

# Personality Traits, Type of Motivation and Diet Duration Are Associated With the Risk of Orthorexia Nervosa in Vegetarians – a Cross-sectional Study

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## Research article

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2   **orthorexia nervosa in vegetarians – a cross-sectional study**

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24 **ABSTRACT:**

25 **Objectives:** There are reports that vegetarians, due to the specificity of their diet, may be at  
26 risk of orthorexia nervosa (ON), although researchers' opinions are not consistent. The aim of  
27 the study was to determine the relationship between the motivation to use vegetarian diet and  
28 the personality traits as well as the tendency to ON.

29 **Methods:** The study group comprised 480 vegetarians aged 18-40 years (414 women) divided  
30 into 3 groups: G1 - semi-vegetarians (n=60), G2 - lacto-ovo-vegetarians, ovo-vegetarians,  
31 lacto-vegetarians (n=238) and G3 - vegans, raw foodists and fruitarians (n=182). The  
32 questionnaire determining the motivation for vegetarian diet, Neuroticism-Extraversion-  
33 Openness - Five Factor Inventory Personality Inventory and Bratman Test of Orthorexia were  
34 used.

35 **Results:** No significant differences in the level of ON risk were observed between the groups.  
36 BMI was significantly lower in G3 than in G1 and G2. In G3 vegetarian diet was used for the  
37 longest time, and the highest level of ethical and health motivation to undertake this diet  
38 compared to the other respondents was seen ( $p<0.0001$ ). The study revealed the lowest level  
39 of agreeableness in the G1. The neuroticism, extraversion, conscientiousness and ethical  
40 motivation to diet were positive predictors of ON, while agreeableness and experience with  
41 diet were its negative predictors ( $F=9.26$ ,  $p<0.001$ ,  $R^2=0.12$ ).

42 **Conclusion:** It is concluded that personality traits, type of motivation to undertake a  
43 vegetarian diet and diet duration are associated with the risk of ON in vegetarians.

44

45 **Level of Evidence:** Level V, cross-sectional descriptive study

46

47 **Keywords:** orthorexia nervosa, vegetarians, personality, motivation to diet, predictors of  
48 orthorexia

49

50      **Background**

51            The subject of healthy nutrition has become extremely popular in the world. A number  
52        of diets have been created to protect us from diseases, and some of them are also ideologically  
53        justified. One of the proposals is vegetarianism, which popularity in the world is constantly  
54        growing. There are many reasons why people choose vegetarian diet and these motivations,  
55        can also dynamically change and develop already during its use [1-3]. Researchers used to  
56        divide the motivation to become a vegetarian into two main categories: health and ethics.  
57        Health motivation was based on own benefits (maintaining good health, weight loss), and  
58        ethical on the rights and welfare of animals or planet. Currently, the motivation, most  
59        frequently mentioned in the literature, is: health, ethics, religious views and spirituality, the  
60        importance of taste values and the influence of culture and society [1,4,5]. It is believed that a  
61        vegetarian diet is effective in the prevention of many diseases, e.g. type 2 diabetes, obesity,  
62        ischemic heart disease, atherosclerosis and some cancers [6].

63            While the introduction of healthy eating habits is a desirable behaviour, the lack of  
64        distance from information about healthy eating and too much attachment to the ideology  
65        associated with it, can lead to the exclusion of entire food groups from the menu, what in turn  
66        can lead to orthorexia nervosa (ON) [7,8]. Dunn and Bratman [9], proposing criteria of ON,  
67        focus on obsessive concentration on healthy eating, dietary restrictions and the introduction of  
68        nutritional principles which violation evokes fear and shame. Such eating pattern can lead to  
69        medical complications, including malnutrition, problems in social functioning and distorted  
70        body image. People suffered from ON are convinced of the harmfulness of some foods and/  
71        or how they are processed. It makes them to avoid some food in an obsessive way, and any  
72        deviation from the diet causes fear and feeling of guilt [10]. People with ON impose  
73        discipline in the area of diet and spend a lot of time planning meals. Sometimes, they avoid  
74        eating in public places, often isolating themselves from others, eat meals alone. Successively

75 further products from their diet are excluded. Thanks to such behaviour, they are convinced  
76 that they are better than people who do not pay attention to the quality of diet. They also have  
77 a need to convince others to their views on nutrition [11,12].

