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ORIGINAL ARTICLE

Westernization of dietary patterns among young Japanese and Polish females – a comparison study

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Abstract

Introduction and objective. Nowadays, the process of the westernization of eating habits is perceived to be one of the main causes of epidemics of civilization diseases, such as metabolic syndrome. The aim of the study was to assess the westernization of eating habits among 100 Japanese (aged 18-23 years) and 111 Polish female students (aged 19-25 years) of nutrition science related faculties.

Materials and methods. Food-frequency questionnaires were used to assess a dietary pattern during the four seasons of a one-year investigation. Data obtained in each season was pooled. The frequency of consumption of different foods (servings/week) between the two countries was compared and characterization of the dietary patterns of both studied populations was analyzed by factor analysis.

Results. When food consumption between the two countries was compared, apart from total meat and meat products and high-energy drink intake, significant differences were observed in all foods and food groups. Three dietary patterns were identified in both groups. Among Japanese participants, the first pattern was 'traditional Japanese', the second 'sweets and beverages', and the third 'Western', explaining 9.0%, 8.5% and 6.4% of the total variance, respectively. Among Polish participants, the first pattern was 'prudent', the second 'Western', and the third 'sweets and alcoholic beverages', explaining 8.2%, 7.7%, 6.4% of the total variance, respectively. Although the 'Western' dietary pattern was found in both groups, there were some differences in the remaining dietary patterns between the two countries.

Conclusions. In the Japanese participants, significant cultural influences on habitual food intake could still be observed, and the extent of diet westernization seems to be smaller compared to the Polish participants.

Key words

dietary patterns, cross-environmental comparison, Japan, Poland, university students

INTRODUCTION

Chronic disease is a major cause of mortality worldwide, especially in developed countries. The World Health Organization (WHO) reported that nearly six out of ten deaths are the result of a chronic disease [1]. Among the reasons for epidemic chronic diseases is the fact that our evolved bodies are 'mismatched' with the foods we eat today and the levels of energy we expand in our daily lives. [2]. One contemporary example of this 'mismatch' has been reported in Okinawa, an island with the highest population of centenarians in the world. Tanaka et al. reported that the metabolic syndrome rate in Okinawa was 30.2% in men and 10.3% in women, and half of the men aged over 40 years were obese in 2004 [3]. They suggested that the main cause of the recent rapid increase in the prevalence of metabolic syndrome in Okinawa is the popularization of a westernized lifestyle in the younger generation which, under the cultural influence of the presence of US forces in Okinawa since 1945, instead of their traditional Okinawan foods has adopted the European and American lifestyle with its high-fat diet.

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In Japan, this trend of an increase in the prevalence of chronic diseases caused by a change of lifestyle, including dietary habits, had been predicted by a study conducted since the 1960s from the viewpoint of nutritional epidemiology [4, 5]. In these studies, the Japanese researchers reported that participants aged 40-60 years in 1989 consumed less rice and more meats, fish and milk than in 1958. They also reported that during the same period the level of serum cholesterol increased from 150 mg/dl to 188 mg/dl in men. These facts indicated that the progression of dietary habits from Japanese traditional foods to westernized foods has a significant influence on the health of Japanese people. It cannot be ruled out the globalization of food culture, associated with the development of food-industrial techniques, such as food-preservation and the world-wide food transportation system, as influencing the causes of these changes in Japanese, as well as the dietary habits other countries.

This trend of the unification of dietary patterns is also observed in European countries, e.g. in the Polish population. Data from the Polish National Diet Survey and the recently published survey by Jarosz et al. show that the consumption of cereal products and potatoes (tradionally the main staple foods in Poland) decreased between the 1950's and 2006 [6], while the consumption of meat (especially pork) and offal, animal fat, vegetable fat (mainly margarine) and sugar

increased [6, 7]. Simultaneously, the percentage of overweight and obese boys and girls aged 7-18 years had doubled between 1971-2000 (7.5% and 6.5% in 1971 to 15.2% and 11.8% in 2000, respectively) [8]. The rates of overweight and obese for adults aged 35-65 years increased from 28% and 18% (men and women, respectively) in 1984 – 29% and 22% in 1993 [9].

