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**Citation for published version:**

Möttus, R., Realo, A., Allik, J., Deary, IJ, Esko, T & Metspalu, A 2012, 'Personality Traits and Eating Habits in a Large Sample of Estonians', *Health Psychology*, vol. 31, no. 6, pp. 806-814.  
<https://doi.org/10.1037/a0027041>

**Digital Object Identifier (DOI):**

[10.1037/a0027041](https://doi.org/10.1037/a0027041)

**Link:**

[Link to publication record in Edinburgh Research Explorer](#)

**Document Version:**

Peer reviewed version

**Published In:**

Health Psychology

**Publisher Rights Statement:**

© Möttus, R., Realo, A., Allik, J., Deary, I. J., Esko, T., & Metspalu, A. (2012). Personality Traits and Eating Habits in a Large Sample of Estonians. *Health Psychology*, 31(6), 806-814. 10.1037/a0027041

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**Personality traits and eating habits in a large sample of Estonians**

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**Abstract**

**Objectives:** Diet is consequential for health, which makes knowing the psychological correlates of dietary habits important. Associations between dietary habits and personality traits were examined in a large sample of Estonians ( $N = 1,691$ ) aged between 18 and 89 years. **Methods:** Dietary habits were measured using eleven items, which grouped into two factors reflecting (1) *health aware* and (2) *traditional* dietary patterns. The *health aware* diet factor was defined by eating more cereal and dairy products, fish, vegetables and fruits. The *traditional* diet factor was defined by eating more potatoes, meat and meat products, and bread. Personality was assessed by participants themselves and by people who knew them well. The questionnaire used was the NEO Personality Inventory-3, which measures the Five-Factor Model personality broad traits of Neuroticism, Extraversion, Openness (to Experience), Agreeableness, and Conscientiousness, along with six facets for each trait. Gender, age and educational level were controlled for. **Results:** Higher scores on the *health aware* diet factor were associated with lower Neuroticism, and higher Extraversion, Openness and Conscientiousness (effect sizes were modest:  $r = 0.11$  to  $0.17$  in self-ratings, and  $r = 0.08$  to  $0.11$  in informant-ratings,  $ps < 0.01$  or lower). Higher scores on the *traditional* diet factor were related to lower levels of Openness ( $r = -0.14$  and  $-0.13$ ,  $p < 0.001$ , self- and informant-ratings respectively). **Conclusions:** Endorsement of healthy and avoidance of traditional dietary items is associated with people's personality trait levels, especially higher Openness. The results inform dietary interventions on possible barriers to diet change.

Keywords: Diet; Dietary patterns; Personality; Five-Factor Model; Openness

## Introduction

People's personality trait levels are associated with numerous common health outcomes such as cardiovascular diseases, diabetes, metabolic syndrome, or inflammation (Deary, Weiss, & Batty, 2010; Goodwin & Friedman, 2006; Sutin et al., 2010a, 2010b). Within the Five-Factor Model (FFM), the currently most popular personality trait taxonomy, the most consistent predictor of the health outcomes appears to be Conscientiousness—the tendency to be orderly, dutiful, disciplined, and considerate—but Extraversion, Openness to Experience (Openness), Agreeableness, and, in particular, Neuroticism also play a role (Goodwin & Friedman, 2006; Smith & MacKenzie, 2006). The associations between personality traits and health outcomes may be partially mediated by health-related behaviors (Bogg & Roberts, 2004; Chapman, Lyness, & Duberstein, 2007; Goodwin & Friedman, 2006). For example, evidence links personality traits, especially Conscientiousness, to unhealthy behaviors such as smoking (Terracciano & Costa, 2004), alcohol consumption (Malouff, Thorsteinsson, Rooke, & Schutte, 2007), drug use (Terracciano, Löckenhoff, Crum, Bienvu, & Costa, 2008), and lack of physical exercise (Rhodes & Smith, 2006). This provides a good basis for hypothesizing that personality traits may also be associated with people's dietary habits, which are known to be predictive of various health conditions such as metabolic (Azadbakht, Mirmiran, Esmailzadeh, Azizi, & Azizi, 2005), immunological (Lopez-Garcia et al., 2004), and cardiovascular functioning (Liu et al., 2009). However, empirical evidence on the possible personality-diet associations is still scarce.

In one of the few previous studies on eating habits and personality, Goldberg and Strycker (2002) analyzed the factor structure of 48 self-report dietary items in a large sample of adults. They delineated a hierarchical structure of dietary habits with a general healthy diet factor at the top, two factors that described avoiding fat and preferring fiber at the second level, and

several more specific factors at lower levels. Scores on the general healthy diet factor were positively associated with Openness—tendency to prefer variety and change, and willingness to experience novelty—and Conscientiousness. High Openness was also consistently associated with higher scores on the lower-level factors of fiber consumption and avoidance of fats, whereas high Conscientiousness was only associated with avoidance of fats (Goldberg & Strycker, 2002). In another study, Brummet and colleagues (2008) found that Openness, but no other FFM personality trait, was associated with higher scores on a comprehensive healthy diet questionnaire in middle adulthood.

