Introduction
Pregnancy is a unique window of opportunity to improve eating patterns. Pregnant women are encouraged by their health care professionals to have a healthy diet for the benefit of fetal development and the ability to carry a pregnancy to term without complications (McDermott et al., 2009; Wen et al., 2010). The 2015–2020 Dietary Guidelines from the U.S. Department of Agriculture recommends the general population, as well as women who are or would like to become pregnant, to consume 2½ cup-equivalents of vegetables, 2 cup-equivalents of fruit, and 3 cup-equivalents of dairy products every day, and at least 8 and up to 12 ounces of fish per week. In addition, the guidelines recommend limiting calories from saturated and trans fats, added sugar, and sodium (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). Recent estimates, however, show that about three-fourths of the population does not meet the recommendations and their daily intake of vegetables, fruits, and dairy is low (Krebs-Smith et al., 2010).
plausible mechanisms is that personality traits influence dietary choices.

Research suggests that healthful diets are particularly important during pregnancy because decreased fruit, vegetable, dairy, and fish intake is associated with an increased risk of gestational diabetes, significantly lower birth weight, small-for-gestational-age at birth, sporadic retinoblastoma in the infant, and pre-term birth (Herring and Oken, 2001; Mannion et al., 2006; Olsen and Secher, 2002; Orjuela et al., 2005; Ramón et al., 2009; Stube et al., 2009). An analysis of data from 19 studies showed that women who ate more than two servings of fish per week during pregnancy were at lower risk of having a small-for-gestational-age baby and a lower risk of preterm birth compared with those eating it less than once a month (Guldner et al., 2007; Leventakou et al., 2014; Meltzer et al., 2011). A moderate consumption of dairy products (2–3 servings per day) is positively associated with adequate fetal growth and birth weight (Brantsæter et al., 2012), whereas a low consumption of dairy (<2 servings) may negatively affect fetal bone development by limiting the amount of calcium provided to the fetus (Chang et al., 2003). Apart from providing essential nutrients during pregnancy, dietary habits are an important factor in maintaining an appropriate weight. A pre-pregnancy body mass index (BMI) is recognized as being one of the most important predictors of adverse maternal and infant outcomes (Vinturache et al., 2014), therefore, women who would like to get pregnant are encouraged to achieve and maintain a healthy weight (Groth and Kearney, 2009).

More recent evidence highlights the importance of an adequate maternal diet. Taking into account that dietary intervention can be conducted at a relatively low cost and provide significant health benefits during pregnancy, more and more researchers and health care professionals are interested in factors that can help achieve the recommended intake of fruit, vegetable, dairy, and fish among pregnant women. The determinants of eating behavior are complex and influenced by biological, developmental, social, cultural and economic factors (Chadwick et al., 2013; Furst et al., 2004; Elfhag and Morey, 2008; Terracciano et al., 2009; van den Bree et al., 2006), and avoid various forms of high-fat foods (Goldberg and Strycker, 2002).

Existing evidence of the association between personality traits and health-related behaviors in general populations indicates that dietary choices during pregnancy may also be driven in part by personality traits (Kikuchi and Watanabe, 2000; Möttus et al., 2012). This study is one of the first to examine the psychological predictors of fish, dairy, vegetable, and fruit intake in a representative group of pregnant women, which can help to extend our understanding of dietary patterns in this population and may inform the development of more effective interventions to improve diet quality during pregnancy. We hypothesized that openness to experience, extraversion, and conscientiousness would be positively associated with the intake of fruits, vegetables, fish and dairy during pregnancy, and neuroticism.
would be negatively associated with appropriate consumption of these food groups during pregnancy.

**Methods**

**Participants**

The sample consisted of 744 pregnant women who participated in the Measures of Maternal Stress (MOMS) Study, a comprehensive study that aimed to systematically develop reliable measures of maternal stress and investigate the correlates of maternal stress during pregnancy. Women were enrolled from prenatal clinics as part of a multisite prospective cohort study that included four geographically and racially diverse regions (Pittsburgh PA, Chicago IL, Schuylkill County PA, and San Antonio TX) between June 2013 and May 2015. Eligible participants were 18 years of age or older, carrying a singleton pregnancy, English-speaking, and had no evidence of fetal congenital or genetic anomalies. Participants were excluded if they did not provide data on dietary pattern and personality traits. A final sample for analysis included 602 women.