OBJECTIVE

The western dietary pattern, based on red meat, animal fat, high-sugar and low-fibre foods, belongs to the common eating habits in developed countries of Western Europe and the USA. Currently, the process of diet westernization seems to be increasingly apparent in other regions – in Eastern and Southern Europe, and even in populations having rich and deep-rooted culinary traditions, e.g. Japan. Simultaneously, the adverse impact of a western-style diet on human health is also well known. The aim of the presented study was to evaluate the extent of the westernization of dietary habits in two culturally and environmentally different populations. In order to examine the above-mentioned postulation, the food group intake data and dietary patterns of female Japanese and European (Polish) university students were analyzed.

MATERIALS AND METHOD

Participants. 100 Japanese (18-23 years) and 111 Polish (19-25 years) female university students from the Faculty of Human Life Science at Osaka City University in Japan, and from the Faculty of Food Science and Nutrition at Poznan University of Life Sciences in Poland, participated in the cross-environmental comparison study as paid participants. Nutritionists were chosen as participants familiar with portion sizes and accurately reporting food intake, and aware of universal dietary guidelines. The surveys were conducted according to the guidelines laid down in the Helsinki Declaration and all procedures involving human subjects/patients were approved by the Research Ethics Committees. Written informed consent was obtained from all subjects/patients.

Methods of dietary survey. To obtain data concerning habitual food consumption, the participants were asked to answer a self-administered, quantitative food-frequency questionnaire (FFQ) four times a year. The Japanese students answered the FFQ in April, July and October 2008 and January 2009. The Polish students answered the FFQ in the analogous months, but one year later (2010). The Japanese FFQ, containing semi-quantitative questions on food items, was derived from the diet history questionnaire (DHQ-L) [10]. The Polish FFQ was created based on its brief version as described by Wozniewicz et al. [11]. The questionaire was modified to increase the number of foodstuffs according to all food categories defined in the Food Guide Piramid [12], and to reflect local eating habits and food availability in Poland in more detail, as well as to be comparable as far as possible with the Japanese FFQ.

The FFQs included food items most frequently eaten in Japan (135 items) and Poland (199 items). All of the food items, from both questionnaires, were divided into generally the same product groups. Some environmental differences in food supplies were taken into consideration (Tab. 1a-b).

Table 1-a. Food groupings used in the dietary pattern analysis (Japan)

Food group subgroups	Food items
Milk & dairy products	
Whole milk	Whole milk
Low-fat milk	Low-fat milk
Cream	Coffee cream
Yoghurt	Yoghurt (plain, low fat, low sugar, sweetened)
Hard cheese	-
Other cheese	Processed cheese, cottage cheese
Other	Lactic acid bacteria beverage, cocoa
Eggs	Eggs
Meat & meat products	
Poultry	Poultry
Pork	Pork, ground meat
Beef	Beef, ground meat
Offal	Liver
Processed meat	Sausage/ham, bacon/salami
Fish, fish products & shellfish	Eel, white-meat fish (sea breams/flatfish/codfish/others), blue-back fish (mackerel/sardine/herring/others), red-meat fish (tuna/bonito/others), fish sausage, shrimp/crab, octopus/squid, oyster, other shellfish, dried fish, small fish with bones, canned tuna, fish roe, boiled fish in soy sauce, salted guts, surimi (ground fish meat) products
Butter	Butter
Plant fat	
Plant oils & olive oil	Plant oils, salad dressing with oil
Margarine	Margarine
Mayonnaise	Mayonnaise
Cereal products	
White bakery products	White bread, rolls, croissant
Dark bakery products	-
Cornflakes, oat meals & Bran	Cornflakes
Rice	White rice, 70% rice & 30% barley, rice with embryo, half-milled rice, 70%-milled rice, brown rice
Wheat pasta	Pasta/spaghetti
Pizza	Pizza
Others	Buckwheat/Japanese wheat noodle, instant noodles, Chinese noodles, pancakes, Japanese-style pancakes