In a sample of older Scottish adults, Möttus and colleagues (2011) found that dietary patterns (as measured by a comprehensive Food Frequency Questionnaire) could be best described by four distinct factors: Mediterranean style, health aware, convenience, and sweet foods dietary patterns. The first two patterns included several dietary items that are typically considered healthy: preference for fresh vegetables and fruits, rice, fish and poultry, and avoidance of meat. The other two patterns indicated presumably less healthy dietary habits (e.g., eating pastries, sausage rolls, tinned vegetables, and various types of sweets). After controlling for the effects of gender, education, and cognitive ability, Openness appeared to be the most consistent and strongest correlate of dietary patterns. More ‘open’ people preferred more Mediterranean-style and less convenience and sweet foods. Neuroticism was negatively related to scores on the Mediterranean style and positively to scores on the convenience diet, high Extraversion was associated with endorsement of the Mediterranean-style diet, and high Agreeableness and Conscientiousness were linked to preference for the health aware diet (Möttus et al., 2011).

Taken together, the few FFM-based studies suggest Openness as the most consistent correlate of dietary habits that are often considered healthy. Other personality traits may also be

involved but less consistently. On one hand, this is a rather surprising discovery amidst the myriad of research findings that show the predominance of Neuroticism and, especially, Conscientiousness in predicting various health-related behaviors (Bogg & Roberts, 2004; Lahey, 2009). On the other hand, the possible role of Openness in contributing to people's dietary habits appears explicable (Möttus et al., 2011). It is possible that, in societies where the availability of food is drastically increased over the recent decades creating what is called toxic food environment (Brownell & Horgen, 2004), sticking to traditional and often more energy-rich forms of diet may no longer be as advantageous as adopting other types of dietary habits such as, for example, the Mediterranean diet (Sofi, Cesari, Abbate, Gensini, & Casini, 2008). Openness being involved in dietary habits may suggest that some of the food items that are potentially healthier in the modern food environment are generally perceived as unfamiliar and alien among people: it may take some extra Openness and intellectual curiosity to be more likely to consume these items, whereas without that extra Openness people may be more likely to stick to traditional or convenient forms of eating.

The finding that Openness is the most consistent predictor of healthier diet has potential practical implications. Specifically, it is possible that the barrier of low Openness on the way to potentially healthier diet could be removed by familiarizing novel but now-healthier food items to people. That being said, the possible contributions of Openness and other personality traits are still too little explored to allow of definitive conclusions and practical suggestions.

First, as shown above, there are still only a handful of studies available. Second, all of these few studies have been carried out either in the US or British samples, whereas dietary habits are likely to be tied to cultural, historical and, geographical settings. Third, little is known about the extent to which the personality-diet associations are robust across age, gender and educational groups. Fourth, diet is typically measured using self-report measures and so is

personality, which may imply possible problems resulting from method overlap (e.g., a socially desirable responding which generalizes across reporting personality and diet). The current study, based on a large sample of Estonians ( $N = 1,691$ ) from age 18 to 89 years, aimed to advance the field by addressing all of these four issues.

In early 20<sup>th</sup> century, the traditional Estonian cuisine was based on a fairly limited number of items such as (mostly boiled) potatoes, rye bread, pork, (mostly salted) fish, and dairy products (Moora, 2007). The eating habits of contemporary Estonians, although still often based on the traditional cuisine, are more variable and influenced by various sociocultural developments. During the 20<sup>th</sup> century, when the participants of this study were born and developed their dietary preferences, Estonia experienced several different cultural and culinary influences: from traditional and German cuisine before World War II, emerging Soviet/Russian influences after the war and up to late 20<sup>th</sup> century, and rapid Westernization thereafter. Additionally, availability of increasingly wide range of food items (especially from late 20<sup>th</sup> century on) may have left more room for personality characteristics to influence dietary habits. All this suggests possible moderating effect of age/cohort on diet-personality associations, which could be readily tested in the present study due to the large sample size and participants' wide age range.

Importantly, participants' personality traits were not only rated by themselves but also by informants who knew them well. If the associations between dietary habits and personality traits were robust and not the product of self-report method overlap, they were expected to replicate across self- and informant-reports. Also, besides the broad FFM personality traits, six facets of each broad trait were measured, providing more detailed information on personality traits than has been available in some of the few previous studies (e.g., Mõttus et al., 2011). Overall, the present study constitutes what Lykken (1968) has called 'constructive

replication’—the vital empirical test of the validity of scientific findings.