78 There are unclear and ambiguous reports on the relationship between ON and  
79 vegetarianism and its variants [13]. Some researchers show that people on a vegetarian diet  
80 may be at greater risk of ON than the rest of the population, especially vegans [8,14-16]. In  
81 the research of Bardone-Cone et al. [5] respondents who struggled with eating disorders more  
82 often undertook a vegetarian diet to avoid suspicions that the diet was used due to lose weight.  
83 Other studies have shown that eating disorders were more common among people who said  
84 they were on a vegetarian diet to reduce weight [17,18]. In 2021 Brytek-Matera [19]  
85 published the review where showed the evidence indicating that vegetarians report more  
86 orthorexic behaviours. According to Dittfeld et al. [18] a frequent reason for using a  
87 vegetarian diet is the desire to improve health, and often people with ON are guided by the  
88 same motivation. It is pointed out that health and ethical motivation are the strongest  
89 predictors of the evolution of a vegetarian diet into an increasingly restrictive one [3].  
90 However, other researchers report that ethical motivation and religious considerations are  
91 secondary predictors of ON [20]. Barthels et al. [21] emphasize that the risk of ON among  
92 vegetarians is associated with the use of diet to improve their health and appearance, and not  
93 with the desire to improve animal welfare, ethics or politics. They show that vegetarian  
94 lifestyle is not directly related to the risk of ON, but rather depends on the motivation for its  
95 use.

96 There are no definitive data on personality risk factors for ON. Research using Big  
97 Five factors - neuroticism, extraversion, openness to experience, conscientiousness and  
98 agreeableness - is scarce. The research by Gleaves et al. [22], conducted on American  
99 undergraduate students, has shown that there is a relationship between neuroticism and ON. In

100 turn, in the Forester [23] study, ON was associated with a higher level of neuroticism,  
101 openness to experience and conscientiousness. Whereas, Strahler et al. [24] found that ON  
102 was negatively associated with agreeableness. Research shows that personality traits affect  
103 specific nutritional behaviours [25,26]. At the same time, it is known that vegetarians show a  
104 different intensity of individual personality traits compared to the rest of the population.  
105 Vegetarians are characterised by higher openness to experience and lower conscientiousness  
106 compared to the group that eats traditionally, and there is a negative correlation between  
107 openness to experience [27], agreeableness and conscientiousness with meat consumption. In  
108 turn, the Forestell and Nezlek [28] study showed that vegetarians are more open to  
109 experience, neurotic, but also depressive compared to the meat-consuming group.  
110 Due to exploratory nature of this study, the hypothesis was not made. The aim of this study is  
111 to determine the relationship between the motivation to use a vegetarian diet and the  
112 personality traits as well as a tendency to ON. Answers to 3 basic research questions were  
113 sought:

- 114 1. Are vegetarian groups different in terms of the risk of ON, body weight, personality traits  
115 and types of motivation to undertake a vegetarian diet?
- 116 2. Are the personality traits of vegetarians related to motivation for a vegetarian diet?
- 117 3. What factors increase the risk of ON in vegetarians?

