Research Article

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Diet quality indicators and organic food consumption in mothers of young children

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Abstract

Background: The health benefits of organic food provide one reason for consuming it. Various studies have shown that regular organic food consumers (REG eco-con) follow a healthier diet. However, this topic has not been explored in Poland. This study aimed to evaluate the diet quality of mothers with children under 6 years old, residing in three provinces of Poland, who consumed organic food at varying frequencies. Data were collected using validated questionnaires.

Results: Among the mothers surveyed ($N = 667$), 84% achieved an average Diet Quality Index (DQI) score, indicating a neutral impact of their diet on health. Meanwhile, 15% of respondents exhibited diets with a high intensity of health-promoting characteristics. Women with a higher frequency of organic food consumption displayed more health-promoting dietary behavior. Regular organic food consumers demonstrated significantly higher DQI and Pro-Healthy Diet Index (pHDI) scores than those with lower organic food consumption frequency. The REG eco-con mothers also reported significantly more frequent consumption of vegetables, fruit, whole-grain bread and cereals, fermented dairy products, legumes, and fish. Respondents who rated their state of health as better than that of their peers were characterized by more frequent consumption of organic food.

Conclusion: An organic diet may play a significant role in an individual's quality of life and well-being. The results of this study could be relevant for the organic food sector and policymakers in developing nutritional transformation towards sustainability.

Keywords: diet quality; Diet Quality Index (DQI); mother's diet; organic food; organic consumer

INTRODUCTION

Consumers of organic food in Europe and beyond have declared that they consume organic products because of their healthiness,[1-10] lower pesticide content,[8] health-promoting ingredients, and because they are free of artificial additives and genetically modified organisms (GMOs).[9,10]

Research shows that, in comparison with conventional food, organic food is richer in health-promoting substances and contains lower levels of harmful substances.[11-15] Cohort studies have shown that regular consumers of organic food have more energy, better health, and a lower risk of several diseases, including obesity and cancers such as lymphomas, non-Hodgkin lymphoma, and post-menopausal breast cancer.[11,14,16-18] The positive effect of organic food consumption on fertility has also been observed, including reduced incidences of infertility, birth defects, allergic sensitization, otitis media,[19] lower risk of pre-eclampsia during pregnancy,[19,20] and higher probability of live births.[21]

There are few studies assessing the diet quality of regular organic food consumers. Extensive studies from European countries – such as the Nutrinet-Santé Cohort Study in France,[22] the German National Nutrition Survey II (NVS II) in Germany,[23] and studies of Danish households,[24] and the Danish population[25] – have shown that regular organic food consumers followed dietary guidelines more closely and that they had healthier dietary patterns. However, in these studies, participants' diets were not investigated in detail and international indicators of diet quality were not used, unlike in the current study. Only a few studies analyzed the diets of Polish organic food consumers. The organic food sector and consumers in the countries mentioned above are also different from those in Poland, so a thorough study of the diet of Polish organic consumers is needed.

There has only been one study on diet quality among Polish consumers of organic food, and this was published 16 years ago.[26] Other studies have focused on purchase motivators and consumer characteristics of Polish women. It was found that consumers of organic food products were conscious of the importance of nutrition for health and were interested in the nutritional value of food.[27] They also stated that they followed dietary recommendations and paid attention to the relationship

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between diet and health.[28] However, there are no studies regarding the diet quality of female organic food consumers in Poland, especially from eastern provinces (such as Lubelskie or Podlaskie). This paper therefore makes an important contribution by addressing this knowledge gap.

Female consumers could be among the most important clients for the organic food sector because the health and safety of the family are strong motivators for them to purchase organic products.[29] Previous studies found that Polish organic consumers reported a significantly better health status than conventional food consumers.[26,30] Foreign publications have indicated that there is an impact of organic food consumption on consumer well-being[31-34] and better life satisfaction.[35] However, there is a huge gap in research on this issue in Poland.

The aim of this study was to assess the quality of the diets of mothers of children up to 6 years of age, living in the provinces of Eastern Poland (Mazowieckie, Lubelskie, and Podlaskie), consuming organic food at different frequencies. Only respondents who chose the correct definition of organic food were included in the analysis. This aspect was not taken into consideration in other studies involving female respondents from Poland.[26-28,36]

The study tested the following research hypotheses:

H 1: The diets of mothers who regularly consume organic food are of better quality than those who consume organic food less frequently.

H 2: Mothers who consume organic food more often perceive themselves as healthier than those who consume organic food less frequently.

MATERIALS AND METHODS

Ethical approval

The study design and all procedures were approved by the local ethics and human research committee of the Institute of Human Nutrition Sciences of the Warsaw University of Life Sciences (consent number: 08/2020; July 6, 2020). All participants consented to participate in the study.

Study design

The study was a part of the 'BIO for Mother and Child' educational and research project implemented by the Warsaw University of Life Sciences in Warsaw in 2020–2022. The survey was conducted between July 2020 and May 2021. The study sample was selected from a broader group of female beneficiaries of the project and could be divided into three phases:

(1) PHASE I – Targeted selection

The project was addressed to women who were pregnant and/or had children up to 6 years old and at the same time lived in one of the voivodeships of Eastern Poland.

