

# Personality Traits, Motivation and Bone Health in Vegetarians

Jasminka Bobić<sup>1</sup>, Selma Cvijetić<sup>1</sup>, Irena Colić Barić<sup>2</sup> and Zvonimir Štalić<sup>2</sup>

<sup>1</sup> Institute for Medical Research and Occupational Health, Zagreb, Croatia

<sup>2</sup> University of Zagreb, Faculty of Food Technology and Biotechnology, Laboratory for Food Chemistry and Nutrition, Zagreb, Croatia

## ABSTRACT

*Vegetarian diets attract more and more attention due to growing concerns about health, ecology and/or animal welfare in general population. The main purpose of this paper was to examine whether vegetarianism could be associated with some specific personality characteristics, with the emphasis on the main motivational factors which determined acquiring the diet. Since the nutrition is also an important determinant of bone health we additionally analyzed the association between personal characteristics and bone density. On a sample of 109 adult vegetarians of both sexes we applied Eysenck Personality Questionnaire (including Psychoticism, Extraversion, Neuroticism and Lie scale), bone densitometry and questionnaire on dominant motives for dietary choices. The results on overall personality characteristics, bone density and basic anthropometric measures were within expected values for age. Vegetarian men had significantly more fractures during lifetime and lower neuroticism scores than women. Dominant motivational factors for acquiring vegetarianism were moral values. In addition »moral vegetarians« showed more pronounced introversion compared to »health vegetarians«, lending further support to the argument that personality plays an important role in the structure of motivation.*

**Key words:** *personality, neuroticism, extraversion, bone density, motivation, vegetarians, osteoporosis*

## Introduction

It seems that vegetarianism is getting more and more popular and publicly accepted, while estimated number of followers reaches 2,5 to 7% in US<sup>1-4</sup>, 3 to 7% in UK<sup>5,6</sup>, 4% in Canada<sup>7</sup>, and 3.3% in Finland<sup>8</sup>. Estimated numbers of vegetarians for Croatian population reaches 4–5%<sup>9</sup>. But, Vinnari and coauthors found on a large sample of more than 24 000 participants that self-identification is not good method for observation the prevalence of vegetarianism because self-identification indicated more than double the incidence of vegetarianism than the operationalized definition<sup>8</sup>. Self-identification meaning that respondents denoted themselves as vegetarians, while operationalized definition groups were formed by obeying strict inclusion criteria, those who reported less than once *per* month or rarely consumption were considered non-consumers. Thus pescio-lacto-ovo-vegetarians are defined as those eating vegetarian food, dairy products, eggs and fish but not meat or poultry less than once *per* month.

Based on the available literature vegetarians adopted their diet for a variety of reasons including moral, environmental, health, or religious. Marjaana Lindeman and Minna Sirelius<sup>10</sup> suggested that food choice has become much more than what one is allowed to eat and became a part of one's philosophy of life. Since vegetarians and non-vegetarians differ in their attitude toward meat, it is possible that they differ in some personality characteristics too. In accordance with this presumption Lindeman found on a large sample of female subjects that vegetarians express less happiness than other individuals<sup>11</sup>.

It appears that food related lifestyle can be associated with some socioeconomic variables as higher educational level, higher socioeconomic status or living in more urban areas<sup>12</sup>.

Jabs and coworkers<sup>4</sup> examined the process of adopting vegetarian diets and found clear distinction between those whose dominant motive was ethical as contrasted

to health. Ethical motives included moral considerations, aligning dietary behaviors with beliefs and values about animal welfare. Health motives comprised perceived threat of disease as well as potential health benefits associated with vegetarian diets.

Vegetarians differ among themselves at the extent to which they avoid animal products from the avoidance of red meat only to the avoidance of all food derived from animals.