Detailed information on the socio-economic, health, and demographic characteristics of the study population used in this analysis were collected via survey at 12–20 weeks gestation, and after delivery via postpartum medical chart review. Prior to data collection, IRB approval was obtained at each participating site. All participants received 40 U.S. dollars for their participation.

**Measures**

**Personality traits.** Personality was measured using the NEO Five-Factor Inventory (NEO-FFI; Costa and McCrae, 1992). The NEO-FFI is a self-report questionnaire consisting of 60 items answered on a five-point Likert scale ranging from 0 (strongly disagree) to 4 (strongly agree). The NEO-FFI is a shortened version of the NEO Personality Inventory (the NEO-PI-R) and assesses neuroticism, extraversion, conscientiousness, agreeableness, and openness to experience; each of the five subscales is comprised of 12 items. Respondents were given a list of statements such as “I like to have a lot of people around me” and “Too often, when things go wrong, I get discouraged and feel like giving up.” The summary score for each domain ranges from 0 to 48. NEO-PI-R scales have shown longitudinal stability, cross-observer agreement, and convergent and discriminant validity in a large body of studies (Costa & McCrae, 1992).

**Fruit, vegetable, dairy, and fish intake.** Participants were asked to indicate how many servings of fruit, vegetables, and dairy they consumed in a typical day. A serving of fruit is equal to one small piece of fresh fruit about the size of a tennis ball, 1/2 cup of cut fruit, 1/4 cup of raisins, apricots, or other dried fruit, or 1/2 cup of 100% orange, apple, or grapefruit juice, and excludes fruit punch, lemonade, Gatorade, Sunny Delight, or fruit drinks. A serving of vegetables was defined as one medium carrot or other fresh vegetable, one cup of green salad, one cup of raw or 1/2 cup cooked vegetables, or 1/2 cup of vegetable juice, and did not include French fries, onion rings, potato chips, or fried okra. Dairy was defined as milk, cheese, soy, or yogurt products, with one serving equal to one cup of milk or soy milk, one slice of cheese, or one cup of yogurt. Finally, fish consumption was assessed on a monthly basis, with a single serving defined as 3 oz. of cooked fish. Participants could indicate that they did not know how many servings of these foods they typically consumed.

**Covariates.** Sociodemographic variables in this analysis included age, education, parity, pre-pregnancy body mass index (BMI) calculated as weight at first prenatal visit divided by the square of height, race/ethnicity, and income. Race/ethnicity was categorized as white, black, Hispanic, and other. Initially, educational attainment was categorized into three groups: “high school diploma or less”, “some college but no degree”, and “college and higher”. Annual household income was reported in brackets: under $15 000; $15 000–$50 000; $50 000–$100 000; and more than $100 000.

**Statistical analyses**

Separate hierarchical and logistic regression analyses were conducted to predict pregnant women’s fish, dairy, vegetable, and fruit consumption. Data were first screened for violations of univariate normality; none were detected. Potential covariates (education, income, age, and BMI) were entered together in the first block; personality traits were entered together in the second block to determine whether they explained a significant additional portion of variance in fruit, vegetable, dairy, and fish consumption. Taking into account consuming a diet poor in fruits, vegetables, and fish, may have detrimental effects on birth outcomes (Jarman et al., 2018), we also conducted additional exploratory analyses to see if fruit, vegetable, fish, and dairy consumption predicted birth outcomes. All significant differences or associations were based at $p < 0.05$ level. All analyses were conducted using SPSS 21.0 (SPSS, Inc., Chicago, IL).

**Results**

Characteristics of this sample are presented in Table 1. The mean age of the eligible 602 women was 29 years. The average pre-pregnancy BMI ($M=27.6$) of participants in our sample was above the normal range (18.5–24.9 BMI). The majority of participants in the sample were non-Hispanic white (61.8%), 19.3% were Hispanic white and 13% were black. The average monthly fish consumption was 2.7
Table 1. Characteristics of the study sample (n = 602).