Table 1-a (Continuation). Food groupings used in the dietary pattern analysis (Japan)

Food group subgroups	Food items
Color vegetables	Broccoli, carrots, pumpkins, green pepper, tomatoes, lettuce, green leafy vegetables such as spinach, pickled green vegetables, vegetable juice, tomato juice
White vegetables	Aubergine, onion, cucumber, cabbage, Chinese cabbage, bean sprouts, cauliflower, Japanese radish, lotus root, burdock, pickled white vegetables, pickled and dried plum
Pulses	Tofu, tofu products, natto, soy milk, miso, cooked beans
Potatoes	Potatoes, French fries, sweet potatoes/taros, konnyaku
Mushrooms	Mushrooms
Fruits	Grapes, bananas, apples, pears, mandarins/oranges, strawberries, melons, peaches/nectarines, kiwifruits, watermelons, persimmons, dried fruits, canned fruits, fruit juice, fruit jelly
Nuts & seeds	Peanuts, other types of nuts
Sugar	Jam/marmalade, sugar
Sweets & snacks	
Chocolates	Chocolates
Cakes	Cakes
Salty & savoury snacks	Potato chips, rice snacks, crackers, salted snacks
Other sweets	Candies, cookies, doughnut, ice creams, Japanese sweetened bun, Japanese sweets with azuki beans, Japanese sweets without azuki beans
Coffee, tea	Coffee, black tea, green tea/oolong tea
High-energy drinks	Revitalizer, fizzy & non-fizzy sweet drinks
Low-energy drinks	Fizzy & non-fizzy drinks sweetened with sweetener alternatives
Alcohol	
Beer	Beer
Wine	Wine
Vodka/Sake	Vodka/Sake, shochu, whiskey, shochu-based beverage
Mineral water	Water
Algae	Wakame seaweed/brown algae, dried laver seaweed

Table 1-b. Food groupings used in the dietary pattern analysis (Poland)

Food group subgroups	Food items
Milk & dairy products	
Whole milk	Milk (3.2% fat)
Low-fat milk	Milk (< 2% fat)
Cream	Cream (30%/36% fat, 9%/12%/18% fat)
Yoghurt	Yoghurt (plain, fruit)
Hard cheese	Cheese
Other cheese	Mould cheese, fresh cheese (whole fat, low fat/semi fat), cottage cheese, processed cheese, fresh cheese/homogenized cheese, fromage cheese
Other	Kefir/buttermilk, pudding
Eggs	Eggs
Meat & meat products	
Poultry	Chicken chops, turkey chops, chicken fricassee
Pork	Pork chops, ground meat, minced balls, minced meat roast
Beef	Beef, ground meat, veal
Offal	Offal/giblets and offal/giblets products, pate
Processed meat	Meat products (cured/smoked meats)-ham/loin (pork), salami, sausage/vienna sausage
Fish, fish products & shellfish	Ground fish chops, fish meat balls, tilapia, sole, panga, cod, pike perch, walleye pollock/alaska pollock, pike, tuna canned in oil, tuna canned in water, smoked mackerel, winter flounder, sardine canes in oil, hake, salmon, herring, fish (vegetable salad)
Butter	Butter
Plant fat	
Plant oils & olive oil	Plant oils, olive oil
Margarine	Margarine
Mayonnaise	Mayonnaise
Cereal products	
White bakery products	Pumpernickel, white bread, milk rolls/milk crescent rolls/milk croissant, crisp bread, toast, rolls/French rolls
Dark bakery products	Graham bread, graham rolls
Cornflakes, oat meals & Bran	Muesli, cornflakes, bran, oat flakes
Rice	Rice cakes, white rice, brown rice
Wheat pasta	Pasta
Pizza	Pizza with meat topping, vegetarian pizza
Others	Pearl barley/hulled barley/buckwheat groats, millet groats, dumpling, plum-filled dumpling, dumpling filled with meat, yeast rolls, pancakes, gnocchi made of boiled potatoes and cheese, gnocchi with potato-cheese filling, "Kładzione" noodles, Chinese noodles, "Śląskie" noodles, yeast patties filled with meat/sauerkraut, cabbage stuffed with minced pork, boiled dough pockets filled with meat, boiled dough pockets filled with fresh cheese, boiled dough pockets filled with strawberries
Color vegetables	Broccoli, beetroots, pumpkins, red pepper, tomatoes, lettuce, carrots, zucchinis, string beans, spinach, brussels sprouts, multi-vegetable juice, tomato juice
White vegetables	Aubergine, onion, leek, kohlrabi, cauliflower, radish, cucumber, bigos, asparagus, cabbage, canned corn, sauerkraut, pickled/sour cucumber
Pulses	Green peas, broad beans, peas, lentils, canned green peas, soy beans, beans, baked beans