(2) PHASE II – Convenient (random) but controlled selection

Random birthing schools and childcare institutions providing care for children up to the age of 6 (nurseries and kindergartens) located in the towns and cities of Eastern Poland covered by the project voluntarily applied and were selected to participate in the project.

(3) PHASE III – Convenient (random) selection

Random mothers using care facilities selected in phase II, after voluntarily agreeing to participate in the project and the study, received questionnaires, and after completing them, participated in educational workshops about organic food.

Study sample

The target group of this study was adult mothers of children under 6 years of age, living in the Mazowieckie, Lubelskie, or Podlaskie provinces. A total of 1142 correctly completed survey forms were obtained. Of the 1142 respondents, 674 women who were able to choose the correct description of organic food were selected for further analyses and those who were unable to choose the correct answer were rejected. The authors considered it necessary to ensure the reliable assessment of the consumption of organic food by the women surveyed. This is because women who do not have a clear understanding of what organic food is may have incorrectly assessed the proportion of organic food in their diets. In addition, seven subjects with vocational and primary education were discarded from the sample of 674, as they represented a very small group that could not be separately included in the statistical evaluations. Finally, 667 people were included in the analysis in this study.

Questionnaire design

The research tool was a questionnaire that was administered in two ways: (i) a printed version distributed in selected establishments (the PAPI method) (89% of respondents); (ii) an online version available on the project website (the CAWI method) (11% of respondents). As most of the data (89%) were obtained using the PAPI method and to maintain a uniform way of processing data. The questionnaire was very extensive. This article presents analyses of three sections.

Frequency of organic food consumption

The data on the frequency of organic product consumption were collected using ordinal scales ranging from 'never' to 'several times a day'. To facilitate quantitative analysis, these six intake frequency categories were transformed into semi-quantitative data, expressed as consumption frequency in times per day and numerical values (points). This transformation aimed to reflect the increasing intensity of consumption logically. The conversion was as follows:

- 'never' = 0 times per day (0 point);
- '1–3 times a month' = 0.06 times per day (0.06 point);
- 'once a week' = 0.14 times per day (0.14 point);
- 'several times a week' = 0.5 times per day (0.5 point);
- 'once a day' = 1 time per day (1 point);
- 'several times a day' = twice per day (2 points).

Seventeen food groups were analyzed: (1) bread, (2) cereal products, (3) milk, (4) dairy products, (5) eggs, (6) vegetables, (7) fruit, (8) vegetable and fruit products, (9) processed meats, (10) meat, (11) fish, (12) legumes, (13) ready meals, (14) confectionery, (15) honey, (16) coffee and tea, and (17) alcoholic beverages. The daily consumption frequencies of the seventeen organic product groups were converted into the points (from 0 to 2 per food group) and then summed up into a range from 0 to 34 points. The results with 0 points were interpreted as no consumption of organic food (classified as 'NON eco-con'). Those with between 0.01 and 8.49 points were interpreted as indicating a mean consumption that was less frequent than once a week (classified as

'OCC eco-con'). Those in the range of 8.5–34.00 points were interpreted as having a mean consumption at least once a week (classified as 'REG eco-con'). More details are described in an article by Woś *et al*.[10] The total sample was divided into three groups of participants distinguished by their declared frequency of the consumption of organic food groups:

(1) Consumers who never eat organic food products (NON eco-con);
(2) Occasional consumers (OCC eco-con);
(3) Regular consumers (REG eco-con).

Diet quality assessment

The frequency of consumption of 24 food groups was assessed with a validated questionnaire (the Dietary Habits and Nutrition Beliefs KomPAN Questionnaire) developed by the Committee of Human Nutrition of the Polish Academy of Science.[37,38] The frequencies of consumption were converted into numerical values (points) and expressed as times per day (never = 0 times/day; 1–3 times per month = 0.06 times per day; once a week = 0.14 times per day; several times a week = 0.5 times per day, once per day = 1 time per day; several times per day = twice per day). Diet quality scores were calculated according to the manual of the KomPAN Questionnaire, based on the usual frequency of declared consumption of 24 food items over the past 3 months and converted into the sum of points.[39]

Different scores were calculated to evaluate diet quality:

- The Pro-Healthy Diet Index (pHDI-10) was calculated by summing the daily consumption frequencies converted into numerical values of ten food groups with potentially positive health effects: 1. wholegrain bread and bakery products, 2. wholegrain cereal products, 3. milk, 4. fermented milk beverages, 5. fresh cheese curd products, 6. white meat, 7. fish, 8. legumes, 9. fruits, and 10. vegetables. The pHDI range was 0–20.
- The Non-Healthy Diet Index (nHDI-14) was calculated by summing the daily consumption frequencies 14 food groups with potentially negative health effects: 1. white bread and bakery products, 2. white rice, white pasta, and fine groats, 3. fast foods, 4. fried foods, 5. butter, 6. lard, 7. cheeses (including processed and moldy cheeses), 8. cured meats, smoked sausages, and hot dogs, 9. red meat, 10. sweets, 11. canned meats, 12. sweetened carbonated or non-carbonated drinks, 13. energy drinks, and 14. alcoholic beverages. The nHDI range was 0–28.

