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Attitudes to meatless meals: a comparison of the general public and those with links to the agricultural economy.

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Attitudes to meatless meals in the North East of Scotland: a comparison of the general public and agricultural workers.

Abstract

Introduction Adopting meat reduction strategies within the United Kingdom (UK) is fundamental to limiting environmental damage and achieving public health benefits. This study aimed to compare the attitudes to adopting meat reduction strategies within the general population and people with a link to agriculture to understand attitudes to meat reduction.

Methods Cross sectional self-administered questionnaires were disseminated using online fora, community groups and by attending agricultural marts. Questionnaire development was informed by current literature, and structured around four theoretical domains – knowledge, social/cultural influences, beliefs about consequences and intentions to change and a food frequency questionnaire for meat consumption. Inclusion criteria were people > 18 years, living in the North East of Scotland. 470 adult participants, from within the North East of Scotland, were recruited. The study population was divided into two groups, individuals with a link to the agricultural economy (n=174) and the general public (n=296).

Results. The 'general public' group were more willing than the agricultural community to adopt meatless meals (or were doing so) (55.1% (n=162) vs 28.1% (n=49), $p < 0.001$). Barriers to change included habit, limited choice when eating out, resistance of family members, lack of information, income related to meat consumption and the status of meat within a meal. Men were less likely to choose meatless meals than women (23.8%, n=36, vs 55.1%, n=176), $p < 0.001$).

Conclusion Meat reduction strategies should be tailored appropriately to population groups, with an understanding of social and political drivers, and further studies investigating barriers within the agricultural economy are warranted.

Key Words: Attitudes: Barriers: Meatless Meals: Agricultural Economy: General Public

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4 Abbreviations: GHGE: Green House Gas Emissions; SACN: Scientific Advisory Committee on
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6 Nutrition; NHS: National Health Service; RGU: Robert Gordon University; WWF: World Wildlife
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8 Fund; BMI: Body Mass Index; NDNS: National Diet and Nutrition Survey; DEFRA: Department
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10 for Environment, Food and Rural Affairs.
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15 Within the UK it is estimated that approximately 19% of annual Green House Gas
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17 Emissions (GHGE) are attributable to the food supply chain (Garnett 2008), consistent with other
18
19 developed countries. Meat (in particular ruminant meat) and dairy products contribute most
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21 significantly to GHGE within the food supply chain and recommendations have been made to
22
23 decrease dietary intakes of these products in order to reduce the GHGE. However, a growing world
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25 population and rising affluence worldwide means that global demand for livestock products is
26
27 increasing and is set to grow by 70% between 2005 and 2050 (Food and Agriculture Organisation
28
29 2013). In addition, recommended changes in the diet in relation to sustainability must also take into
30
31 consideration any nutritional implications and ensure that there are no negative health
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33 consequences, for example to iron status (McDiarmid 2013).
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36 McDiarmid et al (2011) in collaboration with the World Wide Fund for Nature (WWF), developed
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38 the 'Livewell' guide, using the original 'Eat well plate' intended as a starting point for assisting
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40 individuals to understand the concept of a healthy, sustainable diet. This adapted model shows that
41
42 our diets will only require small changes from the current guidelines to meet these targets. Despite
43
44 this work, no healthy and sustainable dietary guidelines, and no policies supporting consumer
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46 behaviour change have been formally published within the UK (Dibb and Fitzpatrick 2014).
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49 Campaigns promoting a reduction in meat consumption remain limited (Laestadius, Neff, Barry and
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51 Frattaroli 2013) and often developed by organisations such as Meat Free Mondays.
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54 There is a scarcity of studies which directly explore the attitudes of individuals towards
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56 meatless meals and meat reduction and current research on the subject remains limited within the
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3 UK. McDiarmid, Douglas and Campbell (2016) carried out research into public perspectives and
4 understanding of meat consumption in both rural and urban areas in Scotland, and suggested that
5 there is a lack of awareness of the association between meat consumption and climate change, and
6 little willingness to change eating habits, with many describing the social, cultural and pleasurable
7 aspects of meat eating. However, a study conducted in the Netherlands, the population of whom
8 have similar meat consumption per capita to the UK (FAO 2013), suggested that exploring attitudes
9 to meat consumption and meatless meals is necessary to appropriately tailor behavioural change
10 strategies to specific populations (De Boer, Schösler and Aiking 2014). Factors influencing
11 change included limited meatless options when eating out, resistance of self or family to alter their
12 current dietary intake and the taste and pleasure associated with meat consumption (Lea, Crawford
13 and Worsley 2006; Schösler, De Boer and Boersema 2012). De Boer, Schösler and Aiking also
14 suggested that involving commercial stakeholders e.g. food manufacturers and retailers in future
15 research is important as they may act as facilitators of, or barriers to, modifications in meat
16 consumption. A limitation of this study was that it was unable to focus attention to the role of male
17 or female sex in relation to attitudes to meat reduction strategies.