118

## 119 **Methods**

### 120 *Participants and procedures*

121 A targeted sample selection was used for the vegetarian diet and age. This cross-sectional  
122 study involved 480 volunteers, who finished the survey. The age of participants was 18 to 40  
123 years. The survey was conducted in March 2019 using the Internet method, via the Lime  
124 Survey platform. The study procedure was approved by the Bioethics Committee of the

125 Medical University of Silesia (Approval PCN/0022/KB/276/19). Participation was fully  
126 voluntary and anonymous, respondents expressed an informed consent to participate in the  
127 study by signing at the beginning a statement attached to the study. General instructions and  
128 instructions for individual questionnaires were attached to the study. Respondents were asked  
129 to fill in the data sheet and three questionnaires, the whole procedure lasted about 20 minutes.  
130 Due to the significant disproportion of participants declaring different types of vegetarian  
131 diets, the subjects were finally divided into three groups, guided by the main criterion of  
132 consuming products of animal origin and meat:

- 133 • G1 - comprised 60 semi-vegetarians, eating plant, dairy, eggs and partly meat products  
134 (e.g. fish and poultry)
- 135 • G2 - comprised 268 lacto-ovo-vegetarians, ovo-vegetarians and lacto-vegetarians; they  
136 do not eat meat, but eat other animal products (eggs, dairy products)
- 137 • G3 - comprised 182 vegans, raw foodists and fruitarians; not consuming meat or other  
138 animal products (eating only products of plant origin).

139

#### 140 *Measures & statistical analyses*

141 The survey used a data sheet and three questionnaires: own questionnaire, determining the  
142 motivation for a vegetarian diet (M. Pawlak), Neuroticism-Extraversion-Openness - Five  
143 Factor Inventory (NEO-FFI) Personality Inventory P.T. Costa, R.R. McCrae [29] and  
144 Bratman Test of Orthorexia (BOT) S. Bratman [11].

145 The data sheet includes questions about age, sex and education. Respondents also declared  
146 their current body weight and height and on this basis body mass index (BMI, kg/m<sup>2</sup>) was  
147 calculated. The own questionnaire consists of 5 questions regarding five types of motivation  
148 to undertake a vegetarian diet: health, ethics, spirituality and religion motivation, motivation

149 related to taste preferences and cultural and social conditions. The surveyed responded to each  
150 statement on a Likert type scale: 1 (*definitely not*) - 5 (*definitely yes*).

151 The NEO-FFI Personality Inventory was used to measure 5 basic personality dimensions. It  
152 consists of 60 items falling within the range of 5 scales: neuroticism, extraversion, openness  
153 to experience, agreeableness and conscientiousness. Each item is a statement that a  
154 respondent can respond to on a five-point Likert scale 1 (*strongly disagree*) - 5 (*strongly  
155 agree*).

156 The BOT consists of 10 questions, to which the respondent answers 'yes' or 'no'. One point is  
157 awarded for each affirmative answer. If the respondent scores less than 5 points, he is  
158 considered a person with a correct attitude to food, 5 - 9 points means "fanaticism of healthy  
159 eating", while 10 points is synonymous with ON [11].

160 A statistical analysis of the data was performed using SPSS Statistics 25. The  
161 distribution was verified by the Kolmogorov-Smirnov and Shapiro-Wilk tests. Due to most of  
162 the data characterised with non-normally distribution, Kruskal-Wallis followed by the least-  
163 significant difference (LSD) test for multiple comparisons when applicable, R-Spearman and  
164 the analysis of regression (the forward selection method) were used. All values were  
165 expressed as mean (standard deviation) and the level of statistical significance was set to  
166  $p<0.05$ .

167 **Results**

168 Sociodemographic, psychological and clinical characteristics of the study group is  
169 presented in Table 1.

170

171 **Table 1.** Sociodemographic, psychological and clinical characteristics of the study group

Variable	G1 (n=60)	G2 (n=238)	G3 (n=182)
----------	--------------	---------------	---------------

		n (%)	n (%)	n (%)
Sex	Woman	52 (86.7)	212	150 (82.4)
	Man	8 (13.3)	(89.1)	32 (17.6)
			26 (10.9)	
Education	Primary	-	1 (0.4)	1 (.5)
	Jr secondary	2 (3.3)	6 (2.5)	9 (4.9)
	Vocational	1 (1.7)	1 (0.4)	5 (2.7)
	Secondary	23 (38.3)	124	74 (40.7)
	Higher	34 (56.7)	(52.1)	93 (51.1)
106 (44.5)				
BMI	Underweight	9 (15)	27 (11.3)	38 (20.9)
	Normal weight	35 (58.3)	170	123 (67.6)
	Overweight	13 (21.7)	(71.4)	18 (9.9)
	Obesity	1 (5)	29 (12.2)	3 (1.6)
10 (4.2)				
Tendency to orthorexia	Normal attitude to eating	42 (70)	179 (75.2)	129 (70.9)
	Fanaticism of healthy nutrition	18 (30)		52 (28.6)
	Orthorexia	- (-)	59 (24.8)	1 (.5)
- (-)				