As recommended by the authors of these indices, to standardize the range of pHDI and nHDI, daily frequencies of the consumption (times/day) of 10 or 14 food items were summed up and recalculated into ranges from 0 to 100 points. Scores ranging from 0 to 33 points were classified as indicating low dietary intensity, 34 to 66 points as average dietary intensity, and 67 to 100 points as high dietary intensity (reflecting adherence to the dietary index). Higher pHDI scores indicate more pro-healthy dietary choices, while higher nHDI scores reflect more non-healthy dietary choices. Consequently, a health-promoting, high-quality diet is characterized by a high pHDI and a low nHDI.

Based on the pHDI and nHDI scores, an overall diet quality indicator could be calculated:

- The Diet-Quality Index (DQI) is a total diet quality index based on the previous two indices, p-HDI and n-HDI. The DQI is the combination of the two indices, calculated using the formula:

DQI (in points) = [(100/20) × pHDI] + [(−100/28) × nHDI] = [(100/20) × the sum of the frequency of consumption of 10 food groups with potentially positive health effect (times/day)] + [(−100/28) × the sum of the frequency of consumption of 14 food groups with a potentially negative health effect (times/day)].

The higher the score, the better the overall quality of the diet as measured by the DQI. The DQI can take scores from −100 to 100 points, with a range of:

- −100 to −26 points – a high intensity of non-healthy dietary characteristics (an adverse dietary effect is predicted);
- −25 to 25 points – a low intensity of unhealthy and health-promoting attributes of diet (a neutral dietary effect is predicted because the frequency of consumption of foods with potentially adverse health effects is similar to the frequency of consumption of foods with potentially beneficial health effects);
- 26 to 100 points – a high intensity of healthy dietary characteristics (a beneficial dietary effect is predicted).

A detailed description of the method can be found in the KomPAN 2020 questionnaire guide.[39]

Other aspects studied

Respondents were also asked about:

- *The type of diet followed*. Respondents choose one of the following options: (1) vegan diet, (2) vegetarian diet, (3) pesco-vegetarian diet, (4) no milk and dairy products, (5) omnivore diet, (6) other diet (they were asked to specify the type of diet).
- *The body mass and the height of the participants*. The body mass index (BMI) was then calculated. The participants were categorized into groups based on their BMI as: underweight (BMI < 18.5 kg x m^{-2}), normal weight (BMI between 18.5 and 24.9 kg x m^{-2}), pre-obesity (BMI between 25.0 and 29.9 kg x m^{-2}), or obesity (BMI ≥30.0 kg x m^{-2}).[40] The last two categories were combined during data analysis as 'excessive weight'.
- *Participants' self-assessed health status compared with that of their peers*. Respondents chose an option using a 3-point scale: (1) worse than peers, (2) same as peers, and (3) better than peers.

Statistical analysis

The data obtained from the survey were transferred to an Excel spreadsheet and then processed, coded, and analyzed. All statistical analyses were performed using SPSS v. 28.0 software (IBM Corp., Armonk, NY, USA).

The Kolmogorov–Smirnov test was used to verify the normality of distribution. The Kruskal–Wallis test was used to compare the results on the frequencies of food consumption between the groups. After a post-hoc analysis of the results obtained with the Kruskal–Wallis test, the Bonferoni correction for multiple tests was also used. A one-way ANOVA was used to compare the DQI score between groups. For post-hoc analysis, the Scheffé test was used. Statistical analysis was performed using Pearson's linear and Spearman's signed rank correlation coefficients (depending on the nature of the variables).

Spearman's correlation test was used to compare the frequencies of organic food consumption and the DQI. The study's significance level was set to $\alpha = 0.05$.

RESULTS

Characteristics of the study sample

Table 1 reports the general characteristics of the sample. Participants were primarily mothers with a high level of education (85%), living mainly in medium-sized or small cities (59%), in Mazowieckie province (47%), with one child under 6 years (58%) and four family members in the household (49%), with a good or very good economic status (85%). The mean age of the participants was 34.55 ± 4.61 years. Most of the respondents (69%) had a normal weight and the mean BMI was 23.14 ± 4 kg x m^{-2}.

The study sample was dominated by omnivores (87%). The 'other' diet category was described by the respondents as, among others: gluten-free diet, low glycemic index diet, diabetic diet, ketogenic diet, high-protein diet, no-sugar diet, and diet adapted to children's food allergies. The respondents mentioned the following reasons for following a special diet:

- doctor's health recommendations – 52 respondents;
- health reasons (eating meat/animal products is unhealthy) – 24 respondents;
- ethical reasons (I am against killing animals) – 14 respondents;
- desire to lose weight/maintain weight – six respondents;
- environmental reasons (animal husbandry is harmful to the environment) – four respondents.