## **Method**

### *Participants*

Participants came from the Estonian Genome Centre (EGC). The EGC was launched as an initiative of Estonian Government in 2001 to create a database of health, genealogical and genome data representing 5% of Estonia’s population; currently, it is affiliated with the University of Tartu (for details see [www.biobank.ee](http://www.biobank.ee)). The EGC participants have been randomly selected from individuals visiting general practitioners (GP) and hospitals and recruited by the GPs and hospital physicians. All participants have given informed consent (see [www.biobank.ee](http://www.biobank.ee)). In addition to donating blood samples and answering a medical questionnaire (which included questions on dietary habits), participants were asked to complete the self-report version of a comprehensive personality test and find a knowledgeable informant who would also complete the same questionnaire about them. In total, the sample used in the present study included 1,691 people (of whom 976 were women) with a mean age of 42.9 years ( $SD = 16.5$ , ranging from 18 to 89 years). Although the number of participants was lower at older ages, there were still 305 people aged over 60, and 132 people older the 70 years. Of the 1,691 participants, 178 people had basic (i.e., lower secondary) education, 420 had secondary school education, 425 had secondary specialized education, and 668 had higher educational level (degree).

### *Measures*

*Personality.* The NEO Personality Inventory-3 (NEO PI-3; McCrae, Costa, & Martin, 2005) is a slightly modified version of the NEO PI-R questionnaire (Costa & McCrae, 1992) that was adapted into Estonian by Kallasmaa and colleagues (2000). Like the original NEO PI-R,



the NEO PI-3 has 240 items which measure 30 personality traits grouped into the five FFM domains. The NEO PI-3 has excellent psychometric properties in a wide range of countries including Estonia (De Fruyt, De Bolle, McCrae, Terracciano, & Costa, 2009). Participants themselves completed the self-report form of the NEO PI-3. Informants completed the observer report form of the NEO PI-3. Of the informants, 52% were spouses or partners, 15% friends, 12% parents, 9% children or grandchildren, 6% siblings, 3% acquaintances, and 3% were categorized as other relatives. Women comprised 69% of the informants. In line with typical findings (Connolly, Kavanagh, & Viswesvaran, 2007), the correlations between the respective scale scores from based on self-reports and informant-ratings were 0.52, 0.66, 0.61, 0.48, and 0.52 for Neuroticism, Extraversion Openness, Agreeableness, and Conscientiousness, respectively, and ranged from 0.39 to 0.63 (median = 0.48) for 30 facet scales (all correlations significant at  $p < 0.001$ ).

*Diet.* Dietary habits were measured by asking participants to rate the frequency of consuming 13 food items during the previous week (in cases where the last week had differed from their typical week in terms of eating, they were asked to rate a typical week). The ratings were given on a four-point scale: from 'never' (0); '1-2 days' (1); '3-5 days' (2); to '6-7 days' (3). The 13 items cover typical foods consumed by Estonians: potatoes; rice or pasta; porridge, muesli or cereals; dairy products; fish; meat; meat products (sausages, frankfurters); fresh vegetables; boiled vegetables; fresh fruits and berries; pickled fruits or jams; sweets; and eggs. In addition, participants were asked to write how many slices of rye bread (a traditional Estonian food item) and white bread they typically eat in a day. Therefore, the dietary habits were quantified on the basis of 15 items in total.

#### *Analytic Strategy*

First, in order to efficiently summarize the information in the responses to dietary questions,

an exploratory principal components analysis (PCA) was carried out on the 15 dietary items to identify groups of items that co-varied and formed consistent and meaningful dietary patterns. This is a widely used method in nutritional research (e.g. Craig, Geraldine McNeill, Macdiarmid, Masson, & Holmes, 2010; Goldberg & Strycker, 2002; Hamer, McNaughton, Bates, & Mishra, 2010; Mõttus et al., 2011). Further analyses were then based on the resulting factor scores. Second, interactions of personality traits with age, gender and educational level in predicting diet factor scores were tested. In addition to having a potentially substantive meaning, significant interaction effects would have pointed to the need to carry out analyses separately in men and women, in different educational groups, or at different age levels. Third, the correlations between the personality traits and the diet factor scores were calculated. Fourth, personality traits and dietary scores were residualized for the effects of age, gender and educational level as these variables may have confounded (or possibly mediated in case of education) the personality-diet associations (irrespective of the (non)existence of any interaction effects), and this was followed by re-calculating the associations between personality traits and diet factor scores using the residualized variables. Presenting both raw and adjusted correlations between personality traits and dietary factors allows us to estimate the effect of the covariates. All statistical analyses were carried out in R version 2.13.0 (R Development Core Team, 2011).

Attention was paid to the problem of multiple testing. Strictly speaking, testing the diet-personality associations involved 140 correlations: 35 (personality traits) x 2 (self vs informant-ratings) x 2 (dietary variables) = 140. According to Bonferroni correction, the corrected 5% alpha level ( $p$ -value) would have been  $p = 0.05/140 = 0.0004$ . However, the Bonferroni correction would have been incorrectly and unreasonably strict, because the 140 correlations were not independent from each other: self-ratings and observer-ratings

described the same individuals, and the six facets of the each FFM domain measured largely the same underlying construct.