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Meat production is an important industry in Scotland with the red meat industry generating
revenues of over £2 billion in 2013 from the farming and processing of red meat (Quality Meat
Scotland 2014). The Scottish Red Meat Industry profile also reported that 1% of Scotland's labour
force are employed in beef cattle, sheep and pig rearing and it is estimated that 250,000 jobs are
dependent on the agricultural sector within Scotland (National Farmers Union of Scotland 2015).
This study was carried out in the North East of Scotland which is primarily an agricultural region,
and meat production, mainly beef, is important to the local economy.

In the UK, meat has a special status in society, forming an integral part of the structure of meals
(Douglas 1972) and is linked firmly to cultural identity (Bows 2012). Indeed, it has been argued
that the term 'meatless meal' only makes sense if we assume that all meals contain meat (Heinz

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3 and Lee 1998).

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5 The aim of this study was to investigate attitudes and barriers to meat reduction strategies in an
6
7 agricultural economy in comparison to attitudes to meat reduction strategies in the general public
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9 within the North East of Scotland.
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11 12 13 14 15 16 17 18 **Methods**

19 20 21 22 *Survey Design*

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26 A cross sectional self-administered questionnaire was developed to include information on
27
28 demographics, knowledge of and attitudes to meat eating, and willingness to change. Demographic
29
30 information collected consisted of open and closed questions determining sex, age range, location,
31
32 education level achieved, and if the participant was a meat eater or a non-meat eater. In this section
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34 participants were also asked if they or an immediate family member had ever been primarily
35
36 dependent on agriculture for their household income and if so were asked for further information.
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40 The self-administered questionnaire was informed by current literature De Boer, Schösler
41
42 and Aiking (2014), and used the Theoretical Domains Framework (Michie et al 2005). Four
43
44 domains were investigated: around knowledge (about plant based diets and preparing meatless
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46 meals, perceived benefits of consuming meatless meals, including environmental benefits, and
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48 awareness of the term 'sustainable and healthy diet), social or cultural influences (e.g. reluctance of
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50 study participant or their partner/family to eat meatless meals, perception of meat eating being
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52 associated with masculinity, meatless meals being unacceptable within the respondent's culture),
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54 beliefs about consequences (e.g. nutritional content being lower in meatless meals, meatless meals
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3 being less satisfying, meatless meals being more expensive than those containing meat). The final
4 domain was intentions, which used a Stages of Change model (Prochaska and Di Clemente) to
5 assess participants' willingness to consume more regular meatless meals.
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9 A food frequency question was used to investigate the frequency with which individuals consumed
10 red meat and meat substitutes using a nine point scale (0= rarely/never, 1=1-3 times per week,
11 2=once/week, 3=2-4 times per week, 4=5-6 times per week, 5=once/day, 6=2-3 times per day 7 =
12 4+ per day, 8=6 + per day) (Cade et al 2001) and collapsing the higher frequency end, as we felt
13 that there was little likelihood of people consuming meat over 6 times per day. We did not ask
14 about portion size.
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22 The topic of meat substitution was introduced with the question "Do you choose to eat
23 meatless meals instead of meat containing meals on a regular basis?" The possible answers were
24 "yes" and "no". All participants were then asked "If you were to choose a meatless meal, would you
25 replace the meat with something?" The answers were "yes" and "no", followed by an open ended
26 question, "if yes, what would you substitute the meat with?"
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33 A paper-and-pencil version of the survey was initially developed and subsequently adapted
34 using an online tool (SurveyMonkey Inc., Palo Alto, California, USA. www.surveymonkey.com).
35 Twenty individuals from the agricultural economy and the general public completed the pilot
36 survey for face and content validity, and following this, minor adjustments were made to the
37 wording to ensure understanding and to the formatting. Ethical approval for this study was granted
38 by the School of Pharmacy and Life Sciences Ethical Committee, Robert Gordon University,
39 Aberdeen.
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52 *Sample population and recruitment*
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3 The geographical area of Aberdeen City and Aberdeenshire (including Morayshire) was
4 used to define the population surveyed. The sample size estimates were based on the population
5 of NHS Grampian of 472,320 (Scotland's Census 2011). Assuming a Confidence Level of 95%
6 and a confidence interval of 5% -7%, we aimed to recruit between 196 and 384 participants to each
7 group. Convenience sampling was used, with the survey posted on various online fora (Young
8 Farmers Groups, church and youth groups), encompassing those from both the agricultural
9 economy and the general public in order to obtain a wide, stratified sample. Paper-and-pencil
10 versions of the survey were also distributed within various community groups (eg luncheon clubs
11 and church groups) and at Farmers Markets and agricultural marts across the region. Permission
12 from the organisers of the Farmers Markets and community groups was granted through email and
13 telephone communication. Written survey data collection method was non-interviewer led, with
14 the researcher collecting completed questionnaires from study participants on site. Participation was
15 voluntary, individuals aged ≥ 18 living in the Aberdeen City or Shire area were eligible to complete
16 the survey and all information collected was confidential and anonymous. An information sheet was
17 included in the questionnaire, and consent from participants was assumed on submission of their
18 completed survey. The survey was accessible for three weeks in March 2015.