Frequency of consumption of selected food groups

Table 2 provides detailed data for the frequency of consumption of 24 food groups. The REG eco-con mothers had a significantly higher frequency of consumption of seven food groups classified as food products with potentially positive health effects (vegetables, fruits, whole-grain bread and cereals, fermented dairy products, legumes, and fish). There were no significant differences in the frequency of consumption of the other food groups.

Table 1. Characteristics of the study population

Variables	Total sample *N* = 667 (100%)	Organic food consumer category		
		NON eco-con *N* = 35 (5.2%)	OCC eco-con *N* = 342 (51.3%)	REG eco-con *N* = 290 (43.5%)
Age				
Under 35 years old	326 (49%)	14	166	146
35 years old or more	341 (51%)	21	176	144
Educational level				
Secondary	103 (15%)	10	57	36
Higher	564 (85%)	25	285	254
Place of residence				
Big city (>500 000 inhabitants)	165 (25%)	15	89	66
Medium-sized city (100 000 to 500 000 inhabitants)	118 (18%)	5	57	51
Small city (10 000 to 100 000 inhabitants)	270 (41%)	12	140	118
Rural areas and villages with up to 10 000 inhabitants	114 (17%)	3	56	55
Province of residence				
Mazowieckie	311 (47%)	19	169	123
Lubelskie	181 (27%)	8	97	76
Podlaskie	175 (26%)	8	76	91
Number of young children (up to 6 years old) in the household				
1	386 (58%)	24	200	162
2 or more	281 (42%)	11	142	128
Number of people in the household				
2–3	205 (31%)	8	116	81
4	325 (49%)	21	160	144
5 and more	137 (21%)	6	66	65
Self-assessed financial situation				
Good and very good	571 (85%)	27	285	259
Neither good nor bad	79 (12%)	5	50	24
Bad or very bad	17 (3%)	3	7	7
Type of diet				
Vegan, vegetarian, pesco-vegetarian	32 (5%)	3	11	18
Milk-free and dairy-free diet	29 (4%)	0	12	17
Omnivores	581 (87%)	32	307	242
Other	25 (4%)	0	12	13
Body weight status (by BMI categories)				
Underweight	29 (4%)	2	13	14
Normal weight	460 (69%)	19	245	196
Excessive weight	178 (27%)	14	84	80

Table 2. Average frequency of consumption of selected food groups (times/day) according to the organic food consumer categories