172 G1: semi-vegetarians, G2: lacto-ovo-vegetarians, ovo-vegetarians and lacto-vegetarians, G3:  
173 vegans, raw foodists and fruitarians; BMI (body mass index): underweight <18.5 kg/m<sup>2</sup>,  
174 normal weight 18.5-24.9 kg/m<sup>2</sup>, overweight 25-29.9 kg/m<sup>2</sup>, obesity >30 kg/m<sup>2</sup>; tendency to  
175 orthorexia: normal attitude to eating (Bratman Test of Orthorexia BOT <5 points), fanaticism  
176 of healthy nutrition (BOT 5-9 points), orthorexia (=10 points).  
177

178 The study involved 480 participants in early adulthood (including 414 women).  
179 Respondents with secondary and higher education dominated (48.5%). Most of them had a  
180 normal BMI (68.5%) and a good attitude towards food (72.9%). The mean age of the  
181 respondents was 25.8 ( $\pm 6.2$ ) years and there was no significant difference between the groups  
182 (Table 2). Comparing the vegetarian diet duration in individual groups, the longest experience  
183 was observed in the G3 (range: 1-32 years), then in the G2 (range: 1-25 years) and G1 (range:  
184 1-20 years) (Table 2).

185        The results did not reveal significant differences in tendency to ON between  
186 participants using different types of diet (Table 2). However, in G3 significantly lower BMI  
187 than in other vegetarians was observed ( $p<0.05$ ). Additionally, G1 had significantly lower  
188 level of agreeableness than other vegetarians ( $p<0.05$ ). A statistical trend was also observed in  
189 the area of openness to experience - G1 showed the lowest intensity of this trait. It was a  
190 group with the shortest duration of vegetarian diet compared to others. The compared groups  
191 significantly differed in the aspect of motivation to use a vegetarian diet. The G3 had the  
192 highest level of health and ethical motivation. In turn, the lowest level of motivation  
193 associated with cultural and social conditions was observed in this group ( $p=0.06$ ).

194        Despite of no differences in the risk of ON found in individual groups of vegetarians,  
195 it was decided to present the results of subsequent statistical analyses, allowing to define the  
196 factors determining the risk of ON in a group of vegetarians without division into subgroups  
197 (Table 3). A higher level of health motivation to undertake a vegetarian diet was associated  
198 with a lower level of neuroticism and higher level of extraversion, agreeableness and  
199 conscientiousness. The increase in ethical motivation was accompanied by an increase in  
200 openness to experience and agreeableness. Greater spiritual and religious motivation was  
201 observed in participants with a higher level of openness to experience. More neurotic subjects  
202 had stronger motivation related to taste preferences. Finally, a higher level of culturally and  
203 socially conditioned motivation dominated in extroverted participants.

204

205 **Table 3.** Correlations coefficient between personality and motivation to vegetarian diet

206

Motivation to diet					
	Health	Ethical	Spiritual or religious	Related to taste preferences	Related to cultural and social

						conditions
<b>Personality</b>	Neuroticism	-0.11*	0.06	-0.04	0.12**	0.04
	Extraversion	0.12**	-0.05	-0.03	-0.03	0.11*
	Openness to experience	0.07	0.17**	0.09*	0.00	0.03
	Agreeableness	0.15**	0.20**	0.09	0.01	0.05
	Conscientiousness	0.17**	0.08	0.00	0.07	-0.02

207 \*p<0.05, \*\*p<0.01.