| Variables                      | Pregnant women (n = 602) |
|--------------------------------|---------------------------|
|                                | M (SD)                    |
| Age                            | 29.4 (5.7)                |
| Body Mass Index (BMI)           | 27.65 (7.2)               |
| Educational level, n (%)        |                           |
| Less than a high school diploma | 26 (5.6)                  |
| or GED                         |                           |
| High school diploma or GED      | 53 (11.5)                 |
| Some college but no degree      | 82 (17.8)                 |
| Associate Degree               | 57 (12.4)                 |
| Bachelor’s Degree (e.g., BA, BS)| 111 (24.1)                |
| Post Graduate Degree           | 131 (28.4)                |
| Race/ethnicity, n (%)           |                           |
| Non-Hispanic white              | 285 (61.8)                |
| Black                          | 61 (13.2)                 |
| Hispanic                       | 89 (19.3)                 |
| Parity, n (%)                   |                           |
| Nulliparous                    | 273 (45.3)                |
| Multiparous                    | 329 (54.7)                |
| Personality traits, mean (SD)  |                           |
| Neuroticism                    | 18.1 (8.3)                |
| Extraversion                   | 29.2 (8.3)                |
| Openness to experience         | 26.4 (6.1)                |
| Conscientiousness              | 34.9 (8.7)                |
| Agreeableness                  | 30.09 (4.9)               |
| Food Consumption*              |                           |
| Fish                           | 2.71 (1.5)                |
| Dairy                          | 3.42 (1.1)                |
| Vegetables                     | 3.13 (1.1)                |
| Fruit                          | 3.32 (1.0)                |

SD = standard deviation.  
*Food consumption variables expressed in standard serving sizes.

servings (ranging from 1 to 5). Participants consumed on average 3.42 daily servings of dairy, 3.13 daily servings of vegetables, and 3.32 daily servings of fruit. These values meet the recommendations of the Dietary Guidelines for daily vegetable and fruit servings and exceed the recommendations for dairy servings. The numbers of servings reported for all of these foods ranged from one to five with no woman reporting eating less than one serving.

Results of hierarchical regression analyses predicting women’s fish, dairy, vegetable and fruit consumption

In the first step of hierarchical multiple regression, four predictors were entered: age, pre-pregnancy BMI, education attainment, and income. The model was statistically significant \( F(4,518)=8.662, p<0.000 \) and explained 6.3% of variance in fruit intake. Education attainment emerged as a significant predictor of fruit intake and remained a significant predictor, though partially reduced, after entering personality traits in the second block (\( \beta = 0.16, p<0.01 \)). The model predicting vegetable intake was significant \( F(4,518)=8.302, p<0.000 \) and explained 5.3% of the variance in vegetable intake. Income was a significant predictor of vegetable intake and remained significant even after controlling for other variables entered in the second block (\( \beta = 0.18, p<0.01 \)). For dairy intake, the model including covariates was not significant, \( F(4,518)=1.7; p=0.15 \). There was no relationship between the demographic variables and dairy consumption. In the model predicting fish consumption, the covariates significantly predicted the number of servings consumed monthly, accounting for 7.7% of variance, \( F(4,515)=10.75, p<0.001 \). Higher education, age, and income were associated with increased fish consumption but only income and education attainment remained significant predictors after controlling for personality traits (\( \beta = 0.17, p<0.05; \beta = 0.21, p=0.05 \) respectively). Higher income was also associated with an increased likelihood of exercising during pregnancy (OR = 1.40, 95% CI 1.09–1.78, \( p=0.007 \)).

The personality traits, entered in the second step, significantly predicted fruit intake, above and beyond the demographic factors, \( F(9, 513)=5.502, p<0.000 \). However, the addition of personality traits only slightly improved prediction of fruit intake \( [R^2 \text{ change} = 0.025] \). As shown in Table 2, only openness to experience emerged as a significant predictor of fruit intake (\( \beta = 0.10, p=0.02 \)). Openness to experience was also a significant predictor of vegetable intake (\( \beta = 0.18, p<0.000 \)). After personality traits have been included in a model predicting vegetable intake, the model remained significant, \( F(9,513)=6.740, p<0.001 \), and explained 10.6% of variance (see Table 3). In the model predicting dairy intake, neither the covariates nor personality traits were significant predictors, \( F(9, 513)=1.00, p=0.436 \) (see Table 4). Including personality traits significantly predicted fish consumption above and beyond the covariates \( F(9, 510)=6.28, p=0.026 \), but accounted only for an additional 2.5% of variance. Lower scores on agreeableness (\( \beta = -0.11, p<0.05 \)) and higher scores on openness to experience (\( \beta = 0.12, p<0.01 \)) emerged as significant predictors of fish consumption, even after controlling for demographic variables (see Table 5). High levels on extraversion were associated with an increased likelihood of exercising during pregnancy (OR = 1.05, 95% CI 1.01–1.08, \( p=0.02 \)).