41 *Data analysis*

42 Quantitative data was assessed for normality using the Kolmogorov-Smirnov test ($P < 0.05$)
43 and was analysed using non-parametric tests. Responses were compared based on the following
44 groupings; agricultural economy, general public, sex, education level achieved and age category.
45 Mann Whitney U tests, Kruskal-Wallis H tests were conducted to establish if there was a significant
46 difference between the responses obtained between different groups in relation to ordinal scale data.
47 Chi-squared test for independence was used for analysing and comparing the non-ordinal scale data.
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3 A Spearman's rank-order correlation was used to analyse associations between frequency of red
4 meat consumption and willingness to adopt regular meatless meals. Post-hoc testing methods were
5 employed where appropriate. A P value <0.05 was considered significant for all statistical analyses.
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7 Responses to the open questions were thematically analysed using the method described by Braun
8 and Clarke (2006).
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13 14 15 16 **Results**

17 18 19 20 *Response*

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22 In total, 300 online surveys and 188 paper-and-pencil copies were collected. Incomplete
23 surveys and surveys completed by individuals not residing within the NHS Grampian board were
24 disregarded resulting in 470 responses for analysis, of whom 37% had a link to the agricultural
25 economy (n=174) and 63% general public (n=296). To explore variation in the total sample,
26 participants were classified according to whether they had a self-reported immediate link to the
27 agricultural economy or not. Table 1 describes the demographic information of the participants.
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40 41 42 43 *Perceived attitudes and barriers*

44 A comparison of responses between participants with an immediate link to the agricultural
45 economy and the general public was conducted and is displayed in Table 2. A significant difference
46 ($P<0.05$) was found for all of the statements except for one regarding a lack of availability of
47 meatless options when eating out. A comparison of the responses obtained to the thirteen
48 statements between the variable sex was also carried out and the results are displayed in Table 2.
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Willingness to adopt regular meatless meals and meat substitution practices.

A comparison of the self-evaluation of participants, from the agricultural economy and the general public groups, of their willingness to consume more regular meatless meals was conducted. There was a significant difference, $X^2 P < 0.001$, with 54.8% (n= 162) of the general public more likely to be willing to consider regular consumption of meatless meals or already doing so vs 28.1% (n=49) of those from the agricultural economy. The relation between sex and willingness to eat more regular meatless meals was examined and indicated a significant difference, ($P < 0.001$), with 55.5% (n=176) of women more likely to be willing to adopt regular meatless meals or already doing so, than men (23.8%, n=36). The relationship between frequency of red meat consumption and willingness to adopt a regular meatless meal was investigated. There was a strong, positive correlation between the two variables, $r = 0.53$, $n = 442$, $p < 0.001$, with high levels of red and processed meat consumption associated with participants being less willing to consider adopting regular meatless meals.