Instead, a resampling test was used to estimate the likelihood of type 1 error (Sherman & Funder, 2009). First, because the associations between personality traits and dietary factor scores that replicated across the two sources of personality ratings were more likely to be reliable than those that did not (although this is not a perfect criterion as different raters may have had to some extent differentially accurate information about some aspects of personality), only those associations that were statistically significant in both types of ratings were considered further. Second, to choose the appropriate level of significance, people's scores on the diet factors were randomly reshuffled 10,000 times in relation to their personality scores—so that each participant's personality scores had equal chances to be matched to diet scores of any of the participants—and the likelihoods of simultaneously obtaining significant results in both self- and informant-ratings were determined. When the significance level was set to  $p < 0.05$ , the probability of having at least one of the 35 correlations significant simultaneously in self- and informant-ratings was 17.98% for *health aware* and 17.88% for *traditional* diet factors. When the significance level was set to  $p < 0.01$ , the respective probabilities were 2.30% and 2.54%. Therefore, when the critical  $p$ -value was set to  $p < 0.01$  for both self- and informant-ratings simultaneously the likelihood of type 1 error was about 2.5% which largely corresponds to the respective threshold used for single associations ( $p < 0.05$ ). As a result,  $p < 0.01$  simultaneously for both self- and informant-ratings was chosen as the appropriate criterion for considering an association between personality trait and diet variable statistically significant and reliable.

## Results

### *Grouping Dietary Items Using PCA*

Table 1 gives the descriptive statistics of the 15 food item scores. A PCA on the 15 food items indicated the presence of two predominant components which together accounted for 28.06 % of the total variance (eigenvalues of the first six components were 2.21, 2.00, 1.28, 1.14, 1.01, and 0.94). Therefore, the two first components were retained for further analyses. For better interpretability, the components were rotated using non-orthogonal oblimin rotation, which implied that resulting factor scores could be correlated (it was possible that some people ate more all types of foods than other people). Two items ('rice or pasta' and 'sweets') had very low communalities and were therefore removed from the further analyses. The next round of factor analysis on the remaining items indicated a meaningful pattern of loadings on the two factors, except for two items ('jams or pickled fruits' and 'eggs') that had very similar loadings on both factors and therefore did not contribute any meaningful distinctive information to the factor scores. For that reason, these two items were also removed, resulting in a relatively simple factor solution given in Table 2.

The two factors (correlated at  $r = 0.07$ ,  $p < 0.01$ ) explained 35.75% of the variance of the scores of the 11 remaining items and were meaningfully interpretable as indicating *health aware* and *traditional (Estonian)* type of diet, respectively. The *health aware* diet was primarily defined by positive loadings from more frequent consumption of porridge, muesli and cereals, dairy products, fish, fresh and boiled vegetables, and fresh fruits. The *traditional* diet was defined by higher loadings from more frequent consumption of potatoes, meat and meat products (sausages or frankfurters) and greater consumption of both rye and non-rye breads. As said above, potato, meat and rye bread are some of the most typical items of the traditional Estonian cuisine, whereas processed meat products (sausages, frankfurters) and

white bread are typical convenience food items originating from German and Soviet influences. For the following analyses, participants' scores in the two factors were calculated using the regression method.

Scores on the both diet factors were significantly positively correlated with age ( $r = 0.15$  and  $0.13$ ,  $p < 0.001$ , respectively). Women scored higher on the *health aware* diet factor (Cohen's  $d = 0.37$ ,  $p < 0.001$ ), but men scored higher on the *traditional* diet factor ( $d = 0.70$ ,  $p < 0.001$ ). Scores on both factors were also significantly related to participants' educational level ( $\eta^2 = 0.046$  and  $0.048$ ,  $p < 0.001$ , respectively), such that higher levels of education were associated with higher scores on the *health aware* diet factor, whereas the trend was generally the opposite for the *traditional* diet factor (except for people with specialized secondary education scoring higher than those with simply secondary education).

#### *Interaction of Personality Traits with Age, Gender and Education in Predicting Dietary Scores*

In order to test whether possible associations between personality traits and the dietary factor scores were robust across gender, age and educational level, personality traits (one at a time) were entered into a regression equation together with either gender, age, or education and both main effects and interaction terms were specified. For an interaction term to be statistically significant, the criterion of  $p < 0.01$  simultaneously for both self- and informant-ratings was used. No significant interaction terms emerged for any personality domain or facet. Therefore, there was no evidence for the personality-dietary habits associations possibly depending on the main demographic factors such as age, gender, or level of education.

### *Correlations between Personality Traits and Dietary Patterns*

The correlations between personality traits and dietary factor scores (Table 3) tended to be slightly lower for informant-rated personality traits compared to self-ratings, possibly indicating some method overlap effect in the associations between self-reported personality and dietary habits. However, the majority of the associations replicated across the two sources of personality ratings, suggesting that, to a large degree, they were substantive rather than confounded by possible self-report biases. Alternatively, the slightly higher correlations for self-ratings may also have resulted from people themselves having more accurate information about those aspects of their personality that were associated with dietary habits.