Diet, personality traits and birth outcomes

Additional exploratory analyses were performed to identify which variables might account for birth outcomes such as child’s birth weight, preterm delivery (defined as giving birth between 22 and 37 weeks of pregnancy), postpartum hemorrhage (defined as a blood loss of 500 ml or more within 24 hours after birth), and small for gestational age.
birth (SGA, defined as birthweight less than the 10th percentile for the gestational age at birth according to gender-specific national norms). Hierarchical or logistic regression analyses were used to determine the association of birth outcomes and fruit, vegetable, dairy, and fish intake, controlling for demographic variables, prenatal smoking and alcohol consumption, and indication for delivery (spontaneous term labor, induced term labor, spontaneous preterm labor, medically indicated/induced preterm labor, scheduled term cesarean section, medically indicated scheduled preterm cesarean section). As shown in Table 6, smoking during pregnancy ($\beta = -0.12, p = 0.02$) and dairy intake ($\beta = 0.12, p < 0.02$) were significant predictors of birth weight. None of the other variables were associated with birth outcomes, therefore, results for these outcomes are not presented.

**Discussion**

There is growing evidence that personality also plays a significant role in dietary habits but previous work has focused on general populations and has not addressed the relationship between personality and diet among pregnant women. This study sought to extend previous research by examining the link between personality traits and a healthy diet as well as the relationship between diet and birth outcomes.

---

**Table 2.** Summary of Hierarchical Regression analysis for variables predicting Fruit Intake.

| Model | $\beta$  | B     | Beta  | t     | Sig  | Tolerance | VIF  |
|-------|----------|-------|-------|-------|------|-----------|------|
| 1     | (Constant) | 2.933 | 0.332 | 8.842 | 0.000 | 0.743     | 1.345|
|       | Age      | -0.013| 0.010 | -0.065| -1.321| 0.187     | 0.743|
|       | Education| 0.266 | 0.076 | 0.198 | 3.499 | 0.001     | 0.565|
|       | Income   | 0.101 | 0.060 | 0.096 | 1.680 | 0.094     | 0.558|
|       | BMI      | -0.003| 0.007 | -0.019| -0.423| 0.673     | 0.893|
| 2     | (Constant) | 1.883 | 0.723 | 2.603 | 0.010 | 0.722     | 1.386|
|       | Age      | -0.013| 0.010 | -0.069| -1.394| 0.164     | 0.722|
|       | Education| 0.218 | 0.077 | 0.162 | 2.835 | 0.005     | 0.545|
|       | Income   | 0.075 | 0.060 | 0.072 | 1.252 | 0.211     | 0.543|
|       | BMI      | -0.002| 0.007 | -0.010| -0.228| 0.820     | 0.886|
|       | Neuroticism| -0.006| 0.007 | -0.040| -0.795| 0.427     | 0.714|
|       | Extraversion | 0.008 | 0.009 | 0.045 | 0.924 | 0.356     | 0.733|
|       | Openness | 0.018 | 0.008 | 0.010 | 2.320 | 0.021     | 0.939|
|       | Agreeableness| 0.014 | 0.009 | 0.076 | 1.487 | 0.138     | 0.684|
|       | Conscientiousness| 0.006 | 0.015 | 0.018 | 0.379 | 0.705     | 0.833|

Dependent variable: Fruit Intake.

**Table 3.** Summary of hierarchical regression analysis for variables predicting vegetable intake.

| Model | $\beta$  | B     | Beta  | t     | Sig  | Tolerance | VIF  |
|-------|----------|-------|-------|-------|------|-----------|------|
| 1     | (Constant) | 2.284 | 0.336 | 6.802 | 0.000 | 0.565     | 1.769|
|       | Education group | 0.037 | 0.077 | 0.027 | 0.484 | 0.629     | 1.345|
|       | Age      | 0.010 | 0.010 | 0.051 | 1.029 | 0.304     | 0.722|
|       | Income   | 0.209 | 0.061 | 0.196 | 3.445 | 0.001     | 0.558|
|       | BMI      | -0.002| 0.007 | -0.009| -0.208| 0.835     | 0.893|
| 2     | (Constant) | 1.252 | 0.724 | 1.729 | 0.084 | 0.545     | 1.386|
|       | Education | -0.016| 0.077 | -0.012| -0.206| 0.837     | 0.545|
|       | Age      | 0.011 | 0.010 | 0.056 | 1.143 | 0.254     | 0.722|
|       | Income   | 0.178 | 0.060 | 0.167 | 2.953 | 0.003     | 0.543|
|       | BMI      | 0.000 | 0.007 | -0.003| -0.059| 0.953     | 0.886|
|       | Openness | 0.032 | 0.008 | 0.178 | 4.121 | 0.000     | 0.939|
|       | Neuroticism| -0.008| 0.007 | -0.057| -1.155| 0.249     | 0.714|
|       | Extraversion | 0.016 | 0.009 | 0.085 | 1.747 | 0.081     | 0.733|
|       | Agreeableness| -0.005| 0.009 | -0.027| -0.526| 0.599     | 0.684|
|       | Conscientiousness| 0.008 | 0.016 | 0.022 | 0.485 | 0.628     | 0.833|