208

209 It was observed that the factors favouring ON are personality factors, motivation to  
 210 undertake a vegetarian diet and diet duration. The tendency to ON increased with the increase  
 211 in neuroticism, and the tendency decreased with the increase in agreeableness. Along with the  
 212 increase in the ethical motivation and motivation related to cultural and social conditions, an  
 213 increase in the risk of ON was observed. The tendency to ON decreased as the vegetarian diet  
 214 duration increased (Table 4). The regression analysis (the forward selection method<sup>1</sup>) was  
 215 carried out, introducing diet duration, personality traits and type of motivation as predictors of  
 216 ON risk. The variable with the highest R<sup>2</sup> turned out to be the diet duration - it accounted for  
 217 4.6% of the variance in ON risk; personality traits added from 2.8% for neuroticism to 1.1%  
 218 for extraversion. The only type of motivation that turned out to be a significant predictor of  
 219 ON risk - ethical motivation - added to the explained variance only 1.4% (all R<sup>2</sup> changes  
 220 significant at p <0.05). Table 5 presents the final model that accounts for 12% of the variance  
 221 in ON risk. The regression analysis showed that the strongest predictors of ON were  
 222 neuroticism and diet duration.

223

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<sup>1</sup> The forward selection method begins with no candidate variables in the model. First the variable that has the highest R-Squared is selected. At each step the candidate variable that increases R-Squared the most is selected. Adding variables is finished when none of the remaining variables are significant. Once a variable enters the model, it cannot be deleted.

224 **Table 4.** Correlations between personality, motivation to vegetarian diet, duration of being on  
 225 vegetarian diet and tendency to orthorexia

226

Variable		Tendency to orthorexia
<b>Personality</b>	Neuroticism	0.19**
	Extraversion	0.03
	Openness to experience	-0.06
	Agreeableness	-0.13**
	Conscientiousness	0.05
<b>Motivation to diet</b>	Health	0.01
	Ethical	0.11*
	Spiritual or religious	0.01
	Related to taste preferences	-0.05
	Related to cultural and social conditions	0.08*
<b>Duration of being vegetarian</b>		-0.23**

227 \*p<0.05, \*\*p<0.01.

228

229 **Table 5.** Predictors of tendency to orthorexia in the vegetarian group

230

Variable F= 9.260; p<0.001

R<sup>2</sup>= 0.12

	$\beta$	T	p
Neuroticism	0.22	3.97	<0.0001
Extraversion	0.15	2.79	0.006
Agreeableness	-0.15	-2.79	0.006

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Conscientiousness	0.13	2.43	0.015
Ethical motivation	0.12	2.39	0.017
Duration of being vegetarian	-0.18	-3.56	<0.0001

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231

232

233 **Discussion**

234 This project was performed to determine the relationship between the motivation to  
 235 use a vegetarian diet and the personality traits as well as a tendency to ON. We found no  
 236 significant differences in the level of ON risk between the subgroups of vegetarians.  
 237 Significant differences in terms of BMI was found and in a group using vegan, raw food and  
 238 fruit diet (G3) where BMI was the lowest. The study revealed the lowest level of  
 239 agreeableness in semi-vegetarians (G1) compared to other groups. We showed that this group  
 240 had the highest level of health motivation and ethical motivation to use the diet. Higher levels  
 241 of neuroticism, extraversion, conscientiousness and ethical motivation were related to ON in  
 242 the study group. With the increase in agreeableness the risk of ON decreases. Of all  
 243 personality traits, the strongest correlation coefficients were observed with the neuroticism.  
 244 Our study revealed that the shorter the duration of diet, the higher risk of ON.