Table 1-b (Continuation). Food groupings used in the dietary pattern analysis (Poland)

Food group subgroups	Food items
Potatoes	Potatoes, bliny ziemniaczane, potato dumpling, potato chops, potato pancakes
Mushrooms	Mushrooms
Fruits	Canned peach, canned pineapple, avocado, raspberries, blueberries, blackcurrants/redcurrants, gooseberries, grapes, bananas, apples, plums, grapefruits, apricots, pears, mandarins/oranges, strawberries, kiwifruits, peaches/nectarines, sweet cherries, cherries, watermelons, dried fruits, black/red-currant jelly type dessert made with potato starch, fruit jelly, apple mousse, fruit mousse, fruit juices, roasted apples
Nuts & seeds	Walnuts, hazelnuts/pistachio, almond, pumpkin seeds, sunflower seeds, peanuts
Sugar	Jam (low sugar, high sugar), plum jam, sugar, honey
Sweets & snacks	
Chocolates	White chocolates, chocolates (bitter/milk/filled/with nuts)
Cakes	Sponge cakes with fruit jelly/chocolate coated, cake with whipped cream, cake with cream, eclairs with whipped cream, cheese cake with raisins, pound cake, puff-pastry cakes, yeast cakes with blueberries, yeast cake with cheese/pudding/fruits/crumble and sugar-icing
Salty & savoury snacks	Potato crisps, sticks/pretzels
Other sweets	Chocolate candies, chocolate bars ("Bounty Milk", "Mars", "Milky Way", "Snickers", "Twix"), biscuits, biscuits with chocolate/milk filling, drops, gingerbreads with fruit jam filling chocolate coated or glazed, toffee/fudge, ice creams, ice creams made of fruit juice without cream, gummy bears, chocolate coated wafers
Coffee, tea	Coffee/tea
High-energy drinks	Fizzy & non-fizzy sweet drinks
Low-energy drinks	Fizzy & non-fizzy drinks sweetened with sweetener alternatives
Alcohol	
Beer	Beer
Wine	Wine
Vodka/Sake	Vodk ęcieilowegok powyżej?a
Mineral water	Mineral water

Some particularly important aspects of the nutritional value of food items were considered while food grouping, e.g. fat, fibre and sugar content in dairy products, cereal products and soft drinks, respectively, or meat species when considering meat and meat products. The group 'cereal products', apart from bakery products, rice, groats, pasta, also covered dishes in which flour is a significant ingredient, e.g. dumplings and pancakes; a similar strategy was applied when considering the 'potatoes' group. Pickled vegetables and dishes made of cooked vegetables were included in the 'white vegetables' or the 'pulses' group. Fruit and vegetable juices were included into the 'fruit' and 'coloured vegetables' groups, respectively. This approach resulted in deriving some main groups and subgroups of food items included in the FFQs.