Participants were also asked if they chose to eat a meatless meal instead of a meat containing meal on a regular basis. A significant difference in the responses from individuals with a link to the agricultural economy and the general public was found, ($P < 0.001$) with participants from the general public more inclined to do so (34.5%, n=95) in comparison to participants with a link to the agricultural economy (14.6%, n=24).

Participants were asked whether they deliberately substituted meat with an alternative, if they were to choose a meatless meal. Common substitution options amongst participants who deliberately substituted meat (n=234) were QuornTM (25.8%), pulses (18.6%), eggs (18.2%) and vegetables (16.7%). Items which were mentioned less often included (<21%) cheese, fish, soya, tofu, nuts, seeds and quinoa.

Over half (52%, n=244) of individuals surveyed, rarely/never consumed meat substitutes.

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3 The results were compared between the agricultural economy group (n=166) and the general public
4 group (n=278) and revealed a statistically significant difference, $P<0.001$, between the two groups,
5 with individuals from the general public group more likely to consume meat substitutes. Women
6 (n=297) were also significantly more likely to consume meat substitutes in comparison to men
7 (n=146), $P<0.001$. Lack of knowledge about plant based diets or meal preparation was perceived to
8 be a problem for all groups.

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16 Lack of knowledge of preparing appropriate meatfree meals was identified as a barrier for
17 both the agricultural economy vs the general public and for men vs. women in both groups.

21 22 23 24 *Health consequences associated with high and low meat consumption*

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29 High dietary meat consumption was considered to have negative health consequences by
30 57.4% of individuals (n=270). Consumption of a diet low in meat was considered to have negative
31 health consequences by 38.5% of individuals (n=181). No significant difference was found in the
32 responses obtained from the agricultural economy group and the general public in relation to the
33 negative health consequences associated with high or low meat consumption ($P>0.05$). A
34 significant association between highest level of education achieved and awareness of the negative
35 health consequences associated with high meat consumption, $P<0.001$, was found. 70.7% (n=59) of
36 individuals with their highest level of education being a postgraduate degree were aware of this
37 association in comparison to 37.1% (n=46) of individuals with secondary school education being
38 their highest level of education.

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5 A significant association was revealed between having a link to the agricultural economy or
6 not and familiarity with the concept of a sustainable and healthy diet, $X^2 (1, n=470), P=0.036$, with
7 50.8% of the general public group demonstrating familiarity in comparison to 40.2% of participants
8 with a link to the agricultural economy. A significant association was also found between the
9 variable sex and being familiar with the concept $X^2 (1, n=469), P=0.011$, with 51.1% of women
10 demonstrating familiarity in comparison to 38.2% of men. No significant difference was
11 demonstrated in relation to education level achieved and familiarity with the concept, with 46.8% of
12 the total sample being familiar.
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26 *Qualitative comments*

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31 Within the demographic section of the survey individuals were asked if they or an
32 immediate family member had ever been primarily dependent on a form of agriculture for their
33 household income. Participants with an immediate link to the agricultural economy described ways
34 in which their attitude to meat consumption has been influenced by their link to the agricultural
35 economy. Content analysis was conducted and recurrent themes identified. The most common
36 theme identified was that meat forms an integral part of meals (n=32). For instance comments
37 included “*Meat is part of every main meal and a main meal isn't acceptable if it doesn't contain*
38 *meat*” #370 and “*Meat has always been a staple part of meals*” #321. The themes ‘understand
39 where meat comes from’ (n=28), ‘expect quality produce’ (n=23) and ‘buying locally produced
40 meat’ (n=20) were also important. ‘Income is influenced by consumer’s meat consumption’ (n= 20)
41 was another theme identified. One of the comments included “*My family are all livestock farmers*
42 *so meat consumption and the demand from the general public directly influence our income and*
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3 *therefore living” #311.*

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5 For the participants who answered ‘yes’ to consuming regular meatless meals (general public and
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7 those within the agricultural economy) an open ended question followed, which was used to
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9 investigate their reasons for doing so. The main recurrent themes from participants who chose
10
11 regular meatless meals were, that participants ‘followed a vegetarian diet’ (n=24), for ‘health
12
13 reasons’ (n=25), ‘taste of meatless meals’ (n=14), ‘varies the diet’ (n=12) and ‘help the
14
15 environment’ (n=10). One of the comments included “.....adds variety to our diet” #167.
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22 **Discussion**