It is known that nutrition, especially a calcium intake is important for building and preserving an adequate bone mass<sup>13,14</sup>. It is therefore of great importance to recognize specific patterns in nutrition, like vegetarianism, which might potentially increase the risk for osteoporosis. The lack of estrogen or calcium are principal risk factors for osteoporosis and vegetarians usually have lower circulating estrogens and body mass index, while vegans usually have lower calcium intake or they take calcium of lower bioavailability. On the other hand, a good acidobasic balance, which is present in vegetarian nutrition, could be useful for bone health<sup>15</sup>. However, majority of studies<sup>16–20</sup>, but not all<sup>21–23</sup>, did not show a difference in bone density between vegetarians and omnivores. A few studies found a low bone density in vegans, compared to non-vegans<sup>24</sup>.

Our study is an attempt to examine whether vegetarianism could be associated with some specific personality characteristics measured by Eysenck Personality Questionnaire (EPQ), and to assess bone density in our group of healthy adult vegetarians. Further we shall analyze the association between some personality characteristics with bone density and the number of fractures.

## Materials and Methods

Subjects were 109 vegetarians with an age range of 19 to 67 years of both sexes (89 women and 20 men). They were recruited from the Institute for Education of Adults, from the Animal Friends Society and by personal contact. Potential participants have received an informed letter, with the explanation of the study protocol. Total of 169 subjects responded to the invitation letter, giving the basic information about age, sex, duration and type of the vegetarian nutrition. The study had two phases: 1) taking the blood samples; 123 participants responded, while 46 participants signed off due to diseases and other personal reasons; 2) obtaining nutritional questionnaires and bone density measurement. One hundred and nine subjects completed both phases. Sixteen of our subjects claimed that they were vegans at the time of research. All of them were first committed to vegetarianism and then gradually became vegans. The whole sample is characterized by the equable educational level of approximately 15 years of schooling with the range from secondary school to university degree. At the average they followed their vegetarian diet for 11 years (range 1 to 35 years), and started at the age of 25 years (all of them starting as adolescents or adults). Height and weight were measured using a portable stadiometer and electronic scale. Body

mass index (BMI) was calculated as the weight (kg) divided by the square of the height (m<sup>2</sup>). Content of fat and lean tissue (kg) were automatically calculated in total body densitometry.

Study was approved by Ethical Committee of the Institute for Medical Research and Occupational Health. Each participant has signed an informed consent.

### *Bone density measurement*

Bone mineral density (BMD; g/cm<sup>2</sup>) was measured using dual energy X-ray absorptiometry (Lunar – Prodigy, Madison, WI). Measurements were made in the lumbar spine (L1–L4), and total body. The in vivo coefficient of variation was 1.5% for the lumbar spine and 1.1% for the total body. BMD was also expressed as T score, which represents the number of standard deviations with respect to the mean BMD of a control population between 20 and 40 years of age, using the manufacturer's reference values. T score between –1 and –2.5 is defined as osteopenia and T score lower than –2.5 is defined as osteoporosis<sup>25</sup>. BMD between –1 and –2.5 standard deviations was defined as osteopenia and BMD lower than –2.5 standard deviations was defined as osteoporosis.

### *Diet assessment*

Nutrient intakes were calculated from weighed 7-days food records using food composition tables. Data from a multiply-day records is more representative of usual intake than a single-day data from either a 24-h recall or a 1-day food record, and don't depend on memory. To ensure an adequate level of detail the records were reviewed by trained nutritionists and subjects were additionally contacted for further information. All were recruited through local vegetarian societies and an inclusion criterion was duration of vegetarian diet longer than one year. Confirmation of vegetarianism i.e. veganism was based on food records what is preferred method over self-reporting that can be inaccurate.

### *Eysenck Personality Questionnaire (EPQ)*

Personality traits were assessed by Eysenck Personality Questionnaire, one of the most used questionnaires developed by Hans and Sybil Eysenck in 1975<sup>26</sup>. EPQ has for scales: Psychoticism, Extraversion, Neuroticism and Lie scale, covered by 90 questions:

EPQ-P : Psychoticism represents aggressiveness, assertiveness, egocentrism and tough – mindedness and inclination toward manipulation (25 items).

EPQ-E : Extraversion represents sociability, liveliness, domination, impulsiveness, irresponsibility, risk-taking, and outgoing and talkative persons (21 item).

EPQ-N : Neuroticism represents emotional instability and anxiousness, feelings of guilt and depressed mood (high levels of negative affect such as depression and anxiety)(23 items).