For the purpose of the presented study, the Polish FFQ for the validity was compared with the average of the 4-day dietary records completed in an independent study on the same studied population (unpublished data). Correlation coefficients (r) and deattenuated correlation coefficients between dietary recall (DR) and FFQ were calculated for energy and selected macronutrients. Correlation coefficients for comparative validity ranged from 0.41 for carbohydrates to 0.51 for fat, and the deattenuated correlation exceeded 0.4 for all nutrients (range 0.43-0.55), representing a good FFQ validity. Agreement between the two methods was evaluated by classification into quartiles, and the Bland-Altman analysis was performed for energy, fat, carbohydrate and protein intake, as described in a previous study by Dehghan et al. [13]. Mean agreement between the DR and FFQ ranged from 109 (fat) – 118% (protein). The limits of agreement ranged from 47 (fat and carbohydrates) – 279% (carbohydrates), with most nutrients being overestimated by the FFQ. The FFQ classified 82 – 90% of participants' nutrient intakes into the same or adjacent quartile as their DR. The data shows that the 199-item FFQ is a reasonably valid instrument for the purpose of classification of the Polish participants according to their nutritional habits.

The questionnaires were designed to ask about food intake in the previous month. Food serving intake was specified for each food with response options ranging from 'once a month or less' to '4-5 times a day'. Three possible categories of portion size for each food item (small, medium, large) were also provided. The data for individual food items in the FFQ was transformed to servings per week. First, the size of the portion was transformed into a standard size portion. Then, each category of frequency of consumption was transformed to homogenous units, namely times per week:

- '4-5 times per day' was transformed into 33.75 times per week;
- '2-3 times per day' into 18.75 times per week;
- 'once a day' into 7.5 times per week;
- '4-6 times per week' into 5 times per week;
- '2-3 times per week' into 2.5 times per week;
- 'once a week" into 1 time a week;
- '2-3 times per month' into 0.625 time a week.

The category 'once a month or less' was discounted.

The number of standard portions was then multiplied by the frequency of consumption expressed as times per week, arising in results expressed as servings per week. A similar procedure was used by Papadaki et al. [14] and Georgiou et al. [15].

In order to compare the frequency of food consumption between both studied groups during the whole year, the food intake data obtained in each season was pooled. This approach resulted in receiving the data on food consumption for 400 cases in the Japanese population and 444 cases in the Polish population.

Factor analysis was conducted to identify the dietary patterns in both studied populations. The dietary patterns were generated on the basis of 41 selected food groups among the Japanese participants, and 42 among the Polish participants. In food grouping, core and traditional food, as well as food typical to the westernized diet, were taken into consideration.

Statistical analysis. Statistical differences in the frequency of consumption of different foods (servings/week) between the two countries were tested using the Mann-Whitney

test. The p value <0.05 (two-sided) was considered to be statistically significant. These analyses were performed using the Statistical Package for the Social Sciences version 16.0 (IBM SPSS, Chicago, IL, USA).

The dietary patterns were derived from the factor analysis. In determining the number of factor (patterns) to retain eigen values (>1), Cattell's scree test and the interpretability of factors were taken into consideration. In order to achieve a simpler structure with greater interpretability and to obtain uncorrelated patterns, the factors were rotated by an orthogonal transformation (Varimax rotation). Food groups with an absolute factor loading greater than 0.20 were considered as making an important contribution to the factors. A similar approach was used by Hu et al. [16], Fung et al. [17] and Kerver et al. [18]. Factor analysis was performed using StatSoft, Inc. (2009). STATISTICA (data analysis software system), version 9.0. www.statsoft.com.

RESULTS

A general description of the participants is shown in Table 2. The intake of single foods and food groups in quartiles of weekly intake is shown in Table 3. Foods and food groups listed in the table were selected so that it is possible to evaluate the extent of habitual diet westernization in Japanese and Polish participants.