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26 This study involved individuals with links to the agricultural economy; a group who may
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28 have barriers to changes in the consumption of meat (De Boer, Schösler and Aiking, 2014). The
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30 authors are not aware of any similar study, and our study shows that this group have a vested
31
32 interest in the meat industry, linked with habit, the cultural significance of eating meat, income and
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34 the status of meat within a meal, evident from an analysis of the qualitative and quantitative data
35
36 gathered. Unsurprisingly, when individuals from the agricultural economy group described ways
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38 in which their link to agriculture influences their meat consumption, ‘income influenced by
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40 consumer’s meat consumption’ was one of the themes identified. The importance of income may
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42 act as a barrier to consuming or promoting meatless meals. Ensuring that individuals within the
43
44 agricultural economy are aware of the farm diversification options such as renewable energy,
45
46 leisure and recreation and novel and non-food crops (Scotland’s Rural College 2015a), is important.
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48 Educating individuals in relation to optimising livestock management is also important. These
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50 alternatives can contribute to reducing GHGEs, in addition to diversifying agricultural enterprises
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52 within Scotland. The methods outlined can be marketed as ways to overcome concerns about
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3 generating income, if consumers were to reduce meat consumption. This could contribute to gaining
4 the support and active participation from these commercial stakeholders which has been highlighted
5 by De Boer, Schösler and Aiking (2014) as being important.
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9 The questions designed to ascertain participant's knowledge of the benefits associated with
10 eating meatless meals, yielded interesting results. An observation made by Lea, Crawford and
11 Worsley (2006) in an Australian study into public views on the barriers and benefits of a plant
12 based diet, concluded that individuals had a high awareness of the benefits of eating meatless meals,
13 particularly the health-related benefits such a reduced saturated fat intake, the prevention of diseases
14 and an increase in fibre intake. This is reflected within the present study (Table 2). However our
15 study confirms that a substantial number of participants are not aware of the environmental benefit
16 of reducing meat consumption and choosing meatless meals in line with previous studies, (De
17 Boer, Schösler and Aiking, 2014; Truelove and Parks, 2012), and a survey conducted by Garnett,
18 Mathewson, Angelides and Borthwick (2015) suggested that while 83% of those surveyed people
19 agreed that human activity impacts on climate change, less than a third identified meat and livestock
20 production as a contributory factor. Higher educational level was linked with a significantly greater
21 awareness of the health implications associated with high dietary meat consumption when
22 compared to participants with a lower educational achievement, but there is a need for awareness
23 raising campaigns and the provision of information, outlining the implications that meat and dairy
24 production have on the environment, which may contribute to changing consumer behaviour
25 (Taylor, 2012).
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46 People within the agricultural economy were less inclined to perceive 'improve animal welfare' as
47 a benefit to consuming meatless meals. This may be related to the high animal welfare standards
48 within Scotland under the legislation of the Animal Health and Welfare (Scotland) Act 2006, which
49 individuals with an immediate link to the livestock agricultural industry may have greater
50 awareness of in comparison to the general public (Stoll-Kleeman and Schmidt 2017).
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3 An observation made by DEFRA (2011) identified cost as one of the barriers to purchasing
4 sustainable products. It was interesting that in the present study neither of the two main groups of
5 participants perceived saving money as a benefit to consuming meatless meals despite WWF's
6 Livewell project indicating that shifting dietary patterns towards meatless meals provides the
7 consumer with the opportunity to save money. Meat reduction strategies should ensure that the
8 benefits to consuming meatless meals (including cost benefits) outweigh the barriers (Lea,
9 Crawford and Worsley, 2006).

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12 It was apparent from our study that beliefs about the status of meat in the diet and meat as a
13 staple in the diet appear to be more ingrained within the agricultural economy group in comparison
14 to the general public. However, statements relating to cultural acceptability of meatless meals
15 suggested no difference between the two main groups, with the majority of participants
16 disagreeing/strongly disagreeing with the statement regarding the non-acceptability of meatless
17 meals within the participant's culture.