At the level of the FFM domains, higher scores on the *health aware* diet factor were significantly correlated with lower Neuroticism and higher Extraversion, Openness and Conscientiousness, with the effect sizes ranging from  $r = 0.11$  to  $0.16$  ( $p < 0.001$ ) and  $r = 0.07$  to  $0.14$  ( $p < 0.01$ ), respectively for self- and informant-ratings. Higher scores on the *traditional diet* factor were correlated with lower Extraversion ( $r = -0.12$  and  $-0.09$ ,  $p < 0.001$ , for self- and informant-ratings respectively) and Openness ( $r = -0.25$  and  $-0.21$ ,  $p < 0.001$ , for self- and informant-ratings respectively).

It was shown above that the scores on dietary factors were associated with age, gender and educational level, which also tend to be related to personality traits (e.g. Allik et al., 2009). To control for the potential confounding effects, the associations between dietary factor scores and personality traits were also examined after both had been residualized for the effects of age, gender, and educational level. Compared to the unadjusted associations, higher scores on the *health aware* diet factor had slightly stronger correlations with Extraversion and Neuroticism (informant-ratings only) and somewhat lower correlations with Conscientiousness (Table 3), whereas there was little change for Openness. The correlation of

*traditional diet* factor with Extraversion, however, was strongly attenuated and no longer significant after controlling for age, gender and educational level; its correlations with Openness were also markedly attenuated but still highly significant ( $r = -0.14$  and  $-0.13$ ,  $p < 0.001$ , self- and informant-ratings respectively). Additional analyzes were run where time of assessment (month) was also controlled for as it may have contributed to reported dietary habits (e.g., fruits) but this had almost no effect on the results (since time of assessment was not available for all participants, this co-variate was not included in the reported analyzes).

When large groups of people are considered even such, admittedly modest, effects can make a notable difference. To illustrate this, the residualized *health aware* diet factor scores were used to split people at median into equally sized groups of *health aware* and *less health aware dieters* and people below 10<sup>th</sup> percentile and above 90<sup>th</sup> percentile of residualized self-rated Openness were compared in terms of their likelihood of belonging to either of the diet groups. At the population level, the top and bottom deciles of Openness include very large numbers of people. In the high Openness group, 63.10% of people belonged among the *health aware dieters*, whereas in the low Openness group the percentage was 38.10 [odds ratio (OR) = 2.77, 95% confidence intervals (CI) 1.74 and 4.43]. Put another way, belonging to the bottom decile of Openness incurred a 67.74% higher relative risk of being a *less health aware dieter* compared to belonging to the top decile. When the same was done for the traditional diet dimension, 40.48% of participants in the top and 55.36% participants in the bottom belonged among the *traditional dieters* (OR = 0.55, 95% CIs 0.35; 0.87).

At the level of personality facets, correlations with the *health aware* diet factor varied to some extent within the broad personality domains (Table 3). In the Neuroticism, Extraversion and Openness domains, four of the six personality facets had significant associations with *health aware* diet similarly to their respective domain scores, whereas three facets of the

Conscientiousness domain were significantly correlated with the diet factor. Agreeableness as the broad domain was not related to *health aware* diet but its facet A1:Trust was. For the *traditional diet* factor, there was somewhat less within personality domain variability in terms of the associations, as five of the six Openness facets were significantly negatively correlated with the diet factor but no facets of any other domain. In line with Goldberg and Strycker (2002), the facet-level associations that stood out as being the strongest after controlling for age, gender and educational level—albeit by a small margin—for both diet factors and in both types of ratings were for O4:Openness to Action. In essence, this facet scale measures preference for change and variety (high scores) as opposed to resistance to change and sticking to habitual (Costa & McCrae, 1992).

## **Discussion**

Using a large sample of Estonians from ages 18 to 89 years, the study showed that people's personality trait levels are partly reflected in their dietary habits. People lower in Neuroticism and higher in Extraversion, Openness and Conscientiousness were more likely to endorse a dietary pattern that was defined by frequent consumption of cereal products, fish, fruits and vegetables and was labeled as a *health aware* diet. Conversely, people lower in Openness were more likely to endorse a dietary pattern that was defined by more frequent consumption of potatoes, meat and meat products and bread, and was labeled as a *traditional* diet. These associations were observed also when controlling for age, gender and educational level, which had also contributed to dietary habits, with older and more educated people and women being more likely to endorse *health aware*, and older and less educated people and men being more likely to score higher on the *traditional diet* factor.

To date, there have been only a few studies focusing on the links between FFM personality traits and dietary habits. The present study contributed to the scarce literature by investigating



the associations in a different sociocultural background compared to the few previous studies done in US and UK. Due to the large and demographically diverse sample, the study was also able to show that the personality-diet associations were robust across various demographic groups. Providing further constructive replication (Lykken, 1968), most of the associations were observable in two independent sources of personality information—self-reports and ratings provided by knowledgeable informants. It was therefore not likely that the observed associations were confounded by general self-report biases.

