ORIGINAL ARTICLE

Annals of Agricultural and Environmental Medicine
www.aaem.pl

Comparison of dietary patterns and selected health parameters in an adult population assessed before and during the COVID-19 pandemic

Magdalena Zalewska[1,A,C-D,F], Jacek Jamiołkowski[1,B-C], Magda Łapińska[1,B], Andrzej Szpak[2,C,E], Paweł Sowa[1,B], Łukasz Kiszkiel[3,B], Anna Moniuszko-Malinowska[1,E], Karol Kamiński[1,4,A,E-F]

[1] *Department of Population Medicine and Lifestyle Diseases Prevention, Medical University, Białystok, Poland*
[2] *Department of Epidemiology and Biostatistics, Institute of Rural Medicine, Lublin, Poland*
[3] *Society and Cognition Unit, University of Białystok, Poland*
[4] *Department of Cardiology and Internal Medicine with Cardiac Intensive Care Unit, Medical University, Białystok, Poland*
A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of the article

Zalewska M, Jamiołkowski J, Łapińska M, Szpak A, Sowa P, Kiszkiel Ł, Moniuszko-Malinowska A, Kamiński K. Comparison of dietary patterns and selected health parameters in an adult population assessed before and during the COVID-19 pandemic. Ann Agric Environ Med. doi:10.26444/aaem/217764

Abstract

Introduction and Objective. The COVID-19 pandemic has been associated with changes in health-related behaviours, including dietary patterns. The aim of this study was to compare dietary habits, nutritional intake, and selected health parameters in adult populations assessed before and during the COVID-19 pandemic.
M**aterials and Method**. The analysis was based on two groups from the population-based Białystok PLUS cohort: pre-pandemic (n=565) and during-pandemic (n=637). Dietary intake, lifestyle factors, and clinical measurements were compared. Statistical analyses were adjusted for seasonality using IBM SPSS Statistics 27.0.
Results. Participants assessed during the pandemic reported higher consumption of vegetables, particularly root and cruciferous types, legumes, and water, and demonstrated greater adherence to Mediterranean and Nordic dietary patterns. At the same time, higher levels of sedentary behaviour and screen exposure were observed. Clinically, the pandemic-period group presented lower waist-to-hip ratio, blood pressure, LDL and HDL cholesterol, and interleukin-6 levels. Despite these objectively more favourable dietary patterns, self-rated diet quality was lower.
Conclusions. Significant differences in dietary behaviours, lifestyle factors, and selected health parameters were observed between adult populations assessed before and during the COVID-19 pandemic. The findings indicate the coexistence of both beneficial and adverse behavioural patterns, underscoring the importance of integrated public health strategies addressing diet quality, physical activity, and health awareness.

Key words
inflammation, dietary habits, nutrition, public health, COVID-19

INTRODUCTION

The SARS-CoV-2 pandemic remains one of the greatest global public health and socio-economic challenges. The pandemic has significantly affected healthcare systems and both national and global economies [1, 2]. Recent studies suggest that its long-term consequences on lifestyle behaviours, including dietary habits, may persist for years, highlighting the need for ongoing monitoring and intervention [3]. Currently, growing scientific attention is focused on the long-term health consequences and lifestyle habits associated with the COVID-19 pandemic. Adequate nutrition and hydration improve well-being and reduce the risk of obesity, diabetes, and hypertension [4]. A healthy diet also plays an important role in supporting sleep, mental health, and immune function [2, 5].

Nutritional recommendations during the pandemic emphasized the increased consumption of vegetables, fruits, and whole grain products. Such diets provide essential nutrients that support immune function, including vitamin C, beta-carotene, omega-3 fatty acids, dietary fibre, folic acid, zinc, and selenium [6]. Among dietary patterns aligned with these recommendations, the Mediterranean Diet (MD) is of particular interest. It is characterized by a high intake of plant-based foods, olive oil as the main fat source, moderate consumption of fish, dairy, and poultry, and reduced intake of red and processed meat [7, 8]. The Nordic Diet (ND) similarly encourages fruit, vegetables, whole grain products, and fish, while limiting the consumption of red meat and processed foods [9]. Both dietary patterns are rich in bioactive compounds with anti-inflammatory and antioxidant properties, and are recognized for their potential to support immune health [8, 10, 11]. However, evidence comparing adherence to Mediterranean and Nordic dietary patterns in independent population-based samples assessed before and during the COVID-19 pandemic remains limited, particularly when combined with objective metabolic and inflammatory biomarkers.

✉ Address for correspondence: Magdalena Zalewska, Department of Population Medicine and Lifestyle Diseases Prevention, Medical University of Bialystok, Poland
E-mail: mzalewska@o2.pl

Received: 06.10.2025; accepted: 14.01.2026; first published: 12.03.2026

Aim of the study

The aim of this study is to compare dietary patterns, diet quality, and selected health parameters in an adult population assessed before and during the COVID-19 pandemic.

MATERIALS AND METHOD

Study organization. The study involved 1,202 individuals aged 20 – 79 years. It was conducted between 2018 – 2022 on a representative sample of adult residents of Bialystok, a city located in north-eastern Poland. Participants were randomly selected from the city's population to reflect its demographic structure as closely as possible. Eligible individuals were invited to participate via postal mail and encouraged to contact the research team by phone or e-mail to arrange a study visit. The study sample was divided into 2 groups: a pre-COVID-19 group (n = 565), comprising participants assessed between 5 November 2018 – 17 March 2020, prior to the onset of the COVID-19 pandemic, and a during-COVID-19 group (n = 637), comprising participants assessed between 14 July 2020 – 27 January 2023, during the COVID-19 pandemic. Both groups were recruited using identical randomization and invitation procedures. No significant differences in age or gender distribution were observed between the groups.