EPQ-L : Lie scale represents dissimulation, social naïveté, social conformity (21 item).

Mc Crae and Costa<sup>27</sup> confirmed the assumption that dimension measured by Lie scale is in fact a stable personality characteristic, rather than a response set, or a tendency to fake, which was indicated before<sup>26</sup>.

### Motivation

To determine basic food preference motives 105 respondents were presented with the choice list of 9 major reasons for adopting a vegetarian diet:

1. Negative attitude toward meat; 2. Ethic; 3. Health; 4. Animal welfare; 5. Ecology; 6. Spiritual believes; 7. Vegetarian food is sufficient; 8. Taste; 9. Other.

### Statistics

Data were analyzed using the software Statistica, version 9.0 (StatSoft Inc., Tulsa, USA). The results are shown as mean  $\pm$  standard deviation. Differences between groups (means) were tested using the t-test. The relation between two variables was tested with the linear correlation. The multiple regression model was created with bone mineral density as dependent variable and with psychological characteristics and all potential confounding factors as independent variables. Those included age, sex, body mass index and duration of vegetarian nutrition. The distribution of variables was tested using the Kolmogorov-Smirnov test. Variables not distributed normally, were recalculated to the new variables, using logarithmic function. In all tests, p value lower than 0.05 was considered significant.

### Results

There were more women than men in this study, which is expected as there are generally more women than men who practice vegetarian diet<sup>2,6</sup>. Men had significantly higher weight, height, content of lean tissue ( $p < 0.0001$ ) and total body BMD ( $p = 0.005$ ). All anthropometric measures and bone density variables showed expected values for age and gender (Table 1). Eight women (9%) and four men (22%) had an osteopenia, while two men (11%) had an osteoporosis. Total number of fractures was 38, but the vast majority of fractures (88%) occurred before the beginning of the vegetarian diet, which supports significant association between the frequency of fractures and personality characteristic – extraversion (Table 2).

Multiple regression analysis did not reveal any of the four psychological characteristics as significant predictors of bone density in our vegetarians. Dominant factors affecting food choice decision were recorded into one of the following nine categories as follows: 1. Negative attitude toward meat (11); 2. Ethic (36); 3. Health (19); 4. Animal welfare (26); 5. Ecology (1); 6. Spiritual believes (4); 7. Vegetarian food is sufficient (3); 8. Taste (1); 9. Other (4). The majority of our respondents cited moral reasons for vegetarianism (36) followed by animal welfare/strong opposition to cruelty toward animals (26), both of which are in fact ethical categories. We may assume that persons who were brought up as vegetarians or whose vegetarianism is strictly regulated by strong religious rules may have different rank of motives. Kim

**TABLE 1**  
DESCRIPTIVE STATISTICS (N=109) AND GENDER DIFFERENCES (T-TEST) FOR ANTHROPOMETRY, BONE DENSITY MEASUREMENTS AND EYSENCK PERSONALITY QUESTIONNAIRE VARIABLES (EPQ)