The analysed food groups[†]	Groups of food products	Total sample ($N = 667$)	Organic food consumer category: NON eco-con ($N = 35$)	Organic food consumer category: OCC eco-con ($N = 342$)	Organic food consumer category: REG eco-con ($N = 290$)	P
		Mean ± SD Median Min-Max	Mean ± SD Median Min-Max	Mean ± SD Median Min-Max	Mean ± SD Median Min-Max	
10 food groups with a potentially positive effect on health	Wholegrain bread and bakery products	0.65 ± 0.59 0.50 0.00–2.00	0.58 ± 0.63 0.50 0.00–2.00	**0.59 ± 0.56 a** 0.50 0.00–2.00	**0.73 ± 0.61 a** 0.50 0.00–2.00	**a, 0.007**
	Wholegrain cereal products (e.g., buckwheat, oats, wholegrain pasta, or other coarse-ground groats)	0.39 ± 0.36 0.50 0.00–2.00	0.34 ± 0.31 0.14 0.00–1.00	**0.34 ± 0.32 b** 0.14 0.00–2.00	**0.46 ± 0.40 b** 0.50 0.00–2.00	**b, <0.001**
	Milk	0.93 ± 0.69 1.00 0.00–2.00	1.22 ± 0.75 1.00 0.00–2.00	0.92 ± 0.68 1.00 0.00–2.00	0.91 ± 0.70 1.00 0.00–2.00	NS
	Fermented milk beverages (e.g., yogurts, kefir)	0.48 ± 0.42 0.50 0.00–2.00	0.53 ± 0.57 0.50 0.00–2.00	**0.44 ± 0.38 c** 0.50 0.00–2.00	**0.54 ± 0.43 c** 0.50 0.00–2.00	**c, 0.01**
	Fresh cheese curd products (e.g., cottage cheese, homogenized cheese, fromage frais)	0.36 ± 0.35 0.14 0.00–2.00	0.37 ± 0.31 0.50 0.00–1.00	0.35 ± 0.36 0.14 0.00–2.00	0.37 ± 0.34 0.50 0.00–2.00	NS
	White meat (e.g., chicken, turkey, rabbit)	0.41 ± 0.26 0.50 0.00–2.00	0.35 ± 0.26 0.50 0.00–1.00	0.41 ± 0.25 0.50 0.00–2.00	0.41 ± 0.27 0.50 0.00–2.00	NS
	Fish	0.16 ± 0.15 0.14 0.00–1.00	**0.10 ± 0.06 d** 0.14 0.00–0.14	0.15 ± 0.14 0.14 0.00–1.00	**0.18 ± 0.16 d** 0.14 0.00–1.00	**d, 0.03**
	Legumes (e.g., from beans, peas, soybeans, lentils)	0.18 ± 0.27 0.06 0.00–2.00	**0.13 ± 0.21 e** 0.06 0.00–1.00	**0.13 ± 0.21 f** 0.06 0.00–2.00	**0.24 ± 0.33 e, f** 0.06 0.00–2.00	**e, 0.006** **f, <0.001**
	Fruits	1.20 ± 0.62 1.00 0.00–2.00	**0.95 ± 0.59 g** 1.00 0.06–2.00	**1.11 ± 0.61 h** 1.00 0.00–2.00	**1.34 ± 0.59 g, h** 1.00 0.00–2.00	**g, <0.001** **h, <0.001**
	Vegetables	1.38 ± 0.62 1.00 0.00–2.00	**1.09 ± 0.60 i** 1.00 0.06–2.00	**1.28 ± 0.63 j** 1.00 0.00–2.00	**1.53 ± 0.57 i, j** 2.00 0.14–2.00	**i, <0.001** **j, <0.001**
14 food groups with a potentially negative effect on health	White bread and bakery products (e.g., wheat bread, toasted bread, white bread rolls)	0.93 + 0.67 1.00 0.00–2.00	0.86 ± 0.62 1.00 0.00–2.00	0.97 ± 0.68 1.00 0.00–2.00	0.89 ± 0.66 1.00 0.00–2.00	NS
	White rice, white pasta, fine groats (e.g., semolina, couscous)	0.38 ± 0.33 0.50 0.00–2.00	0.39 ± 0.27 0.50 0.00–1.00	0.36 ± 0.27 0.50 0.00–1.00	0.40 ± 0.39 0.50 0.00–2.00	NS
	Fast food (e.g., French fries, hamburgers, pizza, hot dogs, casseroles)	0.07 ± 0.11 0.06 0.00–2.00	0.11 ± 0.15 0.06 0.00–0.50	0.07 ± 0.08 0.06 0.00–0.50	0.07 ± 0.13 0.06 0.00–2.00	NS
	Fried foods (e.g., meat or flour-based dishes)	0.34 ± 0.26 0.50 0.00–1.00	0.42 ± 0.32 0.50 0.00–1.00	0.34 ± 0.26 0.50 0.00–1.00	0.33 ± 0.25 0.14 0.00–1.00	NS
	Butter (for bread spread or as a side dish for frying, baking, etc.)	1.02 ± 0.69 1.00 0.00–2.00	1.21 ± 0.76 1.00 0.00–2.00	1.00 ± 0.68 1.00 0.00–2.00	1.03 ± 0.70 1.00 0.00–2.00	NS
	Lard (for bread spread or dishes. for frying, baking, etc.)	0.09 ± 0.27 0.00 0.00–2.00	0.12 ± 0.36 0.00 0.00–2.00	0.08 ± 0.26 0.00 0.00–2.00	0.08 ± 0.26 0.00 0.00–2.00	NS
	Cheeses (including processed and blue cheeses)	0.49 ± 0.41 0.50 0.00–2.00	0.51 ± 0.54 0.50 0.00–2.00	0.48 ± 0.40 0.50 0.00–2.00	0.49 ± 0.40 0.50 0.00–2.00	NS

Table 2. Continued

The analysed food groups†	Groups of food products	Total sample (N = 667)	Organic food consumer category: NON eco-con (N = 35)	OCC eco-con (N = 342)	REG eco-con (N = 290)	P
		Mean ± SD Median Min-Max	Mean ± SD Median Min-Max	Mean ± SD Median Min-Max	Mean ± SD Median Min-Max	
	Cold meats, smoked sausages. hot dogs	0.63 ± 0.50 0.50 0.00–2.00	0.60 ± 0.50 0.50 0.00–2.00	0.64 ± 0.47 0.50 0.00–2.00	0.62 ± 0.52 0.50 0.00–2.00	NS
	Red meat (e.g., pork, beef, veal, mutton, lamb, game)	0.30 ± 0.30 0.14 0.00–2.00	0.30 ± 0.32 0.14 0.00–1.00	0.30 ± 0.28 0.14 0.00–2.00	0.31 ± 0.33 0.14 0.00–2.00	NS
	Sweets, such as candies, cookies, cakes, chocolate bars, muesli bars, and other confectionery	0.56 ± 0.53 0.50 0.00–2.00	0.51 ± 0.34 0.50 0.00–1.00	0.60 ± 0.54 0.50 0.00–2.00	0.53 ± 0.53 0.50 0.00–2.00	NS
	Canned meats	0.04 ± 0.09 0.00 0.00–1.00	0.07 ± 0.14 0.00 0.00–0.50	0.03 ± 0.08 0.00 0.00–1.00	0.04 ± 0.10 0.00 0.00–1.00	NS
	Sweetened carbonated or non-carbonated beverages	0.15 ± 0.31 0.06 0.00–2.00	0.18 ± 0.36 0.06 0.00–2.00	0.16 ± 0.31 0.06 0.00–2.00	0.13 ± 0.31 0.06 0.00–2.00	NS
	Energy drinks	0.04 ± 0.17 0.00 0.00–2.00	0.02 ± 0.09 0.00 0.00–0.50	0.03 ± 0.15 0.00 0.00–2.00	0.04 ± 0.20 0.00 0.00–2.00	NS
	Alcoholic drinks	0.08 ± 0.12 0.06 0.00–1.00	0.10 ± 0.15 0.06 0.00–0.50	0.08 ± 0.12 0.06 0.00–1.00	0.07 ± 0.12 0.06 0.00–1.00	NS