The study was approved by the Ethics Committee of the Medical University of Bialystok (Poland) on 31 March 2016 (Approval No: R-I-002/108/2016). All participants gave written informed consent following the Declaration of Helsinki.

Dietary and lifestyle data. Information on dietary intake and lifestyle behaviours was collected using standardized questionnaires and structured interviews. This included the frequency of food consumption, adherence to specific dietary patterns (e.g., Mediterranean and Nordic diets), as well as data on physical activity, sedentary time, and screen exposure.

The dietary habits of participants were assessed using 3-day dietary recall. Each participant was asked to record all food, meal, drink and beverage consumption over a 3-day period (2 weekdays and 1 weekend day) using a standardized dietary record form. Portion sizes were estimated based on a photographic food atlas presenting the most commonly consumed products and dishes in Poland. The energy value and nutrient composition of the diets were calculated using the Diet 6.0 software, developed by the National Institute of Public Health (NIPH) in Poland.

To evaluate the quality of the participants' diets, 2 dietary indices were applied: MDI and NDI. The MDI included the intake of nine food groups: (1) vegetables, (2) fruits and nuts, (3) cereals, (4) fish, (5) milk and dairy products, (6) meat and meat products, (7) legumes, (8) alcohol, and (9) olive oil. For vegetables, fruits and nuts, legumes, cereals, and fish, a score of 2 points was assigned for high intake, 1 point for moderate, and 0 for low intake. In contrast, for meat and dairy products, 2 points were awarded for low intake, 1 point for moderate, and 0 for high intake. For alcohol, moderate consumption received the highest score. Regular use of olive oil was scored as 1 point, and no use as 0 points. For each food group included in the Mediterranean Diet Index, intake was classified using population-specific median intake values, following the methodology described by Stefler et al. [12]. These median-based cut-offs were subsequently used to derive low, moderate, or high consumption categories for scoring purposes. The total adherence score to the Mediterranean diet ranged from 0–17 points. Based on total scores, participants were categorized into 3 groups: low adherence (0–7 points), moderate adherence (8–10 points), and high adherence (11–17 points).

The NDI [9] was based on following components: fish, cruciferous vegetables, apples and pears, root vegetables, whole-grain bread, and oatmeal. For consumption each component above the median for each of these groups, 1 point is awarded, otherwise 0 points are awarded, resulting in a total score from 0 (lowest adherence) to 6 points (highest adherence). Based on the total score, participants were classified into 3 categories: low adherence (0–1 points), moderate adherence (2–3 points), and high adherence (4–6 points). Alcohol consumption was additionally assessed using a separate question regarding alcohol use in the preceding 30 days ('Have you consumed any alcoholic beverages during the last 30 days?', to which participants responded *yes* or *no*).

Additionally, participants were asked about the average daily time spent in front of a computer screen, rated using a 5-point scale: never, up to 1 hour, 1–3 hours, 4–6 hours, and more than 6 hours. Time spent watching television was assessed using the following categories: never, up to 2 hours, 2–6 hours, and 6–10 hours.

Anthropometric and Biochemical Measurements. Anthropometric data, including height, weight, waist and hip circumferences, were collected using the SECA 201 measuring tape (SECA GmbH & Co. KG, Hamburg, Germany). All measurements were conducted in accordance with the guidelines of the World Health Organization (WHO). The waist-to-hip ratio (WHR) was calculated as the ratio of waist circumference to hip circumference. Body mass index (BMI) was determined as body weight in kilograms divided by height in meters squared (kg/m²).

Blood pressure (BP) was measured using the oscillometric method with an Omron M6 Comfort device (Omron Healthcare Co. Ltd, Kyoto, Japan). After participants had rested in a seated position for at least 5 minutes, 2 readings were taken 5 minutes apart, and the average was recorded.

Body composition was assessed using dual-energy X-ray absorptiometry (DEXA). A comprehensive biochemical analysis was performed, including total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C), triglycerides (TG), glucose, and glycated hemoglobin (HbA1c). Blood samples were processed by centrifugation and stored at -70 °C until further analysis.

In accordance with WHO guidelines, an oral glucose tolerance test (OGTT) was performed in fasting participants without a known diagnosis of diabetes mellitus. A 75 g glucose solution was administered, and blood samples were drawn at 0, 60, and 120 minutes. Plasma glucose concentrations were determined using an enzymatic reference method with hexokinase (Cobas c111, Roche Diagnostics, Mannheim, Germany). LDL-C and HDL-C concentrations were measured using a homogeneous enzymatic colorimetric method, and total cholesterol and triglycerides were analyzed with an enzymatic colorimetric assay, all using the Cobas c111 system (Roche, Meylan, Isère, France).

Statistical analysis. Participants were divided into 2 groups according to the date of examination: before versus after the onset of the COVID-19 outbreak. Continuous variables are presented as means with standard deviations (SDs). To compare these between groups, the Mann-Whitney U test was applied in order to provide robustness against potential deviations from normality; given the large sample size, the use of a non-parametric test did not materially affect statistical power. Categorical variables are presented as counts and percentages and were compared using the chi-squared test. To account for potential seasonal variation in nutritional parameters, additional analyses were performed using linear regression models that included the season of examination as a covariate. All statistical analyses were carried out using IBM SPSS Statistics, version 27.0 (IBM Corp., Armonk, NY, USA). A 2-sided p value <0.05 was considered statistically significant.

RESULTS

A total of 1,202 individuals were included in the study: 565 in the pre-pandemic group and 637 in the during-pandemic group. The demographic characteristics of the 2 groups were comparable in terms of age, gender distribution, and education level (Tab. 1). The mean age was 50.23 ± 15.07 years in the pre-COVID group and 50.68 ± 14.94 years in the during COVID-19 group. The proportion of male participants was similar (44.6% vs. 45.1%). Over half of the participants in both groups had higher education.