	Women (n=89) $\bar{X} \pm \text{Std.Dev.}$	Men (n=20) $\bar{X} \pm \text{Std.Dev.}$	p
Age (years)	35.9 $\pm$ 10.2	35.2 $\pm$ 8.7	0.767
Education (years)	15.0 $\pm$ 1.4	14.5 $\pm$ 1.6	0.139
Height (cm)	167.5 $\pm$ 6.4	180.6 $\pm$ 6.4	0.000
Weight (kg)	61.1 $\pm$ 9.4	76.3 $\pm$ 14.1	0.000
BMI (kg/m <sup>2</sup> )	21.7 $\pm$ 3.2	23.3 $\pm$ 3.9	0.065
Fat tissue (g)	19.0 $\pm$ 7.7	14.1 $\pm$ 10.5	0.020
Lean tissue (g)	38.3 $\pm$ 5.9	60 $\pm$ 5.8	0.000
Spine BMD (g/cm <sup>2</sup> )	1.217 $\pm$ 0.14	0.30 $\pm$ 0.20	0.663
Spine T score	-0.17 $\pm$ 0.60	0.67 $\pm$ 0.80	0.143
Total body BMD (g/cm <sup>2</sup> )	1.166 $\pm$ 0.115	1.249 $\pm$ 0.119	0.005
Total body T score	1.33 $\pm$ 0.62	0.67 $\pm$ 0.80	0.271
Number of fractures	0.27 $\pm$ 0.5	0.65 $\pm$ 0.8	0,006
Duration of vegetarian nutrition (years)	11.1 $\pm$ 7.2	11.0 $\pm$ 6.7	0.964
Onset of vegetarianism	24.85 $\pm$ 8.4	24.2 $\pm$ 7.1	0.752
EPQ – Psychoticism	4.45 $\pm$ 2	5.15 $\pm$ 1.9	0.149
EPQ – Extraversion	12.98 $\pm$ 3.8	13.45 $\pm$ 3.5	0.614
EPQ – Neuroticism	8.27 $\pm$ 4.8	5.30 $\pm$ 3.9	0.011
EPQ – Lie scale	9.45 $\pm$ 4	7.70 $\pm$ 3.7	0.076

**TABLE 2**  
CORRELATION MATRIX

	Age	Edu	Veg	Ons	P	E	N	L	Fr	Fat	Lean	Spine BMD	TB BMD	H
Edu	0.17													
Veg	0.59	0.18												
Onset	0.71	0.06	-0.15											
P	-0.05	-0.22	-0.11	0.04										
E	-0.16	-0.08	0.05	-0.24	0.05									
N	0.07	0.05	-0.05	0.13	0.09	-0.38								
L	0.37	0.07	0.24	0.24	-0.17	-0.01	-0.21							
Fr	-0.03	-0.12	-0.01	-0.03	-0.02	0.25	-0.10	0.01						
Fat	0.17	-0.10	0.12	0.10	0.00	0.01	0.01	0.12	0.14					
Lean	0.06	-0.15	0.09	0.00	0.08	0.07	-0.25	-0.14	0.33	-0.04				
Spine BMD	-0.31	-0.01	-0.08	-0.31	0.03	0.18	-0.08	0.00	-0.09	0.10	-0.05			
TB BMD	-0.12	-0.17	0.07	-0.19	0.05	0.24	-0.27	0.08	0.05	0.22	0.39	0.60		
H	-0.13	0.08	-0.09	-0.08	0.13	0.02	-0.14	-0.22	0.21	-0.05	0.57	0.02	0.29	
W	0.12	-0.14	0.11	0.05	0.15	0.08	-0.16	-0.05	0.31	0.58	0.58	0.17	0.45	0.51

$r \geq 0.21$  are significant at  $p < 0.05$ ; Pairwise deletion of missing data was used

Legend: Edu-education in years; Veg-duration of vegetarian diet in years; Ons-age of the onset of vegetarianism in years; P-psycho-ticism; E-extraversion; N-neuroticism; L-lie scale; Fr-number of fractures; Fat-fat tissue; Lean-lean tissue;Spine BMD; TB BMD- Total body BMD; H-height; W-weight.

and coworkers noted increase in importance of ethical and animal welfare motivational factors over time, investigating dietary choice in two groups of vegetarians 25 years apart<sup>28</sup>.

For statistical analysis we grouped answers about the dominant motives of adherence to a vegetarian diet into two categories: 1. ethical motives (answers 2. Ethic, 4. Animal welfare, 5. Ecology, and 6. Spiritual believes) and health motives (1. Negative attitude toward meat, 3. Health, 7. Vegetarian food is sufficient, and 8. Taste), excluding four answers in category »other«. The only statistically significant difference between these two groups was found for the continuous variable »extraversion – introversion« on EPQ, suggesting that health motivated vegetarians are more extraverted compared to those whose motives were predominantly ethical in nature ( $M_{health} = 14.2$ ;  $M_{ethic} = 12.5$ ;  $p = 0.035$ ). EPQ results revealed that our whole group is characterized by somewhat lower scores on psychoticism ( $M = 4.58 \pm 2$ ), neuroticism ( $M = 7.72 \pm 4.7$ ) and lie scale ( $M = 9.13 \pm 4$ ), while extraversion results show expected values ( $M = 13.06 \pm 3.8$ ) compared to published norms for general population<sup>25</sup>.