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20 Meat has a special status within the diet and society (DEFRA 2011), and is historically
21 linked with the structure of meals (Douglas 1972), and in our study those consuming ≥ 1 portion of
22 red and processed meat per day showed resistance to consuming regular meatless meals. This group
23 of participants present as the greatest challenge for future meat reduction and health promotion
24 strategies.

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27 'Meat is associated with masculinity' was a statement with which a substantial proportion
28 of participants strongly agreed or agreed when asked as part of the Likert scale series of statements
29 (Table Men reported significantly greater difficulties with choosing meatless meals and meat
30 substitutes. The results reflect those found in similar studies and confirm that men are less willing to
31 reduce their meat consumption and consider consuming more regular meatless meals when
32 compared with women as has been demonstrated (Fieldhouse 1986). The findings reinforce the
33 theory explored by existing literature; that this pattern may reflect the statement that "meat is
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3 traditionally associated with masculinity” (Tobler et al 2011, Roos, Prattala and Koski, 2001).
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5 Table 2 displays the Likert series of statements with the lowest median values for the entire
6 series related to the statement that meat is a staple in the diet. A significant difference was noted
7 between the two main groups and between men and women. Participants were asked about
8 choosing a meatless meal and those who responded positively were then questioned whether they
9 would substitute the meat with an alternative. The largest proportion of participants (25.8%)
10 reported that they would substitute the meat with QuornTM and (18.2%) with eggs. These substitutes
11 often preserve the traditional meal format (Schösler, De Boer and Boersema 2012) and potentially
12 more attention should be paid to minimally processed meat substitutes, eg peas, beans and lentils, in
13 provision of information about meat substitution strategies. Taylor (2012) suggested that meat
14 substitutes are suitable as an alternative when transitioning to a reduced meat diet, however, for
15 these substitutes to be successful they are required to be aesthetically similar to meat in a dish. With
16 52% of individuals within the present study rarely or never consuming meat substitutes, it is in the
17 interest of the food industry to supply products which appeal to the consumer and to provide
18 appropriate product information to the consumer (De Boer, Schösler and Aiking 2014). Our study
19 suggested that a large proportion of individuals would be more likely to increase their intake of
20 meatless meals if they were given the information, recipes and knowledge of simple ways of
21 preparing meatless meals. This finding is of particular importance to health professionals, health
22 promotion workers and the food industry as it emphasises the need to appropriately educate the
23 general population in relation to meatless meals, in order to promote their consumption. However, it
24 should be noted that provision of information does not necessarily translate to dietary behaviour
25 change.
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50 A substantial percentage of participants reported concerns with the perceived negative
51 health consequences associated with low dietary intake of meat and Millward and Garnett (2010)
52 reported that reducing meat consumption creates nutritional challenges for certain nutrients such as
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3 iron. We did not explore specific concerns, but previous authors have suggested that iron and
4 protein intakes may be compromised by following a meat free diet. Dibb and Fitzpatrick (2014)
5 acknowledge this as an opportunity to inform and educate individuals on the nutritional adequacy of
6 alternative protein sources, reduced meat consumption and the increased intake of meatless meals,
7 which has the potential to address these types of health concerns.
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14 Dibb and Fitzpatrick (2014) suggested that young people are more inclined to be non-meat
15 eaters, potentially indicating a generational shift in attitudes and behaviours towards meat
16 consumption. However, this sample of individuals within the North East of Scotland do not appear
17 to show a generational shift towards reducing meat consumption and increasing the intake of
18 meatless meals, with no significant difference between age categories ($P>0.05$).
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25 This study did not address the question of consuming ‘less but better’ meat because in
26 practice there is no clear evidence or understanding of what ‘better’ meat production method is
27 (Millward and Garnett 2010). The public’s perception of rural Britain is embedded with imagery of
28 grass fed farm animals which look natural (Capper 2012), however, this may not be the most
29 environmentally sustainable method of meat production. A life cycle analysis study conducted by
30 Garnett (2011), reported that this is a complex issue which is situation and product specific, with
31 strengths and weaknesses associated with both intensive and extensive meat production methods.
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44 *Strengths*