Lifestyle factors differed notably between the groups (Tab. 1). A significantly higher proportion of individuals in the during COVID19 group reported spending more than 6 hours daily in front of a computer screen (30.9% vs. 23.5%; *p*=0.006). Conversely, fewer individuals in the during pandemic group watched television for less than 2 hours per day (*p*=0.006), while more declared not watching television at all (*p*=0.001).

As shown in Table 1, both groups had mean BMI values indicative of overweight (27.05 ± 4.88 vs. 27.24 ± 5.11; *p*=0.752). In contrast, the waist-to-hip ratio (WHR) was significantly lower in the during COVID-19 group than in the before COVID-19 group (0.86 ± 0.10 vs. 0.88 ± 0.10; p = 0.002). Blood pressure values were significantly lower during-pandemic: systolic (122.68 ± 17.48 mmHg vs. 125.32 ± 17.66 mmHg; *p*=0.011) and diastolic (79.88 ± 10.04 mmHg vs. 81.79 ± 9.84 mmHg; *p*=0.001). Lipid profile analysis showed lower levels of LDL-C and HDL-C in the during COVID-19 group (*p*<0.001 for both). Additionally, participants assessed after the pandemic had lower levels of total protein, albumin, and IL-6 (*p*<0.001 for all), indicating reduced systemic inflammation.

Dietary intake analysis revealed significant differences between groups in several nutrients (Tab. 2). Participants assessed during the COVID-19 pandemic reported significantly higher water intake (2238.4 ± 979.5 ml vs. 2035.3 ± 732.6 ml; *p*<0.001), with this difference remaining significant after adjusting for total energy intake and season (*p*=0.035).

Among micronutrients, intakes of vitamin D, vitamin B2, vitamin B6, folate, and β-carotene were significantly higher in the during-pandemic group. Seasonally adjusted models confirmed significant differences for vitamin B2 (*p*=0.013), folate (*p*=0.045), and β-carotene (*p*=0.030). Intakes

Table 1. Study group characteristics

Variable	preCOVID		duringCOVID		P value
Demographic characteristics					
	n=565	%	n=637	%	
Gender /M	252	44.6	287	45.1	0.875b
Age/years, X ± SD	50.23±15.07		50.68±14.94		0.307a
20–39	167	29.5	166	26.1	0.399[b]
40–59	210	37.2	250	39.2	
60–79	188	33.3	221	34.7	
Educational level					
below secondary	82	14.5	85	13.4	0.352[b]
secondary	180	31.9	205	32.2	
higher education	302	53.6	346	54.4	
Lifestyle Habits					
Smoking – currently smoking	91	16.5	119	19.1	0.237[b]
Alcohol – consumption in the last 30 days	408	73.5	440	70.5	0.252[b]
Computer time					
No use	109	20.0	113	19.3	0.830[c]
<1h	129	23.7	126	21.5	0.432[c]
1–3h	114	20.9	91	15.6	0.024[c]
4–6h	65	11.9	74	12.6	0.780[c]
>6 h	128	23.5	181	30.9	0.006[c]
Watching television					
No use	54	9.9	144	15.1	0.001[c]
<2h	329	60.3	340	56.9	0.006[c]
2h–6h	155	28.4	156	26.1	0.091[c]
6h–10h	8	1.5	12	2.0	0.781[c]
Anthropometric and clinical data					
BMI, X ± SD	27.05±4.88		27.24±5.11		0.752[a]
<18,5	10	1.8	8	1.3	0.464[c]
18,5–24,9	206	36.5	232	36.4	0.989[c]
25–29,9	201	35.6	240	37.7	0.451[c]
>30	148	26.2	157	24.6	0.538[c]
WHR, X ± SD	0.88±0.10		0.86±0.10		0.002[a]
Fat mass, %	33.56±7.84		33.83±7.69		0.603[a]
Lean mass, %	63.4±7.79		63.4±7.72		0.815[a]
Visceral fat, %	1.5±0.94		1.5±1.04		0.206[a]
Fasting glucose, (mg/dL), X ± SD	103.12±15.69		104.27±19.76		0.958[a]
Glucose 120 (mg/dL), X ± SD	125.63±37.22		127.44±38.34		0.707[a]
HbA1c, %	5.49±0.56		5.56±0.66		0.386[a]
non-HDL,	130.27±42.54		132.45±41.71		0.370[a]
TC, (mg/dL), X± SD	193.71±42.48		192.39±41.11		0.741[a]
LDL-C, (mg/dL), X± SD	127.30±38.09		119.79±37.00		<0.001[a]
HDL-C, (mg/dL), X± SD	63.43±17.45		59.95±15.88		<0.001[a]
Triglycerides, (mg/dL), X± SD	113.92±70.01		116.20±81.85		0.798[a]
Blood pressure (mm Hg)					
Systolic, (mm Hg), X± SD	125.32±17.66		122.68±17.48		0.011[a]
Diastolic, (mm Hg), X± SD	81.79±9.84		79.88±10.04		0.001[a]
Total protein, g/dL	7.46±0.42		7.24±0.49		<0.001[a]
Albumin, g/dL	4.68±0.26		4.58±0.29		<0.001[a]
IL-6, (pg/ml)	2.69±5.59		2.12±5.59		<0.001[a]