As is typical for such epidemiological studies, the personality-diet associations were not strong in terms of effect size. However, even such effects can make a marked difference at population level: for example, belonging to bottom decile of Openness (which represents a large number of people at the population level) notably decreased the chances of being among health aware dieters (38%) compared to people who were among the 10% highest scorers in Openness (63%).

The findings are largely consistent with the few previous studies on the topic as these have also underscored the associations between Openness and dietary habits that are considered healthier (Brummett, Siegler, et al., 2008; Goldberg & Strycker, 2002; Möttus et al., 2011). Therefore, evidence is accumulating that relates people's levels of cultural and intellectual openness and curiosity to their dietary preferences, with more open people being willing to adopt newer—and often arguably healthier—dietary habits and less open people more often sticking to convenient of traditional forms of diet. These findings are also in line with a recent study showing the links between food neophobia and low Openness (Knaapila et al., 2011). Although less consistently, the possible roles of Conscientiousness, Neuroticism, and Extraversion in dietary habits have also been suggested by the previous studies (Brummett, Siegler, et al., 2008; Goldberg & Strycker, 2002; Möttus et al., 2011).

To quantify dietary habits, the present study (like many others) used an *a posteriori*, data-driven approach. Instead of scoring dietary items according to a predefined scheme (e.g., based on national dietary guidelines), the covariation of dietary items was tested to identify consistent patterns of eating habits that exist among people. For comparability of the findings, it is important to know to which extent the content of such data-driven dietary patterns are similar across studies. The dietary factors found in the present study are in many ways similar to those found by Mõttus and colleagues (2011) in older Scots. In this study, a more comprehensive food-frequency questionnaire revealed four dietary patterns: Mediterranean-style, health aware, convenience diet, and sweets. Broadly, the *health aware* diet found in the present study covered some of the content of the Mediterranean-style and health aware diet factors found on Scots (e.g. higher consumption of fish, vegetables and fruits) and the *traditional diet* factor of the present study remotely corresponds to the convenience diet pattern of Scots (taking into account the somewhat different food-cultural backgrounds of Scotland and Estonia). Similar parallels can be drawn with other studies such as the one by Hamer et al (2010) which extracted four dietary patterns among older Britons—Mediterranean, health aware, traditional, and sweet and fat—and a study on a nationally representative sample of British adults, which contrasted healthier dietary patterns with traditional and convenience food-based dietary patterns (Pryer et al., 2001).

Therefore, despite the cross-cultural differences in the specific dietary items that are consumed, it may be possible to more or less universally identify groups of people who endorse some sort of health aware dietary patterns. These patterns contain elements that may be somewhat alien and be viewed as having modern flavors in particular cultural contexts, such as Mediterranean-style diet in Great Britain and high-fiber breakfast cereals in Estonia. There also appear to be groups of people who tend to stick to dietary habits that are most

convenient or traditional in the local context. Of course, the traditional or convenient eating habits do not necessarily reflect unhealthy diet but as such habits often imply eating more energy-rich food items (e.g., high-fat foods such as meat and processed meat products), they may not always be well in line with modern dietary guidelines.

Obviously, dietary habits have health consequences. For instance, adherence to dietary patterns with increased consumption of cereal (wholemeal) products, fish, vegetable and fruit consumption (often broadly summarized as Mediterranean style diet) has been related to decreased risks of all-cause, cardiovascular, and cancer mortality, as well as cognitive impairment and metabolic syndrome (Bamia et al., 2007; Griep, Verschuren, Kromhout, Ocké, & Geleijnse, 2011; Hamer et al., 2010; Rumawas, Meigs, Dwyer, McKeown, & Jacques, 2009; Sofi et al., 2008). In contrast, sticking to diets rich in meat and highly processed food items has been associated with a variety of adverse health outcomes (e.g. van Dam, Rimm, Willett, Stampfer, & Hu, 2002; Lopez-Garcia et al., 2004). As a result, knowing the potential contributors dietary habits is likely to be informative for the policies and counseling aimed at improving health via nutritional interventions.

The present study consolidates the findings that suggest some of the barriers which stop people from adopting dietary habits that are considered healthy and make people stick to the forms of diet that may potentially have less beneficial health consequences. In particular, one of the barriers seems to be lack of intellectual curiosity and open mind, whereas ability resist urges and act in an organized and disciplined manner seems to be less important for preferring some food items over the others. Thus, it is rather being willing to try and adopt new food items over the traditional ones than being able to deliberately control for dieting habits that matters for which food items tend to be consumed most frequently. As a result, the findings may suggest that influencing the consumption of particular food items may be more

effective via modifying the perceived familiarity of the food than via motivating people to deliberately control for their food preferences. The success of the interventions that are well tailored to people's personality traits has been demonstrated in reducing alcohol use, for example (Conrod, Castellanos-Ryan, & Mackie, 2011).