a, b, c, … the same letters indicates groups for which the results are statistically significant differences at $P < 0.05$ (Method: Kruskal–Wallis adjusted by the Bonferroni correction for multiple tests).
N, number of respondents; NS, no statistically significant differences; SD, standard deviation.
† Frequency of consumption measured on a scale of 0 (never) to 2 (a few times a day).

Diet quality scores and the frequency of organic food consumption

Table 3 shows that most respondents had an average Diet Quality Index score (84% of the total sample)There was a positive correlation between the frequency of organic food consumption and DQI ($P < 0.001$, rho = 0.236, Spearman test), pHDI ($P < 0.001$, rho = 0.240, Spearman test), and a negative correlation between the frequency of organic food consumption and nHDI ($P < 0.001$, rho = −0.080, Spearman test). Regular organic food consumers had significantly higher pHDI and DQI scores (Table 4).

Figure 1 shows the relationship between the respondents' frequency of consumption of 24 organic food products (described in Woś et al.)[10] and their DQI scores (calculated for the total food products, not only organic). The trend line illustrates that, as the indicator of organic product consumption increased (horizontal line), the DQI value also increased (vertical line). It could be concluded that the DQI score of the female consumers in the current study increased with more frequent consumption of organic food.

Health status and the frequency of organic food consumption

Analysis of the frequency of organic food consumption according to consumers' self-assessments of health status showed that female respondents who assess their health status as 'better than their peers' were characterized by a higher median frequency of organic food consumption than groups that rate their health worse (Table 5).

DISCUSSION

Consumption of food products and diet quality indices

This study aimed to assess the quality of the diets of mothers of children under 6 years of age, living in three provinces of Poland, consuming organic foods with variable frequencies. The diet quality was regarded as higher if the diet was in line with dietary recommendations. The Polish principles of healthy nutrition[41] recommend increasing the intake of vegetables, fruits, whole-grain cereal products, pulses, fish, and low-fat dairy, and limiting processed products high in salt, sugar, and fats, red and processed meat, animal fats, and alcohol. The study therefore examined whether the diet of mothers who regularly consume organic food is of better quality than those who consume organic food less frequently.

The study found significant differences in the average frequency of consumption of health-promoting products by REG eco-con compared with other groups of respondents (Table 2). This group had the most frequently consumed fruits, vegetables, wholemeal bread, whole-grain cereal products, fermented dairy products, legumes, and fish. The results are consistent with French, German, and Danish studies, which found that consumers

Table 3. Diet quality indices for the total sample ($n = 667$)

	Pro-healthy diet index (pHDI)		Non-healthy diet index (nHDI)		Diet Quality Index (DQI)	
Score	*N*	Percentage of total sample	*N*	Percentage of total sample	*N*	Percentage of total sample
Low	409	61	634	95	3	<1
Average	256	38	33	5	561	84
High	2	<1	0	0	103	15

Table 4. Diet quality indices scores (pHDI, nHDI, and DQI) according to the organic food consumer category

	Total sample ($N = 667$) Mean ± SD Median Min.–Max.	NON eco-con ($N = 35$) Mean ± SD Median Min.–Max.	OCC eco-con ($N = 342$) Mean ± SD Median Min.–Max.	REG eco-con ($N = 290$) Mean ± SD Median Min.–Max.	*P*-value
pHDI (points, 0 – 100)	31 ± 11 30 6–70	28 ± 12 26 **a** 8–66	29 ± 11 27 **b** 8–63	34 ± 11 34 **a,b** 6–70	**a**, **0.007** **b**, <**0.001**
nHDI (points, 0 – 100)	18 ± 9 17 0–59	19 ± 9 19 0–37	18 ± 8 18 1–45	18 ± 9 17 1–59	NS
DQI (points, −100–100)	13 ± 13 13 −31–54	9 ± 13 **c** 8 −15–32	10 ± 13 **d** 10 −29–48	16 ± 13 **c, d** 15 −31–54	**c**, **0.016** **d**, <**0.001**

a, b, c, … the same letters indicates groups for which the results are statistically significant differences at $P < 0.05$ (Methods: Kruskal–Wallis adjusted by the Bonferroni correction for multiple tests in pHDI and nHDI analyses, ANOVA method in DQI analyses); *N*, number of respondents; NS, no statistically significant differences; SD, standard deviation.