Data is shown as N/%, mean ± SD. SD, standard deviation; [1]Education – below secondary (incomplete elementary, elementary educated, gymnasium); secondary education (secondary school, post-secondary), higher education (higher school, university); Systolic blood pressure; Diastolic blood pressure; mmHg – millimeters of mercury; BMI – Body Mass Index; kg – kilogram; m2 – square meter; WHR – waist-hip ratio; TC – total cholesterol, mg/dL; LDL – C low-density lipoprotein cholesterol, mg/dL; HDL – high-density lipoprotein cholesterol, mg/dL; glucose 0, glucose 120, mg/dL; HbA1c glycated hemoglobin, %; IL-6 interleukin 6, pg/ml
a – Mann–Whitney test, b – chi2 test, c – tests for 2 proportions with Bonferroni adjustment for multiple comparisons

Table 2. Supply of vitamins and minerals in the habitual diets of study participants

Variable	preCOVID n=565	duringCOVID n=637	P value	B	P value*
Energy intake (kcal)	1935.6±597.62	1992.21±623.83	0.164	58.954	0.099
Total protein (g)	84.18±27.71	87.18±27.97	0.043	2.980	0.067
/1000 kcal	44.01±8.25	44.44±8.59	0.400	0.366	0.456
Total fat (g)	74.17±28.27	76.46±28.89	0.160	2.646	0.113
/1000 kcal	38.19±7.99	38.27±7.61	0.688	0.249	0.582
Carbohydrates (g)	235.7±81.07	243.11±87.86	0.278	7.509	0.129
/1000 kcal	122.17±21.23	122.23±20.05	0.821	-0.140	0.908
Water (ml)	2035.27±732.6	2238.42±979.45	<0.001	185.259	<0.001
/1000 kcal	1115.85±449.69	1185.09±496.88	0.005	58.323	0.035
Dietary fiber(g)	20.00±7.75	20.15±7.06	0.464	0.175	0.685
/1000 kcal	10.63±3.45	10.46±3.29	0.386	-0.183	0.351
Vitamin D (mg)	4.01±3.92	4.36±4.06	0.003	0.347	0.136
/1000 kcal	2.07±1.90	2.27±2.19	0.024	0.200	0.096
Vitamin B12 (mg)	4.54±4.22	4.90±4.96	0.022	0.386	0.152
/1000 kcal	2.37±2.15	2.53±2.57	0.119	0.187	0.178
Folate (µg)	271.18±105.15	293.33±240.97	0.005	22.168	0.045
/1000 kcal	144.32±47.06	155.76±195.35	0.222	11.558	0.174
Vitamin B6 (mg)	1.85±1.97	1.98±1.98	0.003	0.120	0.298
/1000 kcal	0.97±0.77	1.03±1.21	0.057	0.064	0.283
Vitamin B2 (mg)	1.66±0.18	1.76±0.71	0.003	0.097	0.013
/1000 kcal	0.88±0.26	0.91±0.44	0.016	0.035	0.107
Vitamin C (mg)	97.12±152.39	95.96±63.95	0.185	-2.130	0.749
/1000 kcal	53.19±87.83	51.53±37.66	0.724	-2.262	0.557
Vitamin E (mg)	11.0±5.57	11.67±2.21	0.005	0.631	0.050
/1000 kcal	5.75±2.25	6.05±3.17	0.104	0.278	0.086
Vitamin A (mg)	1159.33±1071.91	1251.64±1310.62	0.001	111.460	0.112
/1000 kcal	624.06±561.66	662.53±713.19	0.029	48.864	0.194
β-carotene (µg)	3759.71±2820.43	4127.78±2857.43	0.018	359.466	0.030
/1000 kcal	2077.84±1614.28	2232.77±1697.28	0.102	145.473	0.132
Copper (mg)	1.28±0.45	1.35±0.55	0.010	0.077	0.009
/1000 kcal	0.67±0.19	0.70±0.31	0.412	0.026	0.090
Zinc (mg)	10.71±4.10	10.95±4.74	0.317	0.261	0.314
/1000 kcal	5.61±1.36	5.63±2.94	0.426	0.023	0.866
Mangan (mg)	4.80±2.30	4.72±2.08	1.0	-0.038	0.762
/1000 kcal	2.57±1.25	2.47±1.56	0.086	-0.079	0.234
Ferrum (mg)	12.33±4.51	12.71±8.63	0.259	0.456	0.264
/1000 kcal	6.48±1.75	6.63±6.83	0.299	0.190	0.523

Data is shown as mean ± SD. SD, standard deviation; p – Mann-Whitney test; B – difference between the pre- and during-COVID period in the seasonally adjusted model; p* – for the difference between the pre- and during-COVID period in the seasonally adjusted model

of copper and vitamin E also higher among participants assessed during the pandemic ($p < 0.05$).**

Table 3 presents the intake of selected food groups among participants assessed before and during the COVID-19 pandemic. Total vegetable consumption was significantly higher in the during-pandemic group (274.9 ± 139.1 g vs. 243.2 ± 128.9 g; $p < 0.001$), including both root and cruciferous vegetables ($p = 0.024$ and $p < 0.001$, respectively). Legume consumption also increased significantly during the pandemic ($p = 0.001$). These differences remained significant in seasonally adjusted models.

The intake of home-prepared meals was higher in the during pandemic group (adjusted $p = 0.017$), whereas alcohol consumption per 1,000 kcal was significantly lower (adjusted $p = 0.046$). No significant differences were observed in total meat, fish, or grain product consumption, although a decreasing trend in red meat intake was noted.