At the average our participants became vegetarians at the age of 25 years, and only 12 began between 11 and 18 years. Negative correlation between onset of vegetarianism and extraversion ( $r = -0.24$ ) would indicate that those with more pronounced extroversion would start earlier (Table 2). Expected positive correlation ( $r = 0.37$  with pairwise deletion of missing data) was found between chronological age and lie scale results, i.e. older give more socially desirable responses, while younger

show some kind of social naïveté. This is in accordance with data published in the Manual<sup>25</sup>, and with recent results gained on the large sample in Croatia<sup>29</sup>. Extroversion has statistically significant positive association with number of fractures during lifetime (Table 2. and Figure 1.), which is also expected since males have more fractures and higher scores on extraversion scale.

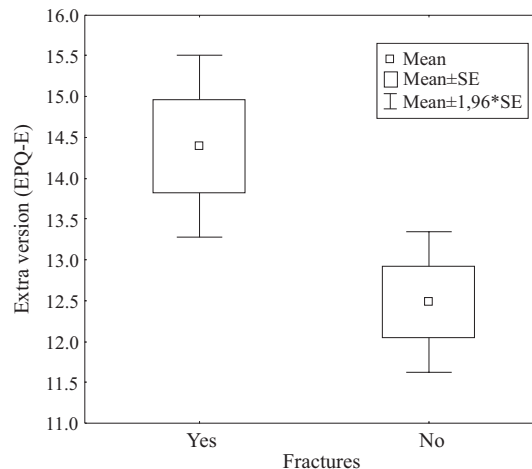


Fig. 1. Extraversion in vegetarians with and without fractures;  $t = 2.49$ ;  $p = 0.014$ .

### Discussion

Although the osteoporosis and osteopenia are more frequent in women, we found a higher prevalence of both



conditions in our male subjects. One man with osteoporosis had the lymphoma in his early twenties, while other men with osteoporosis and those with osteopenia had no condition which could have influenced a bone metabolism. Therefore, it seems that lower bone density in men compared to women was not a consequence of the selection bias. The ratio between women and men in our study sample was approximately 3:1 which is in accordance with the fact that there are more vegetarian women than men<sup>6</sup>.

Vegans had lower bone density than vegetarians, although that difference was not statistically significant. This is similar to the results of several other studies which showed that vegetarianism, especially vegan diet was associated with lower bone density, but on un-significant level<sup>30</sup>. Fractures related to or caused by trauma (serious strokes or falls) were found in 23 women and 10 men. We could not assess whether this fracture prevalence was high or low since we did not have a control group. However, some other studies showed that fracture rate did not differ between omnivores and vegetarians<sup>31</sup>. The symptoms in osteoporosis are usually caused by fracture and they include back pain, loss of height and stooped posture, which can result in loss of confidence or even depression. In 2001, The National Institute of Health launched a study including women ages 21 through 45 who were suffering from depression<sup>32</sup>. Their findings showed a very strong correlation between depression and osteoporosis. It is believed that depression is associated with hormonal abnormalities that can lead to changes in bone tissue<sup>33</sup>.

Concerning main motives of adherence to a vegetarian diet we may assume that stable personality dimension »extraversion – introversion« shapes motivational factors as such, turning introverts dominantly towards motivators of moral nature, and extroverts towards ones own health welfare/benefit. This would mean that the focus within health vegetarianism would more often be internal (desire to sustain good health or lose weight), while ethical vegetarians would more frequently focus outward showing interest for welfare of other living creatures. Very similar results were found recently by Fox and Ward<sup>27</sup>. We may speculate that the strong media promotion of »Cult of healthiness« nowadays may increase the number of health motivated vegetarians in future, especially among extroverts.