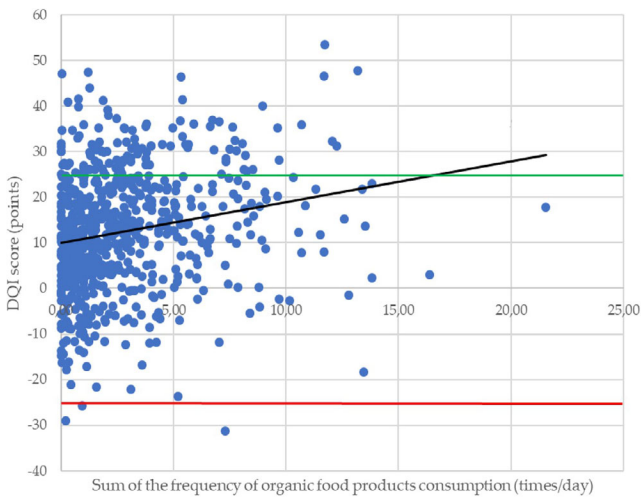

Figure 1. Relationship between DQI scores and total scores for frequency of organic food consumption. The green line indicates the DQI value from which the high DQI range begins; the red line indicates the DQI value beyond which the low DQI range begins, and the average DQI range is marked between the lines.

of organic foods have significantly higher intakes of fruits and vegetables,[22-24,42] whole grains, and legumes,[22] fiber and *n*-3 fatty acids.[42] Consumption of the other studied food groups was not statistically significant but it is noticeable that REG eco-con were the least likely to consume some products with potentially negative health effects: fast food, fried foods, lard, processed meat, sweetened beverages, and alcoholic beverages. This is consistent with the results of studies where regular consumers of organic products had significantly lower consumption of sweet and alcoholic beverages, processed meat,[22] meat/sausages, and soft drinks,[23] fat/confectionary[24] and less saturated fat.[42]

Other studies have emphasized lower meat consumption among regular organic food consumers.[22-24,42-45] In this study, the REG eco-con group consumed red meat dishes most frequently of all groups (Table 2). The differences between the groups were not statistically significant but the results show that red meat was consumed on average 2–6 times a week, which is not in line with current dietary recommendations. Unfortunately, these results are typical for the Polish population, where red meat consumption is deeply rooted in culinary traditions and has been very high for many years – in 2020 it amounted on average to about 1.16 kg of meat and meat products per person per week,[46] whereas according to dietary recommendations it should not exceed 0.5 kg.[41]

In this study, respondents who followed special diets (vegan, vegetarian, pesco-vegetarian, milk-free, and dairy-free) were more frequently consuming organic food (Table 1). This trend is beneficial for their health because such diets are characterized by a high consumption of plant-based foods where pesticide residues could be found and could have harmful health effects. By consuming organic food products more frequently, individuals can lower exposure to such substances. Intervention studies confirmed lower levels of pesticide residues in the urine of consumers following an organic diet.[47-50] Motivation for such behavior among respondents is not only health-related but also relates to

Table 5. Frequency of organic food consumption according to the self-assessed health status of consumers

	Total sample ($N = 667$)		Frequency of organic food consumption (times/day)			
Self-assessed health status	*N*	Percentage	Mean ± SD	Median	Min.–Max.	*P*-value
Worse than peers	77	11.5	2.3 ± 2.3	**1.4 a**	0 – 11.3	**a, 0.007**
Same as peers	500	75	2.8 ± 2.9	**1.8 b**	0 – 16.4	**b, 0.011**
Better than peers	90	13.5	3.8 ± 3.6	**2.7 a, b**	0 – 21.6	

a, b, c, … the same letters indicates groups for which the results are statistically significant differences at $P < 0.05$ (Method: Kruskal–Wallis adjusted by the Bonferroni correction for multiple tests); *N*, number of respondents; SD, standard deviation.

pro-environmental behavior and ethical values, and this has also been shown in previous studies.[42-45]

In the current study, 84% of the female respondents had a DQI score between −25 and 25, which means that their diet can have a neutral effect on health (Table 3). For 103 respondents (15%) the DQI score was greater than 25, so their diet showed a high intensity of health-promoting characteristics. Table 4 shows that the higher the frequency of organic food consumption, the higher the pHDI and DQI scores and the lower the nHDI score. Scores of REG eco-con were statistically significantly higher than those of other consumers (Table 4).

No studies have been conducted on the Polish population regarding the evaluation of organic consumers' diet quality using diet quality indices. A Polish study conducted 16 years ago with 200 female organic consumers revealed that their diets were closer to the dietary recommendations.[26] The results are consistent with a Polish study that showed that the type of food consumed (conventional/organic) and the proportion of organic food in the diet had a significant impact on diet.[51] The results are also in line with the results of a French study that found a positive correlation between the level of organic food consumption and nutritional quality score,[52] and research on US households, which showed a one-way link between diet quality and organic purchases.[53]

The results of the current study were compared with studies that were not focused specifically on organic food consumers. In a random sample of the Polish population aged 20 years and above, measured using the Healthy Diet Indicator (HDI) score, 60% of the total sample had a low-quality diet, whereas 15% had a healthy diet.[54] In the current study, the proportion of respondents with poor-quality diets was much lower (<1% of the total sample).