Table 3. Food products in the diet of study participants

Variable	preCOVID n=565	duringCOVID n=637	P value	B	P value*
Vegetables	243.21±28.97	274.86±139.06	<0.001	26.981	0.001
/1000 kcal	134.48±76.92	148.53±86.03	0.006	10.978	0.020
Root vegetables	33.84±37.07	39.26±40.50	0.024	6.232	0.006
Cruciferous vegetables	160.41±114.09	204.49±130.39	<0.001	38.083	<0.001
Fruit	219.25±177.04	232.28±198.66	0.247	11.066	0.315
/1000 kcal	119.54±96.43	120.82±102.40	0.712	-0.094	0.987
Potatoes	89.13±71.62	95.71±74.6	0.117	6.771	0.113
/1000 kcal	47.05±34.9	49.6±37.9	0.377	2.455	0.249
Grain	55.27±65.7	50.98±60.7	0.516	-3.460	0.347
/1000 kcal	29.65±34.0	26.61±30.36	0.335	-2.708	0.148
Eggs	45.56±48.48	49.17±44.69	0.049	4.078	0.132
/1000 kcal	24.37±26.16	25.76±23.99	0.086	1.741	0.232
Legumes	7.32±21.39	11.01±26.0	0.001	3.773	0.007
/1000 kcal	4.11±11.93	5.79±13.97	<0.001	1.728	0.023
Dairy products	188.57±144.1	199.8±11.72	0.049	10.321	0.212
/1000 kcal	101.59±75.83	103.84±70.36	0.213	1.268	0.764
Meat	155.72±92.74	154.67±93.05	0.972	-1.661	0.759
/1000 kcal	80.58±41.19	78.16±40.68	0.539	-2.663	0.264
Fish	24.21±37.52	25.4±38.9	0.586	1.873	0.407
/1000 kcal	12.85±19.93	13.8±22.01	0.588	1.185	0.340
Nuts	11.11±17.70	12.86±20.33	0.110	1.978	0.076
/1000 kcal	5.69±8.47	6.59±9.98	0.156	1.019	0.060
Olive oil	1.5±4.4	2.03±6.05	0.052	0.561	0.071
/1000 kcal	0.86±2.58	1.07±3.03	0.053	0.227	0.170
Alcohol	67.07±202.63	53.51±167.19	0.194	-16.283	0.130
/1000 kcal	29.07±77.46	22.38±67.81	0.164	-0.501	0.046
Home cooked dishes	16.91±38.72	23.05±48.78	0.067	2.965	0.017
/1000 kcal	8.38±18.48	11.23±23.38	0.090	6.405	0.013
Red meat	110.44±85.71	105.95±80.89	0.052	-5.087	0.294
/1000 kcal	56.12±38.83	52.37±36.22	0.127	-4.052	0.063
Soups	140.03±132.03	156.96±145.57	0.080	17.889	0.028
/1000 kcal	80.15±84.03	86.17±90.08	0.243	5.992	0.239
Coffee	221.78±189.46	229.87±182.56	0.323	10.119	0.350
/1000 kcal	125.04±112.21	126.06±113.72	0.829	2.179	0.741
Tea	273.42±262.08	264.60±262.33	0.329	-6.5	0.671
/1000 kcal	149.62±146.67	141.24±147.98	0.142	-7.597	0.377

Data is shown as N/%, mean ± SD. SD, standard deviation; p – Mann-Whitney test; B – the difference between the pre- and during-COVID period in the seasonally adjusted model; p* – for the difference between the pre- and during-COVID period in the seasonally adjusted model

As shown in Table 4, the mean MDI score was higher in the during-pandemic group (7.18 ± 2.25) than in the pre-COVID group (6.83 ± 2.23; p = 0.013). Similarly, the mean NDI score was higher among participants assessed during the pandemic (3.34 ± 1.38) compared with those assessed before the pandemic (3.11 ± 1.40; p = 0.006). These differences remained statistically significant after adjustment for seasonality (p = 0.006 for MDI and p = 0.005 for NDI). In both indices, a higher proportion of participants assessed during the pandemic fell into categories reflecting greater adherence to dietary recommendations.

Table 4 presents diet quality assessed using the Mediterranean Diet Index (MDI) and the Nordic Diet Index (NDI), with adjustment for seasonal dietary variation. The results indicate that participants assessed during the COVID-19 pandemic demonstrated higher MDI and NDI scores compared with those assessed before the pandemic, reflecting dietary patterns more consistent with nutritional recommendations.

Table 4. MDI, NDI of study participants

Variable	preCOVID n=565	duringCOVID n=637	P value	B	P value*
Mediterranean diet index	6.83±2.23	7.18±2.25	0.013	0.358	0.006
low (0–7)	64.1	58.2			
medium (8–10)	30.1	34.1			
high (11–14)	5.8	7.7			
Nordic diet index	3.11±1.4	3.34±1.38	0.006	0.231	0.005
low (0–1)	12.5	12.1			
medium (2–3)	42.7	38.6			
high (4–6)	44.9	49.3			

Data is shown as N/%, mean ± SD. SD, standard deviation; p – Mann-Whitney test; B – difference between the pre- and during-COVID period in the seasonally adjusted model; p* – for the difference between the pre- and during-COVID period in the seasonally adjusted model

Participants were asked to self-assess their dietary habits and to indicate whether and how their diet had changed during the COVID-19 pandemic. Participants assessed in the pandemic period more frequently rated their diet as poor (13.2% vs. 4.5%; p < 0.001) and less frequently as very good (10.1% vs. 17.6%; p < 0.001) compared with those assessed before the pandemic (Tab. 5). Reported dietary changes were largely comparable between groups; however, a smaller proportion of participants during the COVID-19 pandemic reported a deterioration in diet quality (p = 0.011).

Table 5. Self-assessment of dietary habits and perceived dietary changes during the COVID-19 pandemic in pre- and during-COVID groups

Variable	preCOVID n/%		duringCOVID n/%		P value
How do you rate your dietary habits during COVID-19?					
poor	20	4.5	68	13.2	<0.001
good	344	77.8	396	76.7	0.689
very good	78	17.6	52	10.1	<0.001
How has your diet changed during COVID-19?					
much worse	8	1.8	13	2.5	0.492
worse	42	9.5	28	5.3	0.011
no change	370	83.7	452	85.3	0.499
better	18	4.1	28	5.3	0.376
much better	4	0.9	9	1.7	0.266

Data is shown as N/%, mean ± SD. SD, standard deviation; p – tests for 2 proportions with Bonferroni adjustment for multiple comparisons; N=442/N=528; * The question was also asked to participants examined before the pandemic via telephone interview; ** Participants were asked after COVID-19.