245 In our study there were no significant differences in the risk of ON between different  
 246 groups of vegetarians. Similar results were obtained by Brytek-Matera et al. [30]. However,  
 247 there are reports that lacto-vegetarians present the highest risk of ON, the next group are ovo-  
 248 vegetarians, followed by lacto-ovo-vegetarians, while the lowest risk was observed in vegans  
 249 [18]. There are also reports not revealing such relationships, and finally there are studies  
 250 revealing contradictory relation where vegans are at the higher risk of ON [16]. Differences  
 251 and contradictions in the results of the described research are often attributed to errors related  
 252 to their methodology itself. Most of these studies are conducted on women and do not include

253 male populations, and the measurement tools used also raise doubts. However, high-quality  
254 studies unanimously found that veganism and vegetarianism generally have a greater risk of  
255 ON [13].

256 We found that individual groups of vegetarians differed in terms of BMI. G3 (vegans,  
257 raw foodists and fruitarians) had the lowest BMI compared to the other groups. This is the  
258 expected difference because people on the vegan, raw food, and fruit diets obtain the least  
259 calorie products in their diet. This group do not consume meat or animal products (milk,  
260 cheese, etc.) reach in high calories animal fats, what could be the possibly explanation of  
261 these results. It is worth noting that this is a group that, compared to others, had been using  
262 vegetarian diets for the longest time, and it can be assumed that as the years passed, their diet  
263 evolved towards an increasingly restrictive one.

264 The study groups also differed from each other in terms of personality traits. G1  
265 (semi-vegetarians) were less agreeable than other groups, and they were also less open to  
266 experience. Some manifestations of this can be seen in their diet: the least restrictive, based  
267 partly on meat, not requiring excessive restrictions or making changes. Most probably they do  
268 not look for new products, do not introduce meals that diverge too much from the traditional  
269 ones they were used to. Although researchers report that, in general, vegetarians are more  
270 open to diet experience than the rest of the population [27,28], the lowest level of this trait  
271 observed in G1 may be related to the fact that their diet is most similar to a traditional diet, so  
272 it does not require flexibility or significant changes.

273 Significant differences were observed in the scope of motivation that induces  
274 particular groups of vegetarians to undertake a diet. G3 had the highest level of health  
275 motivation and ethical motivation. This group is the most restrictive one in terms of  
276 restricting consumption and selection of many products, making specific rules for processing  
277 food in a way that does not endanger health [31]. This group was distinguished by the longest

278 experience of vegetarian diet (max. 32 years). It can be assumed that for years the respondents  
279 have expanded knowledge about the benefits of using a vegetarian diet, strengthening its  
280 original motivation - health or ethical motivation. The obtained results turn out to be  
281 consistent, because the total resignation from eating meat and animal products that  
282 characterise this group is clearly justified by both types of motivation. Fox and Ward [3]  
283 assumed that ethical and health motivation may cause the evolution of the vegetarian diet in  
284 an increasingly restrictive direction. However, they did not study its relationship strictly with  
285 ON. While Barthels et al. [17] showed that health motivation is clearly associated with ON  
286 among vegetarians.

287 Correlation studies revealed that health motivation is associated with the greatest  
288 number of personality traits: lower levels of neuroticism, higher extraversion, agreeableness  
289 and conscientiousness. In turn, openness to experience and agreeableness turned out to be  
290 important predictors of ethical motivation. Agreeableness, associated with a positive attitude  
291 towards people, fosters sensitivity to the harm of others [26]. People with a high intensity of  
292 this trait can react to animal suffering in an especially sensitive manner, which translates into  
293 ethical ideas. Vegetarians also often declare a feeling of disgust with meat and their greater  
294 taste sensitivity is related to neuroticism and conscientiousness [32,33]. The  
295 conscientiousness may be associated with a more careful selection of flavours, products and  
296 careful preparation of meals. In turn, extraversion is associated not only with health  
297 motivation, but also with motivation related to cultural and social determinants. Extroverted  
298 individuals engage in a greater number of social interactions, which may contribute to usage  
299 of popular diets in the immediate environment [29]. It allows for quick social support from  
300 the immediate environment and strengthening in dietary decisions.