Our results show expected significant gender differences in height, weight, fat and lean tissue as well as in total body BMD. The number of fractures during life time also shows predictable male supremacy, while variable neuroticism on EPQ shows higher values in female subjects. Among psychological variables there were no other statistically significant differences, although women scored higher on lie scale, and lower on psychoticism and extraversion. These results are again expected and in accordance with recent study in Croatian population<sup>28</sup>. No association was found between the four EPQ subscales and fat (in kg), BMD spine, or weight (in kg). According to our results those with bigger Total Body BMD have

higher results on extraversion scale and lower on neuroticism scale which is characteristic for male participants. Negative correlations often appear between the traits of neuroticism and extraversion (in our case  $r = -0.38$ ), regardless of the instrument used, indicating that those who are more prone to emotional instability tend to be more introverted.

Due to the small number of participants in our study, we could not analyze vegans separately (only 16 subjects), but rather they were studied as a vegetarian sample. Therefore no final conclusion could be made considering differences between these two groups. Further research on the topics of motivational factors, personality and bone health would be needed. Larger study, using the same methods could highlight possible differences between those two subgroups and comparable control group in terms of stable personality traits that influence our dietary choices and attitude towards vegetarianism in broader sense. Also, larger sample may answer the question whether vegan diet induces negative influence on bone health, since our results point to this direction, although at statistically non significant level. Another limitation of our sample is non-homogeneity in respect to age, which should be considered in future study too.

## Conclusions

On a sample of 109 adult vegetarians of both sexes we found that overall psychological profile on EPQ was within the expected boundaries for all four scales. Anthropometric and bone density parameters in vegetarians were within expected values without certain beneficial or harmful effect of vegetarianism on bone health. The only exception was somewhat higher presence of osteopenia and osteoporosis in men than it is generally found in population.

Overall, our participants expressed strong ethical, rather than health component as a dominant motivational factor for acquiring vegetarianism. We found statistically significant difference between health and moral vegetarians in psychological dimension »extroversion-introversion«, and thus we may conclude that »moral vegetarians«, motivated by moral considerations towards animals and environment have outward focus, and are more often introverts. They would start vegetarian diet later in life. On the other hand, »health vegetarians« who would start earlier, are more often extraverts motivated by potential health benefits, and thus focused inward. These findings expand understanding of a wide variety of food-related behaviors, especially specific psychological processes and personality characteristics that affect our dietary choices beside cultural factors, and may help nutrition professionals in developing strategies to work with those who want or need to change diet habits.

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J. Bobić

*Institute for Medical Research and Occupational Health, Ksaverska cesta 2, 10000 Zagreb, Croatia*  
*e-mail: jbobic@imi.hr*

## OSOBI NE LIČNOSTI, MOTIVACIJA I ZDRAVLJE KOSTIJU U VEGETARIJANACA

### SAŽETAK

Vegetarijanski način prehrane privlači sve više pozornosti zahvaljujući rastućoj brizi za zdravlje, ekologiju i/ili dobrobit životinja u općoj populaciji. Osnovni cilj ovoga rada bio je ispitati može li se vegetarijanstvo povezati s nekim specifičnim karakteristikama ličnosti, te osobito s glavnim motivirajućim faktorima koji utječu na usvajanje određenog načina prehrane. S obzirom da je prehrana važan čimbenik zdravlja kostiju, dodatno smo analizirali povezanost osobina ličnosti i gustoće kostiju. Na uzorku od 109 odraslih vegetarijanaca, oba spola, primijenili smo Eysenckov upitnik ličnosti (uključujući skale psihoticizma, ekstraverzije, neuroticizma i iskrenosti), denzitometriju kostiju i upitnik o osnovnim motivima za izbor prehrane. Rezultati karakteristika ličnosti, gustoće kostiju i osnovne antropometrijske mjere su bile u granicama očekivanja s obzirom na dob. Vegetarijanci muškarci su imali značajno više fraktura tijekom života, te niži neuroticizam od žena. Dominantni motivacijski faktor pri usvajanju vegetarijanstva bile su moralne vrijednosti. Osim toga vegetarijanci iz »moralnih pobuda« pokazuju izraženiju introverziju u usporedbi sa vegetarijancima iz dominantno »zdravstvenih pobuda«, podupirući argumente o važnoj ulozi ličnosti u strukturi motivacije.