Number of obs	5264			
LR chi2(18)	245.01			
Prob > chi2	0			
Pseudo R2	0.0139			
AIC	17407.51			
BIC	17591.43			

Appendix
Figure A1. Vegetarianism over time in the UK

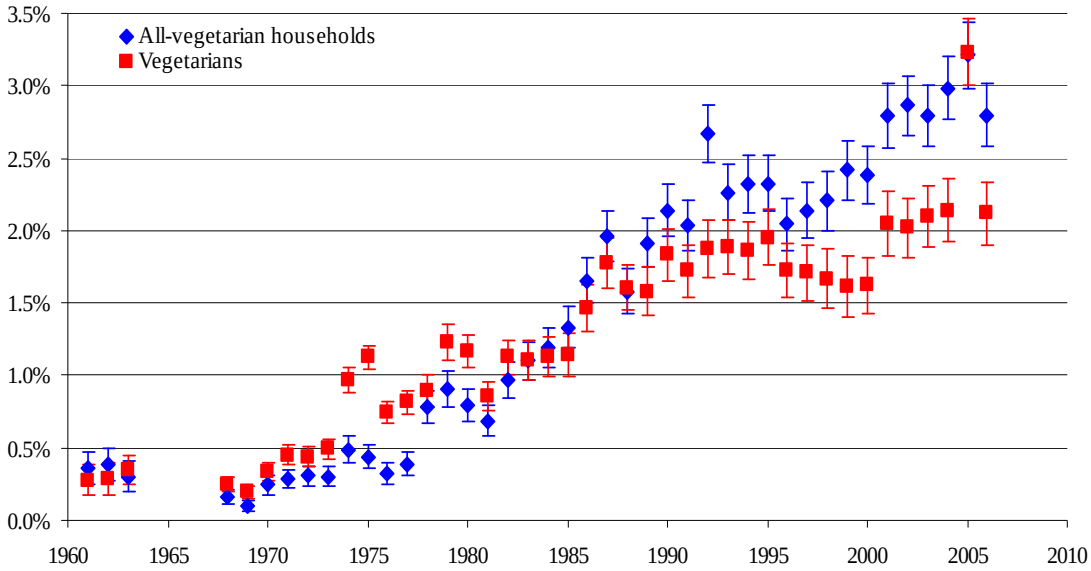


Figure A2. Vegetarianism across income levels: Children

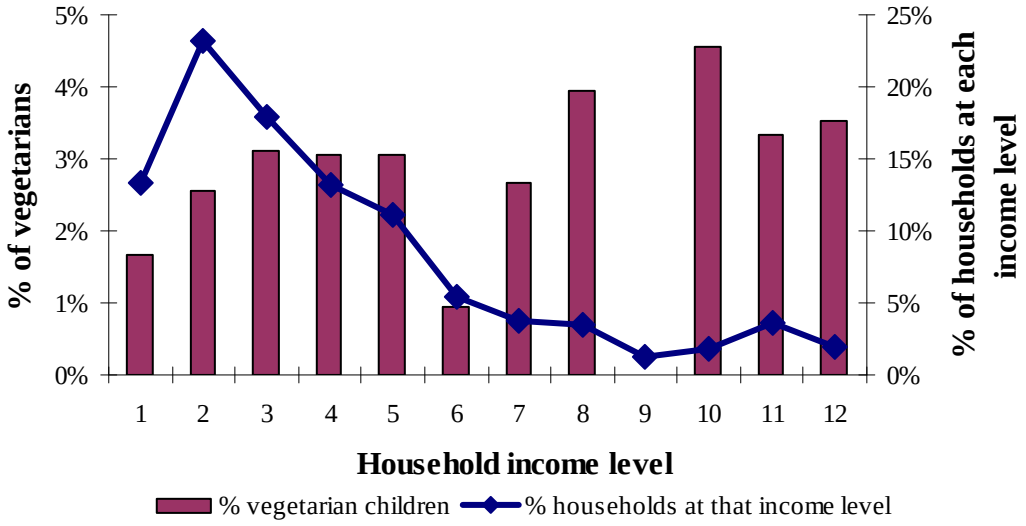


Figure A3. Vegetarianism across income levels: Adults