Interestingly, the associations between personality traits and dietary habits that are quantified as dietary patterns do not map with well-established associations between personality traits and body mass index (BMI), which could theoretically be an obvious outcome of dietary preferences. At the personality domain level, a recent large study found BMI to be associated with Neuroticism and Conscientiousness and to some extent also with Extraversion and Agreeableness, but not with Openness; at the NEO-PI-R facet level, the strongest predictors of high BMI were high N5: Impulsiveness and low C2:Order and C5:Self-Discipline (Sutin, Luigi Ferrucci, Zonderman, & Terracciano, 2011). In the present study, in contrast, Openness was the strongest correlate of dietary habits, whereas N5:Impulsiveness was not at all associated with diet and the contributions of C2:Order and C5:Self-Discipline were no longer consistent after adjusting for co-variates (Table 3). Similar lack of convergence between the personality correlates of diet and BMI were observed and discussed by Möttus and colleagues (2011). There are at least two possible general explanations for these findings.

First, difficulties between establishing clear links between dietary habits and BMI have been also noted by other authors (for a review see Summerbell et al., 2009), suggesting that either people with higher BMI tend to misreport on their diet (Bazelmans et al., 2007) or diet does not contribute to body weight in a direct and straightforward manner (cf. Keith et al., 2006). For example, the contribution of diet may depend on other possible correlates of diet such as physical activity, sleep deprivation or others (Keith et al., 2006). If dietary habits themselves are not straightforwardly and equivocally associated with BMI, this alone could explain the

different personality correlates of dietary habits and BMI. Second, the present study quantified the degrees to which people adhered to general dietary patterns, preferring some groups of dietary items over other. As such, the *relative* food preference may be less important in terms of overall caloric intake, which may be an important contributor to obesity (also even this is not clear, as suggested by Summerbell et al., 2009). However, even if individual differences in dietary patterns may not directly contribute to obesity, dietary habits have well-established associations with various other health outcomes as was reviewed above, which makes knowing the correlates of diet important.

It has been assumed that personality traits were causal to dietary patterns but alternative causal explanations may also be possible. For example, adhering to particular forms of diet may have impact on people's health and this, in turn, may contribute to their personality. Also, there may be other factors—unaddressed in this study—that could have influenced both dietary habits and personality traits, thereby creating spurious associations between them.

The main strengths of the present study were a large sample with diverse demographic backgrounds and highly-detailed personality data from self- and informant reports. A limitation of the study was the less than ideal information on people's dietary habits. Additional and more detailed dietary items could have provided a greater number of and more informative dietary patterns. Also, information on the quantity of food consumption could have helped to further elucidate links between personality and dietary behavior. Another limitation was the lack of information on participants' income, which may have affected dietary behavior. In addition to overcoming these limitations, future research could also investigate the associations of personality traits with regularity of dieting and 'snacking' and fast food consumption, which may contribute to obesity (Summerbell et al., 2009).

To conclude, there is an increasing amount of evidence that people's personality traits are

related to their dietary habits over and above other contributors. Dietary habits appear to be most consistently related to Openness, a personality trait that describes preference for change and variety and willingness to experience novelty. This is potentially helpful in discovering and removing barriers that people have against changing their dietary habits.

## **Acknowledgements**

Estonian Genome Centre of the University of Tartu received financing by FP7 grants (201413, 245536), it also received targeted financing from Estonian Government (SF0180142s08), from University of Tartu in the framework of Center of Translational Genomics, and from the European Union through the European Regional Development Fund in the framework of Centre of Excellence in Genomics. This project was also supported by a grant from the Estonian Ministry of Science and Education to Jüri Allik (SF0180029s08). During the writing of the article, René Mõttus was supported by European Social Fund (grant no MJD44 of the Mobilitas program, coordinated by the Estonian Science Foundation) and an Ernst Jaakson's scholarship.

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Table 1

Descriptive statistics of food items along with their associations with gender, age and education.

	Total			Women			Men		
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>
Potatoes	1691	2.69	0.73	976	2.61	0.73	715	2.81	0.71
Rice or pasta	1691	2.10	0.54	976	2.09	0.54	715	2.12	0.55
Porridge, muesli or cereals	1691	2.23	0.97	976	2.35	0.98	715	2.08	0.94
Dairy products	1691	3.45	0.76	976	3.45	0.75	715	3.44	0.77
Fish	1691	1.97	0.61	976	1.96	0.60	715	1.98	0.62
Meat	1691	2.68	0.77	976	2.58	0.75	715	2.82	0.76
Meat products	1691	2.66	0.96	976	2.47	0.96	715	2.91	0.90
Fresh vegetables	1690	2.72	0.90	975	2.82	0.89	715	2.57	0.89
Boiled vegetables	1691	2.20	0.79	976	2.30	0.80	715	2.05	0.77
Fresh fruits and berries	1691	3.05	0.88	976	3.20	0.83	715	2.85	0.92
Jams and compotes	1691	1.84	0.78	976	1.80	0.78	715	1.88	0.78
Sweets	1691	2.67	0.90	976	2.70	0.90	715	2.62	0.90
Eggs	1689	2.09	0.61	975	2.08	0.59	714	2.11	0.62
Rye bread	1688	2.95	1.81	974	2.63	1.53	714	3.38	2.04
Bread	1685	2.15	2.10	975	1.62	1.60	710	2.89	2.45

NOTE: *N* = number of participants, *M* = mean, *SD* = standard deviation.