Table 6. Changes in time spent sitting during the COVID-19 pandemic in pre- and during-COVID groups

Variable	preCOVID n/%		duringCOVID n/%		P value
Do you spend more time sitting during the COVID-19 pandemic compared to before?					
less time sitting	376	85.1	76	14.4	<0.001
same amount of time sitting	66	14.9	346	65.5	<0.001
more time sitting	0	-	106	20.1	<0.001

Data is shown as N/%, mean ± SD; SD – standard deviation; p – tests for 2 proportions with Bonferroni adjustment for multiple comparisons; N=442/N=528; * The question was also asked to participants examined before the pandemic via telephone interview; ** Participants were asked after COVID-19.

More than 85% of individuals assessed in the pre-pandemic group reported that they spent more time sitting during the COVID-19 pandemic compared with the period before the pandemic. In contrast, 65.5% of participants assessed during the pandemic reported spending a similar amount of time sitting before and during the pandemic. Notably, one in five participants (20.1%) assessed during the pandemic declared a marked increase in time spent sitting (Tab. 6). Information on sitting time before and during the COVID-19 pandemic was collected retrospectively for both groups via a telephone interview conducted after the pandemic.

DISCUSSION

Proper nutrition plays a key role in maintaining health and well-being and received increased attention during the COVID-19 pandemic. The need to effectively address overweight and obesity in society also increased, creating challenges for health-related behaviours, particularly dietary habits aimed at maintaining or reducing body weight. The current study compared diet quality and related health parameters in 2 adult samples assessed before and during the COVID-19 pandemic, using validated indices reflecting adherence to Mediterranean and Nordic dietary patterns. While direct scientific evidence linking the Nordic diet to COVID-19 is limited, its nutritional composition suggests potential benefits in terms of immune support and metabolic health. In the current study it was observed that WHR was significantly lower during the pandemic, although BMI remained unchanged. Body composition parameters were within normal reference ranges, with no clinically relevant deviations observed. This could be associated with differences in fat distribution, as reduced physical activity and prolonged sitting were frequently reported, consistent with other Polish studies showing increased sedentary time [13]. Hypertension has been identified as a risk factor for more severe COVID-19 outcomes [14], thus the lower blood pressure values observed in the during COVID group may reflect a more favourable cardiovascular risk profile. The observed reductions in LDL and HDL cholesterol may be linked to dietary patterns more consistent with nutritional recommendations, as participants reported higher intakes of vegetables (particularly root and cruciferous), legumes, water, and home-prepared meals. Similar trends have been reported by other authors, highlighting more frequent home cooking and an overall improvement in diet quality [15]. This may indicate the replacement of out-of-home meals with healthier, less processed home-prepared options, which – due to reduced 'eating out' – were associated with dietary patterns more consistent with nutritional recommendations. Kucharska et al. [16] reported that during the COVID-19 pandemic, consumption of vegetables, fruits, and whole-grain products increased, while fast-food and processed meal intake reduced. More frequent home-prepared meals were also noted, indicating a shift toward healthier eating patterns consistent with the results of the current study. Higher water consumption and lower alcohol intake were observed among participants assessed during the pandemic period. Similar results were described by Frąckiewicz et al. [13], who observed increased water intake and reduced alcohol consumption during the COVID-19 pandemic. Comparable trends have also been described in other European studies, which documented an overall decline in alcohol consumption in the pandemic and post-pandemic periods [17]. A study conducted among Spanish adults (COVIDiet Study) demonstrated that dietary behaviours during the pandemic were more consistent with nutritional recommendations compared with pre-pandemic patterns. Participants reported lower consumption of fast food, sugary beverages, fried foods, cakes, and salty snacks, alongside increased intake of legumes, vegetables, fruits, and olive oil, reflecting greater adherence to the MD [18]. Similarly, a multinational study involving Brazil, Argentina, Peru, Mexico, and Spain found that 62% of participants reported no change in dietary habits, while 23% adopted healthier dietary patterns, including reduced portion sizes, during the pandemic [19].

However, not all studies reported uniformly beneficial changes. Górnicka et al. [20] observed heterogeneous dietary responses during the pandemic, with approximately one-third of respondents reporting increased overall food intake and higher consumption of sweets or alcohol, while others declared increased water intake, reduced fast-food consumption, and more frequent preparation of home-cooked meals. Similar heterogeneity in dietary responses to the COVID-19 pandemic has been reported in recent international analyses, indicating that changes in diet quality and related metabolic profiles varied considerably across populations and were influenced by contextual and lifestyle factors [21].

In the current study, lower levels of interleukin-6 (IL-6) were observed among participants assessed during the COVID-19 pandemic, suggesting reduced systemic inflammation. This finding is consistent with previous studies indicating that dietary patterns rich in plant-based foods are associated with lower levels of inflammatory biomarkers, including IL-6 [22]. Participants also demonstrated higher adherence to both MD and ND recommendations, consistent with research linking these patterns to lower risk of COVID-19 infection and severity. Other studies have confirmed the beneficial role of the MD in protecting against COVID-19. Vu et al. [23], analysing data from the UK Biobank, reported that higher vegetable consumption was independently associated with lower odds of COVID-19 infection. Similarly, another recent study demonstrated that greater adherence to plant-based dietary patterns was associated with a 73% lower risk of moderate-to-severe COVID-19 outcomes [24].