Dependent variable: Vegetable Intake.
As hypothesized, our study demonstrated that openness to experience is associated with increased consumption of fruits, vegetables, and fish during pregnancy.

Our findings are consistent with previous studies identifying a relationship between sociodemographic variables and a healthy diet in general population. The positive associations between educational attainment, age, and vegetable and fruit consumption demonstrated here are consistent with previous studies (Darmon and Drewnowski, 2008; Mõttus et al., 2012; Tryggvadottir et al., 2016), and we also found that more educated and older women consumed more fish than younger and less educated women. Additionally, we found that women with lower income consumed significantly less vegetables. These findings are in line with previous results showing that vegetable consumption is related to household income, wherein the increased cost of vegetables compared to processed foods can be a significant barrier for low-income households (Erber et al., 2010; Prelip et al., 2011).

Our results indicate that personality traits are significant predictors of fish, vegetable, and fruit consumption during pregnancy. Women who identified as more open to experience consumed more fish, vegetables, and fruit. Openness is a consistent predictor of healthy diet in the literature (Conner et al., 2017; Tiainen et al., 2013). These results confirm previous findings in the general population that openness to experience is a key predictor of fruit and vegetable consumption (Tiainen et al., 2013). Individuals high
on openness tend to be curious, flexible, open-minded, and willing to explore the environment. In contrast, individuals with low openness to experience tend to have little interest in unfamiliar environments and have a more conventional attitude toward values (Costa and McCrae, 1992). It may be that pregnant women who scored high in openness were more likely to change their diet and try new or different products to improve their nutrition during pregnancy, while women who scored low on this trait may have been more likely to keep with their typical diet and avoid novel products.

The 6.3% of variance in vegetable, and fruit consumption attributable to differences in personality traits in this study is similar to that reported by de Bruijn et al. (2005) who found that openness to experience explained 6% of variance in fruit intake and 3% in vegetable intake among adolescents. The results are also supported by other studies that demonstrated the association between openness and increased fruit and vegetable intake in different age groups ranging from school-children to older adults (Kikuchi and Watanabe, 2000; Mõttus et al., 2012, 2013; Myrdal et al., 2016). Although pregnant women are highly motivated to improve their diets and tend to reduce the amount of fast food and artificially sweetened beverages they consume after learning about their pregnancy (Verbeke and Bourdeaudhuij, 2007), pregnant women, similar to the general population, not consume the recommended amounts of fruit, vegetable, fish and dairy intake, it is important to identify factors that can help with adherence to a healthy diet. Our findings have important implications and may aid health care practitioners in encouraging the compliance to dietary recommendations. Maternal diet is thought to be a modifiable factor for adverse pregnancy and birth outcomes (Abu-Saad and Fraser, 2010; Bandoli et al., 2010). Adherence to a healthy and well-balanced diet have the potential not only to reduce a broad range of adverse health effects such as malnutrition or obesity (Mytton et al., 2014), but also offers opportunities for chronic disease prevention and establishing healthy behaviors that could continue into post-pregnancy period. More importantly, research demonstrates a strong parental influence on food consumption and preference in children (Vollrath et al., 2012). If a woman seeks out new, nutrient-dense foods to incorporate into her diet, her child can gain exposure to different tastes and a variety of healthy products. Therefore, interventions among pregnant women could subsequently and indirectly promote healthier eating behavior for her offspring. Further examination of this association is needed in the future work.