301 The conducted research allowed to isolate the risk factors of ON in the area of  
302 personality, motivation to undertake a diet and diet duration in a group of vegetarians. It has

303 been established that ethical motivation, neuroticism, extraversion and conscientiousness are  
304 positive predictors of ON, and agreeableness and diet duration are its negative predictors.  
305 Personality traits such as extraversion, openness to experience or agreeableness are associated  
306 with preferences to choose healthy nutrition, where health benefits become the primary goal  
307 [34]. Researches by Keller and Siegrist [25] showed that a higher level of openness to  
308 experience, as well as a higher level of agreeableness, promote a healthier diet, including  
309 eating fruit and vegetables, and reducing the amount of meat consumed in the diet. The results  
310 of our research revealed that a decrease in openness to experience and a decrease in the level  
311 of agreeableness were conducive to increasing the risk of ON. Lowering the level of cognitive  
312 curiosity and openness to new products also affects eating behaviour, and it is associated with  
313 increase in dietary restrictions. At the same time, a decrease in agreeableness, along with  
314 increase in negative attitudes towards other people, may result in eating meals in isolation,  
315 which in turn may promote the development of ON. Another important personality trait  
316 clearly marked in the study group is neuroticism. According to literature [25,26], neuroticism  
317 is associated with the manifestation of unhealthy eating habits, e.g. reaching for sweet and  
318 spicy foods, and presenting the phenomenon of emotional eating. According to Forestell and  
319 Nezlek [28], vegetarians show a greater intensity of neuroticism, i.e. instability and emotional  
320 maladjustment than the rest of the population, what was observed also in our study group. Our  
321 results are also consistent with the results of Forester [23], who showed that ON was  
322 accompanied by higher level of neuroticism and conscientiousness. Conscientiousness is  
323 associated with perseverance in action and organisation, but this trait also appears to be  
324 conducive to the risk of ON. Dietary selectivity, restrictions, and constant control that  
325 characterise people affected by ON are behaviours that conscientiousness certainly fosters.

326 Our research revealed the relationship between the motivation to use a vegetarian diet  
327 and the risk of subsequent ON. In the study group, vegetarians most often declared health and

328 ethical motivation. The significant importance of the impact of ethical motivation on the  
329 increase in the risk of ON may be associated with the fact that people who are particularly  
330 sensitive to animal suffering exclude animal products from their diet and often these activities  
331 may be restrictive. They also prefer to spend time with people with similar ideology and  
332 nutrition habits, which may be caused by the fact that they feel not understood by most of the  
333 society in their decision to become vegetarian [11]. Consequently, this can lead to social  
334 isolation.

335 We found that the shorter duration of diet, the higher risk of ON exists. This is  
336 consistent with other results, showing that short time of using the diet may be associated with  
337 different motivations, e.g. the desire to lose weight quickly, which in turn can have drastic  
338 health consequences [5,18]. The relationship obtained in our research may be due to the need  
339 for greater control of what you eat, devoting more attention to your diet at the beginning of  
340 being vegetarian. Later it is associated with the gradual building of healthy eating habits as it  
341 continues. Interestingly, when dividing the surveyed into groups only in G1 (semi-  
342 vegetarians), no significant relationship between time and ON tendency was observed.  
343 Perhaps this is because it is the least nutritionally restrictive group, which does not lead to  
344 rapid and unhealthy weight loss [35]. This group additionally differed from other groups in  
345 terms of personality traits. They were shown to be less agreeable, which may predispose them  
346 to ON, as already mentioned, a lower level of agreeableness is associated with a greater risk  
347 of ON.

348 The study limitation is that the study groups differed in terms of the type of vegetarian  
349 diet and sex, but women clearly dominated. This is justified by the fact that, as it is commonly  
350 known, women are more willing to take part in the research as volunteers [36], while men are  
351 less likely to become vegetarians and eat more meat [37]. In the future research, it would be

352 worth collecting cohort with the equal number in terms of the type of vegetarian diet and sex.