Interestingly, self-assessed diet quality was lower among participants assessed during the COVID-19 pandemic, despite objectively healthier eating patterns reflecting a 'nutritional paradox' linked to heightened awareness and more critical self-evaluation. Seasonal adjustment applied in the analysis of the presented study further supports that the observed differences were not driven by temporary fluctuations in food availability. Participants assessed during the pandemic reported higher intake of immune-supporting micronutrients (vitamin D, B2, β-carotene, copper), consistent with literature showing increased consumption of vitamins and minerals that enhance immunity during the pandemic [25]. This suggests that greater exposure to health-related information fostered both healthier eating habits and stricter self-assessment, a phenomenon also described in a German longitudinal study showing increased nutritional awareness but not necessarily higher self-rated diet quality [26]. The discrepancy between objectively healthier dietary patterns and lower self-assessment of diet quality may further reflect neuropsychological effects of the COVID-19 pandemic.

Both SARS-CoV-2 infection and pandemic-related stress have been associated with impairments in cognition, emotional regulation, and health-related self-perception [27]. Treder-Rochna and Witkowska [28] emphasized that individuals may experience lasting neuropsychological effects, including impaired executive functioning, increased self-criticism, and altered health-related self-evaluation. In this context, the lower self-assessment of diet quality observed despite objectively healthier dietary patterns, may represent increased health awareness and more critical self-evaluation rather than a true deterioration in dietary behaviour, potentially influenced by persistent post-infectious neurocognitive alterations [29]. This indicates that it may be valuable to consider both nutritional and neuropsychological factors when interpreting self-assessed diet quality in individuals assessed under pandemic-related conditions.

Limitations of the study. This study has several limitations that should be acknowledged. Dietary intake and lifestyle behaviours were assessed using self-reported data, which may be subject to recall bias and social desirability bias. Additionally, the study population was drawn from a single urban region (Białystok, northeastern Poland), which may limit the generalizability of the findings to other regions with different socio-demographic or cultural characteristics. Although the pre- and during-COVID-19 groups were drawn from the same population cohort, they consisted of different individuals, which may introduce unmeasured or residual confounding factors.

The 3-day dietary recall reflects short-term dietary intake and does not capture long-term dietary habits. Importantly, due to the repeated cross-sectional design of the study, the findings represent differences between 2 independent samples assessed before and during the COVID-19 pandemic. Although the pre- and during-pandemic groups were drawn from the same population cohort, they consisted of different individuals, which may introduce unmeasured confounding. Furthermore, the analysis did not account for potentially influential factors, such as perceived stress or psychological burden, which are known to affect dietary behaviours and may have varied across different phases of the COVID-19 pandemic.

Despite these limitations, the study provides a comprehensive population-based comparison of dietary patterns and selected health parameters assessed before and during the COVID-19 pandemic, integrating dietary indices with objective clinical and inflammatory biomarkers while accounting for seasonal variation, and offering insights into both nutritional and psychological aspects of dietary self-assessment.

CONCLUSIONS

The study demonstrated significant differences in dietary patterns, health-related behaviours, and selected metabolic biomarkers between 2 independent adult samples assessed before and during the COVID-19 pandemic. Participants assessed during the pandemic demonstrated dietary patterns more consistent with current nutritional recommendations, including higher intake of vegetables, legumes, water, and home-prepared meals, reflected by greater adherence to MD and ND indices.

These differences between groups were characterized by lower waist-to-hip ratio, blood pressure, LDL cholesterol, and IL-6 levels, suggesting improved cardiometabolic and inflammatory status. Despite these objective improvements, many participants rated their diet less favourably, likely reflecting greater nutritional awareness, and altered self-perception shaped by pandemic-related psychosocial factors. At the same time, higher levels of sedentary behaviour and screen time were observed in the pandemic-period group.

Due to the repeated cross-sectional design of the study, these findings should be interpreted as differences between groups assessed before and during the COVID-19 pandemic, rather than within-individual changes or direct effects of the pandemic. The results highlight the importance of integrated public health strategies addressing diet quality, physical activity, and psychological well-being, as well as the need for longitudinal studies to evaluate long-term behavioural and health trajectories.