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46 Previous research has raised concerns about the low completion rate and biases in terms of
47 age, sex and education associated with online surveys (Weigold, Weigold and Russell 2013).
48 Therefore secondary to the demographics of the population and the area being researched, it was
49 apparent that individually, neither the online version nor the pencil-and-paper version of the survey
50 would be sufficient to engage with the entire target population. Previous research has shown general
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3 equivalence and that no significant differences in responses given by participants, were found
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5 between the internet and pencil-and-paper versions of surveys, ($P>0.05$). Therefore, a strength of
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7 this survey is that it utilised two methods to disseminate the identical survey, allowing for a wider,
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9 more stratified sample of the population to be surveyed.
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11 12 13 *Limitations* 14

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18 One of the limitations of this study is that the researcher was unable to pay due attention to
19
20 the roles of BMI and socio-economic status. This is an important topic for further research, because
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22 Gilsing et al. (2012) reported that meat consumption or factors relating to the consumption of meat
23
24 show a positive association with weight gain, although the researcher is aware of the complex
25
26 nature of obesity (Flatt 2013). The present study did not gather information on ethnic group
27
28 diversity. Around 4% of Scottish population are from minority ethnic backgrounds, but they are not
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30 evenly distributed across the country. In Aberdeen city, ethnic groups make up approximately 8%
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32 of the population, in common with other major Scottish cities, and in Aberdeenshire, people from
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34 minority backgrounds make up around 1 % of the total population, with the largest population
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36 groups being of eastern European and Asian origin (Scotland's Census 2011). Various different
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38 ethnic cuisines are based on traditional food cultures which are low in meat consumption and are
39
40 mainly plant-based, for example Middle Eastern and Asian cuisines. Further research is required to
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42 establish whether these traditional plant based dishes may have more consumer appeal (Schösler, de
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44 Boer and Boersema, 2012). We also did not stratify the population responses in terms of deprivation
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46 category, which could be important. Another potential limitation of this study was the possibility of
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48 bias in the response, which needs to be considered, and in particular the over-representation of
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50 women within the general public group. Within the context of this study, it is difficult to establish
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52 the impact of sex vs. the impact of an agricultural link. Furthermore, there could be many
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3 unidentified other important variables or confounders and there could be a complex interaction
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5 between sex and attitudes to meat consumption. However, these findings do suggest other issues
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7 which require to be investigated in fully powered, robust studies.
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10 The results obtained from the NDNS (years 1-4 combined) suggest 2.6% of adults self-
11 identify as vegetarians (Food Standards Agency 2014). However, within this study 9.4% were non-
12 meat eaters with 7.4% of these participants from the general public group, which may also be a
13 minor response bias within this study. The age profile in this study was not representative of the
14 general public, with younger and middle aged people over represented, and with the older age group
15 underrepresented. This may have influenced the data, as younger people are generally perceived to
16 have a more positive attitude to vegetarian and vegan lifestyles (Dibb and Fitzpatrick 2014). It
17 should be borne in mind that the findings are associations and should not be interpreted as cause
18 and effect.
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31 **Conclusion**

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35 The findings show that individuals with an immediate link to the agricultural economy
36 display significantly greater negative attitudes and barriers to consuming meatless meals in
37 comparison to the general public ($P < 0.05$). Understanding consumer's attitudes and barriers is
38 pivotal to successfully tailoring change strategies, because, within the researched society meat has a
39 special status and it is closely linked to the traditional format of meals. The present study also
40 highlights that changing the behaviour of individuals towards adapting meatless meals and reducing
41 meat consumption presents as a complex, challenging and multifactorial issue, which needs to be
42 addressed, as it is fundamental to achieving sustainable food security (Westhoek 2011), limiting
43 environmental damage (Millward and Garnett 2009) and achieving public health benefits (Friel
44 2009). The information obtained from completing this research will allow for the implementation
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3 of tailored intervention strategies within this population group within the North East of Scotland
4 and areas with similar demographics. This study also identifies potential pathways towards
5 successful meat reduction strategies which should integrate both health and sustainable dietary
6 guidelines.
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10 11 12 13 14 15 16 *Ethical approval*

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20 Ethical approval was granted by the Robert Gordon University School of Pharmacy and Life
21 Sciences Research Ethics Committee
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25
26 MM conceived the study, MM and LS designed the questionnaire, carried out the analysis and
27 wrote up the results. LS recruited the study participants.
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Table 1. Demographic information of participants (n=470).