Table 2

The final two-factor solution followed by non-orthogonal oblimin factor rotation of the dietary items.

	Health aware diet	Traditional diet	$h^2$
Fresh vegetables	<b>0.65</b>	-0.01	0.42
Fresh fruits	<b>0.62</b>	0.00	0.38
Boiled vegetables	<b>0.61</b>	0.02	0.37
Porridge, muesli or cereals	<b>0.56</b>	-0.18	0.36
Dairy products	<b>0.48</b>	0.20	0.26
Fish	<b>0.39</b>	0.08	0.15
Meat products (sausages, frankfurters)	-0.15	<b>0.68</b>	0.49
Potatoes	0.15	<b>0.68</b>	0.47
Bread	-0.28	<b>0.59</b>	0.45
Meat	0.25	<b>0.54</b>	0.34
Rye bread	0.10	<b>0.47</b>	0.22
<i>Variance explained</i>	<i>19.11%</i>	<i>16.64%</i>	

NOTE:  $h^2$  = communality; loadings higher than |0.35| are shown in bold.

Table 3

Correlations between personality traits and dietary factor scores.

	Health aware diet factor				Traditional diet factor			
	Self-ratings		Informant-ratings		Self-ratings		Informant-ratings	
	Raw	Partial	Raw	Partial	Raw	Partial	Raw	Partial
<i>Correlations with personality domains</i>								
Neuroticism	-0.12**	-0.12**	-0.07*	-0.10**	0.04	0.09**	-0.01	0.04
Extraversion	0.11**	0.16**	0.08*	0.11**	-0.12**	-0.05	-0.09**	-0.04
Openness	0.16**	0.17**	0.12**	0.11**	-0.25**	-0.14**	-0.21**	-0.13**
Agreeableness	0.10**	0.03	0.06	0.02	0.00	0.01	-0.04	-0.02
Conscientiousness	0.16**	0.11**	0.14**	0.08*	-0.01	0.02	-0.04	0.01
<i>Significant correlations with personality facets</i>								
N1:Anxiety:	-0.07*	-0.09**	-0.03	-0.09**				
N3:Depression	-0.11**	-0.12**	-0.07*	-0.09**				
N4:Self-Consciousness	-0.12**	-0.12**	-0.07*	-0.10**				
N6:Vulnerability to Stress	-0.11**	-0.11**	-0.07*	-0.07*				
E1:Warmth:	0.14**	0.14**	0.08*	0.07*				
E2: Gregariousness	0.08*	0.10**	0.03	0.05	-0.07*	0.00	-0.06*	-0.03
E3:Assertiveness	0.10**	0.12**	0.09**	0.09**				
E4:Activity:	0.12**	0.13**	0.14**	0.13**	-0.09**	-0.03	-0.07*	-0.02
E6:Positive Emotion	0.13**	0.16**	0.08*	0.11**	-0.14**	-0.05	-0.11**	-0.04
O1:Fantasy:					-0.14**	-0.07*	-0.10**	-0.06*
O2:Aesthetics	0.20**	0.13**	0.13**	0.07*	-0.21**	-0.12**	-0.21**	-0.11**
O3:Feelings	0.14**	0.12**	0.11**	0.08**	-0.17**	-0.04	-0.15**	-0.04
O4:Actions:	0.16**	0.17**	0.12**	0.14**	-0.22**	-0.14**	-0.17**	-0.11**
O5:Ideas:	0.11**	0.14**	0.07*	0.07*	-0.11**	-0.09**	-0.11**	-0.09**
O6:Values:					-0.22**	-0.10**	-0.12**	-0.08*
A1:Trust:	0.18**	0.12**	0.09**	0.06*	-0.10**	-0.03	-0.08*	-0.05
C1:Competence	0.12**	0.10**	0.13**	0.10**				
C2:Order:	0.08*	0.04	0.09**	0.03				
C3:Dutifulness	0.13**	0.04	0.11**	0.03				
C4:Achievement Striving	0.13**	0.15**	0.11**	0.09**				
C5:Self-Discipline	0.11**	0.08*	0.10**	0.05				
C6:Deliberation	0.14**	0.08**	0.13**	0.07*				

NOTE: Self = self-reports; Informant = informant-ratings; Raw = zero-order correlations; Partial = partial correlations controlling for gender, age and educational level. \*\*  $p < 0.001$ , \*  $p < 0.01$ .