REFERENCES

1. Del Rio C, Collins LF, Malani P. Long-term health consequences of COVID-19. JAMA. 2020;324(17):1723–1724. doi:10.1001/jama.2020.19719
2. Musa S, Dergaa I, Bachiller V, Saad HB. Global implications of COVID-19 pandemic on adults' lifestyle behavior: the invisible pandemic of noncommunicable disease. Int J Prev Med. 2023;14:15. doi:10.4103/ijpvm.ijpvm_157_21
3. Oszajca K, Basińska-Zych A, Szczygieł D, et al. Long-term effects of the COVID-19 pandemic on health behaviors in Europe: a cross-country comparative study. BMC Public Health. 2023;23:1516. doi:10.1186/s12889-023-16023-4
4. Rust P, Ekmekcioglu C. The role of diet and specific nutrients during the COVID-19 pandemic: what have we learned over the last three years? Int J Environ Res Public Health. 2023;20(7):5400. doi:10.3390/ijerph20075400
5. Wilson K, St-Onge MP, Tasali E. Diet composition and objectively assessed sleep quality: a narrative review. J Acad Nutr Diet. 2022;122(6):1182–1195. doi:10.1016/j.jand.2022.01.007
6. de Faria Coelho-Ravagnani C, Corgosinho FC, Sanches FLFZ, et al. Dietary recommendations during the COVID-19 pandemic. Nutr Rev. 2021;79:382–393. doi:10.1093/nutrit/nuaa067
7. Halim M, Iddrisu W, Abdul Razak M, et al. Relevance of Mediterranean diet as a nutritional strategy in diminishing COVID-19 risk: a systematic review. PLoS One. 2024;19(5):e0301847. doi:10.1371/journal.pone.0301847
8. Moore E, Fadel A, Lane KE. The effects of consuming a Mediterranean-style diet on associated COVID-19 severity biomarkers in obese/overweight adults: a systematic review. Nutr Health. 2022;28(4):647–667. doi:10.1177/02601060221127853
9. Olsen A, Egeberg R, Halkjær J, et al. Healthy aspects of the Nordic diet are related to lower total mortality. J Nutr. 2011;141(4):639–644. doi:10.3945/jn.110.131375
10. Galbete C, Kröger J, Jannasch F, et al. Nordic diet, Mediterranean diet, and the risk of chronic diseases: the EPIC-Potsdam study. BMC Med. 2018;16:99. doi:10.1186/s12916-018-1082-y
11. Reyneke GL, Lambert K, Beck EJ. Food-based indexes and their association with dietary inflammation. Adv Nutr. 2025;16(4):100400. doi:10.1016/j.advnut.2025.100400
12. Stefler D, Malyutina S, Kubinova R, et al. Mediterranean diet score and total and cardiovascular mortality in Eastern Europe: the HAPIEE study. Eur J Nutr. 2017;56(1):421–429. doi: 10.1007/s00394-015-1092-x
13. Frąckiewicz J, Tarwacka Z, Drywień ME. Changes in diet and physical activity in students during lockdown by example of COVID-19 pandemic. Rocz Panstw Zakl Hig. 2024;75(1):83–91. doi:10.32394/rpzh.2024.0289
14. Sheppard JP, Nicholson BD, Lee J, et al. Association between blood pressure control and coronavirus disease 2019 outcomes in 45,418 symptomatic patients with hypertension: an observational cohort study. Hypertension. 2021;77(3):846–855. doi:10.1161/HYPERTENSIONAHA.120.16472
15. Smith J, Müller L, Rossi F. Dietary changes during the COVID-19 pandemic in Europe: a systematic review of observational studies. Nutr Res. 2022;101:25–36. doi:10.1016/j.nutres.2022.01.005
16. Kucharska A, Sińska B, Panczyk M, et al. Diet and selected elements of lifestyle in the Polish population before and during the COVID-19 pandemic – a population study. Ann Agric Environ Med. 2023;30(1):118–126. doi:10.26444/aaem/156939
17. Smith L, Merlo M, Botella-Juan R, et al. Global trends in alcohol consumption before, during and after the COVID-19 pandemic: a meta-analysis. Sci Rep. 2025;15:21712. doi:10.1038/s41598-025-21712-0
18. Rodríguez-Pérez C, Molina-Montes E, Verardo V, et al. Changes in dietary behaviours during the COVID-19 outbreak confinement in the Spanish COVIDiet Study. Nutrients. 2020;12(6):1730. doi:10.3390/nu12061730
19. Enriquez-Martinez OG, Martins MCT, Pereira TSS, et al. Diet and lifestyle changes during the COVID-19 pandemic in Ibero-American countries: Argentina, Brazil, Mexico, Peru, and Spain. Front Nutr. 2021;8:671004. doi:10.3389/fnut.2021.671004
20. Górnicka M, Drywień ME, Zielinska MA, et al. Dietary and lifestyle changes during COVID-19 and the subsequent lockdowns among Polish adults: a cross-sectional online survey. Nutrients. 2020;12(8):2324. doi:10.3390/nu12082324
21. Tassakos A, Kloppman A, Louie JCY. The Impact of Diet Quality on COVID-19 Severity and Outcomes – A Scoping Review. Curr Nutr Rep. 2025;14(1):27. doi:10.1007/s13668-025-00618-3
22. Mousavi R, Rostami S, Shourideh Yazdi S, et al. The relationship between healthy eating index and Mediterranean diet adherence score with inflammatory indices and disease severity: a case-control study of hospitalized COVID-19 patients. BMC Nutrition. 2024;10(1):168. doi:10.1186/s40795-024-00983-2
23. Vu THT, Rydland KJ, Achenbach CJ, et al. Dietary behaviors and incident COVID-19 in the UK Biobank. Nutrients. 2021;13:2114. doi:10.3390/nu13062114
24. Kim H, Rebholz CM, Hegde S, et al. Plant-based diets, pescatarian diets and COVID-19 severity: a population-based case-control study in six countries. BMJ Nutr Prev Health. 2021;4(1):257–266. doi:10.1136/bmjnph-2021-000272
25. Pellizzeri M, Cioffi CE, Vieira-Potter VJ, et al. Do pandemics influence food choice motives, diet, and health practices? A mixed-methods study. BMC Nutr. 2025;11:59. doi:10.1186/s40795-024-00959-2
26. Dreyer JO, Bertsche T, Klasen M. et al. Impacts of the SARS-CoV-2 pandemic on the dietary- and nutrition-related behaviour of students in the German region – a longitudinal study 2020–2022. Front Nutr. 2024;11:1302308. doi:10.3389/fnut.2024.1302308
27. Aknin L, De Neve J, Dunn E, et al. The neurological consequences of contracting COVID-19. Acta Neuropsychol. 2021;19(3):301–305. doi:10.5604/01.3001.0014.9953
28. Treder-Rochna N, Witkowska M. Neuropsychological consequences of COVID-19: current approach and clinical recommendations. Acta Neuropsychol. 2024;22(1):107–128.doi:10.5604/01.3001.0054.4467
29. Łuckoś M, Cielebąk K, Kamiński P. EEG neurofeedback in the treatment of cognitive dysfunctions after the infection of SARS-CoV-2 and long COVID-19. Acta Neuropsychol. 2021;19(3):361–372. doi:10.5604/01.3001.0015.2464