In another study involving 657 female students aged 19–30 years, the DQI for almost 90% of the sample indicated a neutral effect on health, 1.2% had a DQI below −25, and only 9.9% of students had a DQI greater than 25.[55] In another study among 638 students of food and nutrition-related majors, the mean pHDI was 25.9 and the mean nHDI was 16.3.[56] Compared with the two studies mentioned above, mothers in the current study were more likely to consume potentially health-promoting foods, which explains the higher percentage of respondents with better pHDI/DQI scores (Table 4).

The respondents in the two studies discussed above were students, whereas all the participants in the current study were mothers with at least one child, and their average age was about 35. According to *Statistics Poland* (in Polish: *Główny Urząd Statystyczny* – GUS), the average age at which Polish mothers gave birth to their first child in 2021 was almost 29 years.[57] Thus, a higher proportion of respondents with better diet indicators in our study might be due to their concern about family members' diets. Some studies confirmed a positive correlation between having children and better dietary choices[58-60] or more frequent purchase of organic food.[29,61-63]

The DQI score of the female consumers in the current study increased with more frequent consumption of organic food (Fig. 1). It can therefore be hypothesized that the health-promoting effect of an organic diet could result either from the food production system, from a better diet quality, or from a healthier lifestyle.

To summarize the results of the survey, the study confirmed H1: the diets of mothers who regularly consumed organic food were of better quality than those who consumed organic food less frequently.

Organic diet impact on self-assessment of health status compared with peers

The results of the survey confirmed H2: mothers who consumed organic food more often perceived their health status to be better than those who consumed organic food less frequently. Female respondents who rated their health as better than the health of their peers tended to consume organic food more frequently (Table 5). These findings are in line with previous studies, which showed that organic consumers assessed their state of health as being significantly better than consumers of conventional foods[26,30] and have better self-rated health scores.[18,64,65] Other studies have also shown a positive effect on well-being[31-34] and higher life satisfaction.[35] In other studies, women with healthier diets also had lower health-service use,[64] a lower number of errors in the Mini Mental State score, and significantly lower depressive symptoms.[65] This suggests that the consumption of organic food should be investigated in the future as a factor affecting the health and well-being of Polish citizens. According to Aschemann-Witzel *et al.*, the results of such studies could play a significant role in promoting sustainable development in the food sector, for example by encouraging people to adopt more sustainable diets and food choices and prioritizing well-being related to food.[66]

Limitations of the study

The results of our study should be considered in the light of several potential limitations:

(1) The survey targeted specific localities and establishments chosen through purposive controlled selection. However, respondents participated voluntarily and randomly, potentially resulting in a higher proportion of women interested in

organic food consumption compared to the general Polish population.

(2) The report analyzed three provinces in Poland: Mazowieckie, Lubelskie, and Podlaskie. Mazowieckie is highly developed with high incomes, whereas Lubelskie and Podlaskie are developing regions with agricultural areas and lower-income residents. In 2020, Podlaskie ranked second in organic producers with 14.6% of the total number in Poland. Mazowieckie ranked third and Lubelskie fifth.[67] Thus, residents of these provinces may have better access to organic food than others where less is produced.

(3) The present study included only female participants who demonstrated a clear understanding of the definition of organic food, as indicated by marking the correct definition in the questionnaire (59% of the total questionnaires obtained during the study). Consequently, it is plausible that the surveyed women possessed a greater knowledge concerning organic food than the average female population in Poland. This may be attributed to a greater interest in the consumption of organic food and related benefits.

(4) The COVID-19 pandemic was ongoing during the study, which might have influenced changes in the dietary behavior and lifestyle of Poles.[68,69]

The above limitations and the specificity of the study make it impossible to interpret the results as representative of the entire Polish population.

CONCLUSIONS

This article analyzed the quality of diet of mothers of children under 6 years old, living in eastern provinces of Poland, who consumed organic food with different frequencies. As far as the authors are aware, this is the first research on this issue in Poland. The results showed that regular consumers of organic food had the best diet quality scores (the strongest health-promoting impact). Respondents who consumed organic food more frequently rated their health status better than their peers. It is possible that an organic diet may play a significant role in an individual's quality of life and well-being. It should therefore be considered as a measurable factor in this regard. Further research is necessary to establish a relationship between an organic diet and its potential positive impact on well-being. The limitations of the study, discussed above, should be taken into consideration. Nevertheless, the implications of these findings may contribute to the development of health policies and the promotion of organic agriculture. Continuing research on this topic could help policymakers to develop nutritional transformation towards sustainability by promoting organic food to Polish consumers. The results of the survey also provide insights into an important group of organic consumers, which can be useful for marketing campaigns and the development of business models for distributors, producers, and manufacturers.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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