Our results show that different factors contributed to the variation in fruit, vegetable, and fish consumption by pregnant women. The results also illustrate the potential benefits of incorporating personality traits into interventions promoting positive health behavior during pregnancy. For example, an intervention conducted by Magidson et al. (2014) demonstrated that it is possible to modify personality traits associated with healthy lifestyle habits by engaging in conscientious-like activities and

Table 6. Predictors of birth weigh.

| Model | $\beta$ | $B$ | Beta | $t$ | Sig | Tolerance | VIF |
|-------|--------|-----|------|----|-----|-----------|-----|
| 1     | 3282.69 | 189.52 | 17.321 | 0.000 | 0.906 | 1.104 |
| Age   | 3.388  | 4.937 | 0.035 | 0.686 | 0.493 | 0.914 | 1.036 |
| Smoking | $-176.68^*$ | 78.700 | $-0.110$ | $-2.245$ | 0.025 | 0.966 | 1.080 |
| Alcohol | $-5.578$ | 86.576 | $-0.003$ | $-0.064$ | 0.949 | 0.978 | 1.023 |
| BMI   | 7.533  | 4.037 | 0.093 | 1.866 | 0.063 | 0.941 | 1.063 |
| Parity | 29.833 | 26.296 | 0.058 | 1.135 | 0.257 | 0.892 | 1.121 |
| Delivery reason | $-169.6^{**}$ | 52.503 | $-0.159$ | $-3.230$ | 0.001 | 0.959 | 1.043 |
| 2     | 3080.986 | 226.642 | 13.594 | 0.000 | 0.838 | 1.193 |
| Age   | 3.414  | 5.118 | 0.035 | 0.667 | 0.505 | 0.926 | 1.080 |
| Smoking | $-194.93^*$ | 80.165 | $-0.121$ | $-2.432$ | 0.015$^*$ | 0.910 | 1.030 |
| Alcohol | $-9.829$ | 86.642 | $-0.006$ | $-0.113$ | 0.900 | 0.936 | 1.069 |
| BMI   | 7.695  | 4.037 | 0.095 | 1.906 | 0.057 | 0.944 | 1.128 |
| Parity | 31.248 | 26.306 | 0.061 | 1.188 | 0.236 | 0.886 | 1.355 |
| Delivery reason | $-160.49^*$ | 52.780 | $-0.150$ | $-3.041$ | 0.003 | 0.944 | 1.059 |
| Fruit  | $-14.644$ | 28.411 | $-0.029$ | $-0.515$ | 0.607 | 0.749 | 1.335 |
| Vegetables | 10.992 | 28.433 | 0.022 | 0.387 | 0.699 | 0.734 | 1.362 |
| Diary  | 56.388$^*$ | 23.583 | 0.117 | 2.391 | 0.017 | 0.962 | 1.040 |
| Fish   | 1.795  | 19.131 | 0.005 | 0.094 | 0.925 | 0.816 | 1.225 |

* $p < 0.05$; ** $p < 0.01$.
thus creating healthier patterns of behavior. Taking into account that women who have high levels of openness tend to eat more vegetables and fruit, health care professionals might encourage all pregnant women to try new, nutritious products which may be especially motivational for these individuals. Exposure to novel and healthful products may result in increased consumption of said healthful products, which may in turn increase liking of the products and facilitate adherence to dietary recommendations over time (Cooke, 2007).

The strength of our study is that we employed a large, demographically diverse sample size. However, some limitations should be also noted. One issue that arises from using the secondary data is that we relied on self-report measures, therefore, there is a possibility that pregnant women were subject to social desirability bias (Hebert et al., 1995). The second limitation is that fruit, vegetable, fish, and dairy consumption was measured by asking participants to indicate a number for servings per day using cup equivalent values. It may be hard to judge for some participants what a serving size is and it can therefore cause errors in estimation. In order to help participants recall how much food they consumed, future research should use visual cues providing examples of one cup equivalents. Such solution has proven to be effective (Almiron-Roig et al., 2013). Another limitation is that we do not know pre-pregnancy dietary patterns of women who participated in this study. Finally, these were cross-sectional; the participants were interviewed only once. Thus we are unable to make inferences about dietary changes. Future work needs to include measures that capture multiple time points (prior, during and post-pregnancy) to gain deeper insights into the process linking personality traits and dietary habits.

Our findings demonstrating that one of the personality traits, openness to experience, is associated with an increased consumption of fruit, vegetable, and fish intake may have implications for promoting a healthy diet among pregnant women. Given that personality traits can explain some of the variance in the dietary patterns of pregnant women, it may be useful to assess personality traits as part of prenatal care and encourage women to try new fruits and vegetables in order to increase intake of healthful foods during pregnancy and in turn improve their health.

**Authors’ note**

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

**Declaration of conflicting interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by: HHSN275201200007—HHSN27500005. National Children’s Study: Vanguard Study–Task Order 5: Stress and Cortisol Measurement for the National Children’s Study. Dr. Ann Borders was the recipient of the grant.