Variable		Total Sample		Agricultural Economy		General Public	
		n	%	n	%	n	%
Sex	Male	152	32.3	71	40.8	81	27.4
	Female	318	67.7	103	59.2	215	72.6
Age (years)	18-24	126	26.8	47	27.0	79	26.7
	25-34	73	15.5	26	14.9	47	15.9
	35-44	83	17.7	23	13.2	60	20.3
	45-54	89	18.9	37	21.3	52	17.6
	55-64	69	14.7	30	17.2	39	13.2
	65 +	30	6.4	11	6.3	19	6.4
Highest education level	Secondary Education	120	25.5	41	23.6	79	26.7
	Trade/Technical/Vocational training	34	7.3	18	10.3	16	5.4
	College Graduate/undergraduate degree	233	49.5	87	18.5	146	31
Link to Agriculture	Postgraduate degree	83	17.7	28	16.1	55	18.6
	Yes	174	37.0	174	100	0	0
	No	296	63.0	0	0	296	100

Table 2 Comparison of male and female responses and a comparison of participants from the agricultural economy and the general public responses to the Likert scale statements, with the results obtained from Mann-Whitney U tests †

	Sex		P-Value	Link to Agriculture		
	Men	Women		Agricultural Economy	General Public	P-Value
	Median	Median	P-Value	Median	Median	P-Value
I would be reluctant to eat meatless meals and meat substitutes.	1.0	3.0	<0.001*	1.0	3.0	<0.001*
My partner and/or family members would be reluctant to eat meatless meals and meat substitutes.	2.0	2.0	0.746	1.0	2.0	<0.001*
I don't have the appropriate knowledge about plant-based diets and simple ways to prepare meals using meat alternatives and meat substitutes.	2.0	3.0	<0.001*	2.0	3.0	<0.001*
Meatless meals and meat substitutes are not acceptable within my culture.	3.0	4.0	0.021*	3.0	4.0	<0.001*
Vegetarian diets and meat substitutes are not as tasty as meat containing meals.	1.0	3.0	<0.001*	1.0	3.0	<0.001*
I am concerned about the nutritional content of meatless meals and meat substitutes.	2.0	3.0	<0.001*	2.0	3.0	<0.001*
Meat is a staple in my diet.	1.0	1.0	<0.001* ‡	1.0	1.0	<0.001*‡
Meatless meals and meat substitutes are inconvenient.	2.0	3.0	<0.001*	2.0	3.0	<0.001*
Meatless meals would not be filling enough and would not satisfy my hunger.	2.0	3.0	<0.001*	2.0	3.0	<0.001*
When eating out, there is a limited choice of meatless meals on menus.	1.0	1.0	0.793	1.0	1.0	0.071
Meat is associated with masculinity.	2.0	3.0	<0.001*	2.0	3.0	0.001*
I think meatless meals and meat substitutes are more expensive than meat containing meals.	2.0	3.0	<0.001*	2.0	3.0	<0.001*

†The question asked was: 'some individuals think that eating meatless meals and using meat substitutes is challenging. Please respond to the statements by placing an X in the appropriate box (one box per statement). Eating meatless meals would be difficult for me because...' Responses were on a scale : 0=strongly agree, 1=agree, 2=neutral, 3=disagree, 4= strongly disagree.

*statistical significance between groups.

Table 3. A comparison of the perceived benefits associated with choosing meatless meals.
Agricultural workers vs. general public

	Agricultural economy n (%)	General public n (%)	P Value
Help the environment	45 (25.9)	121 (40.9)	0.001*
Improve animal welfare	58 (33.3)	147 (49.7)	0.001*
Convenience	11 (6.30)	45 (15.2)	0.060
I would save money	33 (19.0)	68 (23.0)	0.365
Improve my health	68 (39.0)	144 (48.6)	0.055
Reduce saturated fat intake	96 (55.2)	184 (62.2)	0.163
Increase my vitamin and mineral intake	33 (19.0)	72 (24.3)	0.218
Increase the fibre in my diet	44 (25.3)	114 (38.5)	0.005*
Not aware of any benefits	28 (16.1)	27 (9.1)	0.034*

* Statistical significance between groups

Study participants were asked whether they agreed or disagreed with a series of statements regarding the benefits of choosing meatless meals, whether or not they chose to do so themselves.