353 An extension of the age group could also be valuable.

354

### 355 **Conclusions**

356 It is concluded that personality traits, type of motivation to undertake a vegetarian diet  
357 and diet duration are associated with the risk of ON in vegetarians. Higher levels of  
358 neuroticism, extraversion, conscientiousness and ethical motivation are risk factors for ON in  
359 the vegetarian group. The obtained results allow to see that most often more than one leading  
360 motif that encourage respondents to vegetarian diet at the same time is present. There were no  
361 differences in the tendency to ON between persons using different types of vegetarian diet.  
362 The observed differences between subjects using different types of vegetarian diet are an  
363 important hint for building intervention plans for the prevention or treatment of ON.

364

### 365 **List of abbreviations**

366 ON – orthorexia nervosa

367 NEO-FFI Personality Inventory - Neuroticism-Extraversion-Openness - Five Factor Inventory

368 BOT - Bratman Test of Orthorexia

369 BMI – Body mass index

370

### 371 **Declarations:**

372 **Ethics approval and consent to participate** - The study procedure was approved by the  
373 Bioethics Committee of the Medical University of Silesia (Approval No  
374 PCN/0022/KB/276/19). Participation was fully voluntary and anonymous, respondents  
375 expressed an informed consent to participate in the study by signing at the beginning a  
376 statement attached to the study.

377

378   **Consent for publication:** All authors accept full responsibility for all aspects of to the  
379   submitted manuscript.

380

381   **Availability of data and material:** The corresponding author can provide all original data for  
382   the review

383

384   **Conflict of Interest:** The authors declares that there is no conflict of interest regarding the  
385   publication of this article

386

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390   **Authors' contributions:** APO and MP designed the study, developed the study aims and  
391   hypotheses. MP collected the data, APO and MP conducted the statistical analyses. APO, MP,  
392   AZ were involved in the writing of the manuscript and approve of the manuscript in its  
393   current form.

394

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- 493

494 **Table 2.** Differences between participants using different types of vegetarian diet

Variable	G1	G2	G3	p	Post-hoc
	M(SD)	M(SD)	M(SD)		
<b>Age (years)</b>	26.2 (6.0)	25.2 (6.0)	26.3 (6.5)	0.174	
<b>BMI (kg/m<sup>2</sup>)</b>	22.8 (4.6)	22.2 (3.8)	21.1 (3.8)	0.002	G1>G3*; G2>G3*
<b>Duration of being vegetarian (years)</b>	2.7 (3.6)	4.6 (4.9)	5.7 (6.3)	<0.0001	G1<G2*; G1<G3*
<b>Personality</b>	Neuroticism	25.9 (10.3)	27.7 (10.0)	26.2 (10.3)	0.29
	Extraversion	25.1 (7.1)	23.3 (6.6)	23.2 (6.1)	0.11
	Openness to experience	30.1 (6.4)	32.4 (5.9)	32.6 (6.1)	0.06
	Agreeableness	27.3 (4.7)	30.1 (6.6)	29.8 (6.5)	0.002 G1<G2*; G1<G3*
	Conscientiousness	28.5 (7.1)	29.8 (7.7)	30.5 (7.7)	0.15
<b>Motivation to diet</b>	Health related	4.4 (.9)	4.6 (.7)	4.8 (.6)	<0.0001 G1<G3*; G2<G3*
	Ethical	4.2 (1.0)	4.7 (.6)	4.8 (.5)	<0.0001 G1<G2 G2<G3*
	Spiritual or religious	1.6 (1.0)	1.9 (1.1)	2.0 (1.3)	0.16
	Related to taste	2.7 (1.3)	2.9 (1.4)	2.9 (1.4)	0.54
	Related to cultural and social conditions	1.25 (.51)	1.3 (.7)	1.2 (.6)	0.06
<b>Tendency to orthorexia</b>		3.5 (1.9)	3.5 (1.6)	3.6 (1.7)	0.64

495 G1: semi-vegetarians, G2: lacto-ovo-vegetarians, ovo-vegetarians and lacto-vegetarians, G3:

496 vegans, raw foodists and fruitarian; \*p&lt;0.05.

497