**ORCID iD**

Magdalena Leszko https://orcid.org/0000-0002-9985-0325

**References**

Abu-Saad K and Fraser D (2010) Maternal nutrition and birth outcomes. *Epidemiologic Reviews* 32: 5–25.

Almiron-Roig E, Solis-Trapala I, Dodd J, et al. (2013) Estimating food portions. Influence of unit number, meal type and energy density. *Appetite* 71: 95–103.

Bandoli G, Johnson DL, Jones KL, et al. (2010) Potentially modifiable risk factors for adverse pregnancy outcomes in women with psoriasis. *The British Journal of Dermatology* 163(2): 334–339.

Bogg T and Roberts BW (2004) Conscientiousness and health-related behaviors: A meta analysis of the leading behavioral contributors to mortality. *Psychological Bulletin* 130: 887–919.

Booth-Kewley S and Vickers RR Jr (1994) Associations between major domains of personality and health behavior. *Journal of Personality* 62: 281–298.

Brantsæter AL, Olaðsdottir AS, Forsum E, et al. (2012) Does milk and dairy consumption during pregnancy influence fetal growth and infant birth weight? A systematic literature review. *Food & Nutrition Research* 56: 20050.

Chadwick PM, Crawford C and Ly L (2013) Human food choice and nutritional interventions. *British Nutrition Foundation Nutrition Bulletin* 38: 36–42.

Chang S-C, O’Brien KO, Nathanson MS, et al. (2003). Fetal femur length is influenced by maternal dairy intake in pregnant African American adolescents. *The American Journal of Clinical Nutrition* 77: 1248–1254.

Charlton K, Kowal P, Soriano MM, et al. (2014) Fruit and vegetable intake and body mass index in a large sample of middle-aged Australian men and women. *Nutrients* 6: 2305–2319.

Conner TS, Thompson LM, Knight RL, et al. (2017) The role of personality traits in young adult fruit and vegetable consumption. *Frontiers in Psychology* 8: 119.

Cooke L (2007) The importance of exposure for healthy eating in childhood: A review. *Journal of Human Nutrition and Dietetics : The Official Journal of the British Dietetic Association* 20(4): 294–301.

Costa PT and McCrae RR (1992). *Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEOFFI) Professional Manual*. Odessa, FL: Psychological Assessment Resources.

Cruzier SR, Robinson SM, Borland SE, et al. (2009) Do women change their health behaviours in pregnancy? Findings from the Southampton Women’s Survey. *Paediatric and Perinatal Epidemiology* 23: 446–453.
Darmon N and Drewnowski A (2008) Does social class predict diet quality? *The American Journal of Clinical Nutrition* 87(5): 1107–1117.

de Bruijn GJ, Kremers SP, van Mechelen W, et al. 2005. Is personality related to fruit and vegetable intake and physical activity in adolescents? *Health Education Research* 20: 635–644.

Elfhag K and Morey LC (2008) Personality traits and eating behavior in the obese: Poor self-control in emotional and external eating but personality assets in restrained eating. *Eating Behaviors* 9(3): 285–293.

Emanuel AS, McCully SN, Gallagher KM, et al. (2012) Theory of Planned Behavior Explains Gender Difference in Fruit and Vegetable Consumption. *Appetite* 59(3): 693–697. http://doi.org/10.1016/j.appet.2012.08.007

Erber E, Beck L, Hopping BN, et al. (2010) Food patterns and socioeconomic indicators of food consumption amongst Inuit and Inuitulit in the Canadian Arctic. *Journal of Human Nutrition and Dietetics* 23(1): 59–66.

Evers C, Stok M, Danner UN, et al. (2011) The shaping role of hunger on self-reported external eating status. *Appetite* 57: 318–320.

Furst T, Connors M, Bisogni CA, et al. (1996) Food choice: A conceptual model of the process. *Appetite* 26: 247–266.

Goldberg LR and Strycker LA (2002) Personality traits and eating habits: The assessment of food preferences in a large community sample. *Personality and Individual Differences* 32: 49–65.

Groth SW and Kearney MH (2009) Diverse women’s beliefs about weight gain in pregnancy. *Journal of Midwifery & Women’s Health* 54(6): 452–457.

Guelinckx I, Devlieger R, Mullie P, et al. (2010) Effect of lifestyle intervention on dietary habits, physical activity, and gestational weight gain in obese pregnant women: a randomized controlled trial. *The American Journal of Clinical Nutrition* 91: 373–380.