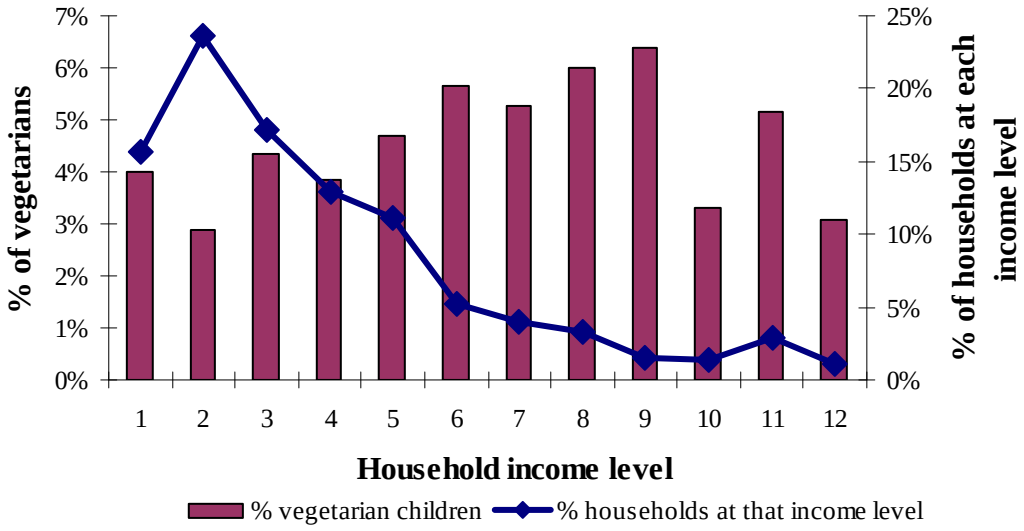


Figure A4. Meat consumption frequency across income levels: Children

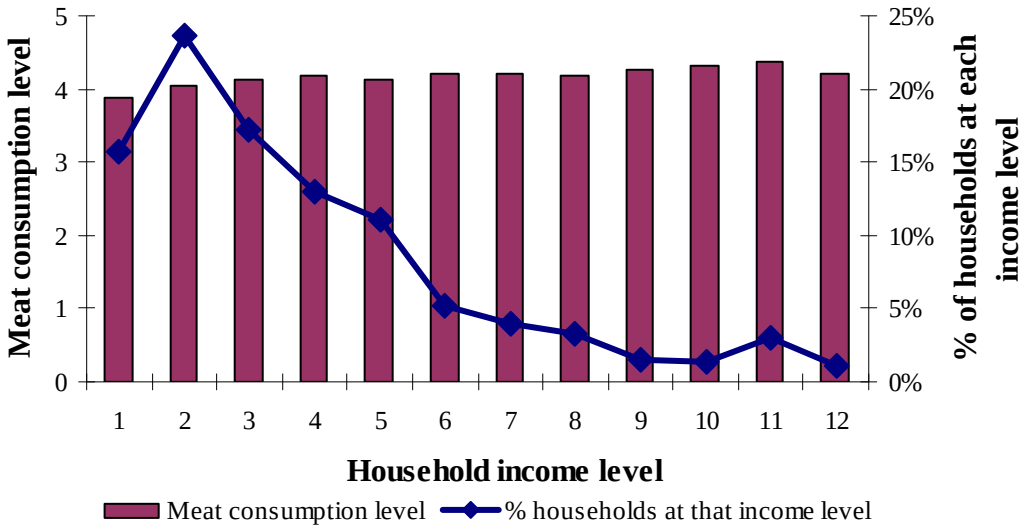
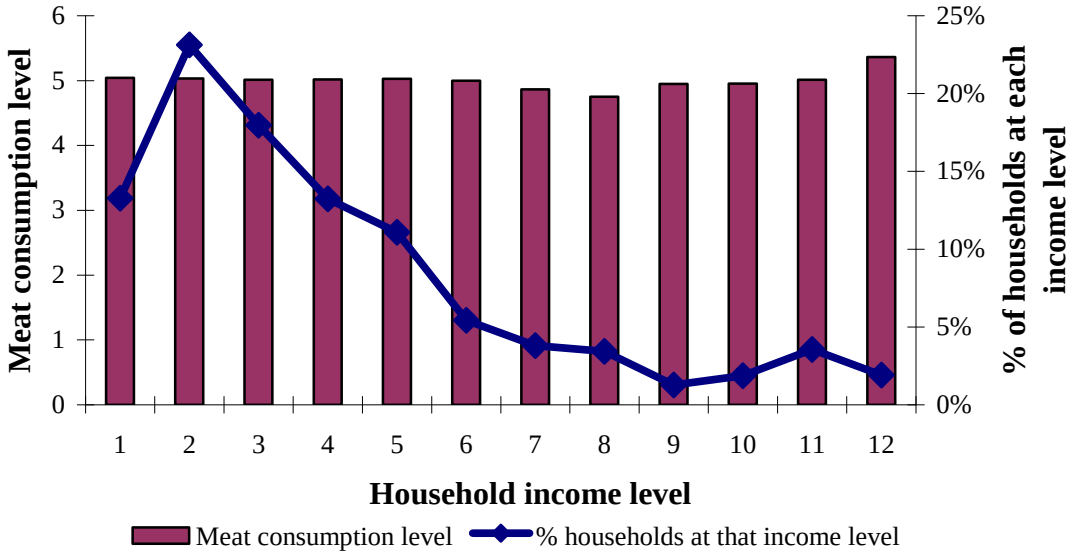


Figure A5. Meat consumption frequency across income levels: Adults



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