Guenther PM, Dodd KW, Reedy J, et al. (2006) Most Americans eat much less than recommended amounts of fruits and vegetables. *Journal of the American Dietetic Association* 106: 1371–1379.

Guldner L, Monfort C, Rouget F, et al. (2007) Maternal fish and shellfish intake and pregnancy outcomes: A prospective cohort study in Brittany, France. *Environmental Health* 6: 33.

Hamburg ME, Finkenauer C and Schuengel C (2014) Food for love: The role of food offering in empathic emotion regulation. *Frontiers in Psychology* 5: 32.

Heaven PC, Mulligan K, Merrilees R, et al. (2001). Neuroticism and conscientiousness as predictors of emotional, external, and restrained eating behaviors. *The International Journal of Eating Disorders* 30: 161–166.

Hebert JR, Clemow L, Pbert L, et al. (1995) Social desirability bias in dietary self-report may compromise the validity of dietary intake measures. *International Journal of Epidemiology* 24: 389–398.

Herring SJ and Oken E (2001) Weight gain in pregnancy: Importance for maternal and child health. (Review). *Annales Nestlé* 68: 17–28.

Jarman M, Mathe N, Ramazani F, et al. (2018) Dietary patterns prior to pregnancy and associations with pregnancy complications. *Nutrients* 10(7): 914.

Keller C and Siegrist M (2015) Does personality influence eating style and food choices? Direct and indirect effects. *Appetite* 84: 128–138.

Kikuchi Y and Watanabe S (2000) Personality and dietary habits. *Journal of Epidemiology* 10: 191–198.

Kimmons J, Gillespie C, Seymour J, et al. (2009) Fruit and vegetable intake among adolescents and adults in the United States: percentage meeting individualized recommendations. *The Medscape Journal of Medicine* 11: 26.

Koren R, Munn-Chernoff MA, Duncan AE, et al. (2014) Is the relationship between binge eating episodes and personality attributable to genetic factors? *Twin Research and Human Genetics : The Official Journal of the International Society for Twin Studies* 17(2): 65–71.

Krebs-Smith SM, Guenther PM, Subar AF, et al. (2010) Americans do not meet federal dietary recommendations. *The Journal of Nutrition* 140(10): 1832–1838.

Leventakou V, Roumeliotaki T, Martinez D, et al. (2014) Fish intake during pregnancy, fetal growth, and gestational length in 19 European birth cohort studies. *The American Journal of Clinical Nutrition* 99: 506–516.

Magidson JF, Roberts B, Collado-Rodriguez A, et al. (2014) Theory-driven intervention for changing personality: expectancy value theory, behavioral activation, and conscientiousness. *Developmental Psychology* 50: 1442–1450.

Mannion CA, Gray-Donald K and Koski KG (2006) Association of low intake of milk and vitamin D during pregnancy with decreased birth weight. *CMAJ : Canadian Medical Association Journal* 174(9): 1273–1277.

Martin LR, Friedman HS and Schwartz J. E. (2007). Personality and mortality risk across the lifespan: The importance of conscientiousness as a biopsychosocial attribute. *Health Psychology* 26: 428–436.

McDermott R, Campbell S, Li M, et al. (2009) The health and nutrition of young indigenous women in north Queensland—intergenerational implications of poor food quality, obesity, diabetes, tobacco smoking and alcohol use. *Public Health Nutrition* 12: 2143–2149.

Meltzer HM, Brantseter AL, Nilsen RM, et al. (2011) Effect of dietary factors in pregnancy on risk of pregnancy complications: results from the Norwegian Mother and Child Cohort Study. *The American Journal of Clinical Nutrition* 94(6): 1970S–1974S.

Miyake Y, Sasaki S, Tanaka K, et al. (2010) Consumption of vegetables, fruit, and antioxidants during pregnancy and wheeze and eczema in infants. *Allergy* 65: 758–765.

Mytton OT, Nsoah K, Eyles H, et al. (2014) Systematic review and meta-analysis of the effect of increased vegetable and fruit consumption on body weight and energy intake. *BMC Public Health* 14: 886.

Meier BP, Moeller SK, Riemer-Peltz M, et al. (2012). Sweet taste preferences and experiences predict prosocial inferences, personalities, and behaviors. *Journal of Personality and Social Psychology* 10: 163–174.

Möttus R, McNeill G, Jia X, et al. (2013) The associations between personality, diet and body mass index in older people. *Health Psychology : Official Journal of the Division of Health Psychology, American Psychological Association* 32(4): 353–360.