Table 2. Representative of participants' age, height, body weight and BMI

	Japanese (*n* 100)		Polish (*n* 111)	
	Mean	SD	Mean	SD
Age (years)	19.6 (18-23)†	1.4	22.4 (19-25)	1.2
Height (cm)	159.3 (148.0-174.4)	5.5	167.7 (150.0-181.0)	5.8
Weight (kg)	50.7 (38.0-66.0)	5.2	59.9 (40.0-94.0)	9.3
BMI (kg/m^2)	20.0 (16.7-24.5)	1.8	21.9 (13.4-31.8)	2.8

†Range (highest-lowest)

Apart from total meat and meat products (p=0.073), as well as high-energy drink intake (p=0.840), significant differences (p<0.001) in the consumption frequency of all foods and food groups between Japanese and Polish participants were observed. The food items or groups which Japanese students consumed more were as follows: whole milk, eggs, fish, fish products and shellfish, plant fat, plant oils and olive oil, mayonnaise, rice, coloured and white vegetables, pulses, potatoes, mushrooms, sweets and snacks, chocolate, salty and savoury snacks, sweets, and algae. In contrast, the Polish students consumed the following food items or groups more than the Japanese: milk and dairy products, low-fat milk, cream, butter, margarine, cereal products, white and dark bakery products, flakes, wheat pasta, pizza, fruits, nuts and seeds, sugar, and cakes. The intake of different types of cheese was significantly higher among Polish than Japanese participants – the Japanese did not eat hard cheese at all. There was no significant difference in the total intake of meat and meat products in Polish and Japanese students. However, the intake of individual food items from the group was significantly different between them. The Japanese ate significantly more poultry, pork and beef, and the Poles ate significantly more processed meat products, such as sausages, ham and organ meat. Coffee and tea were consumed in bigger amounts by the Japanese compared to Polish students. Among Japanese students, the consumption of tea (black, green or oolong) accounted for more than 80% of the total consumption of coffee and tea taken together. By contrast, the consumption of water was significantly higher in the Polish participants compared to Japanese. Among the Japanese participants, the intake of water in the 75th percentile was much higher than in the 50th percentile.

Table 3. The frequency of food consumption (servings/week) among Japanese and Polish students

	servings/week						
	Osaka, Japan (*n* 400)			Poznan, Poland (*n* 444)			
Foods†	25th§	50th	75th	25th	50th	75th	*p*‡
Milk and dairy products	4.97	9.38	14.41	8.75	13.15	18.78	0.000
Whole milk	0.00	0.63	3.75	0.00	0.00	0.63	0.000
Low-fat milk	0.00	0.00	1.59	0.00	0.63	3.75	0.000
Cream	0.00	0.00	1.00	0.00	0.50	1.00	0.000
Yoghurt	0.00	1.00	5.00	0.75	1.75	3.75	0.000
Hard cheese	-	-	-	0.63	2.50	5.00	-
Other cheese	0.00	0.63	1.25	1.25	2.50	4.44	0.000
Eggs	2.50	5.00	7.50	0.50	1.00	1.25	0.000
Meat & meat products	3.88	5.81	8.63	3.41	6.38	10.56	0.073
Poultry	0.63	1.00	2.50	0.42	0.79	1.25	0.000
Pork	1.00	1.42	3.00	0.21	0.63	1.09	0.000
Beef	0.63	1.06	1.50	0.08	0.31	0.63	0.000
Offal	0.00	0.00	0.00	0.00	0.42	1.25	0.000
Processed meat	0.63	1.25	1.91	1.25	3.31	6.00	0.000
Fish, fish products & shellfish	2.80	5.00	7.68	0.63	1.25	2.25	0.000
Butter	0.00	0.00	0.63	0.13	1.25	7.50	0.000
Plant fat	4.04	5.51	8.58	1.56	3.75	8.75	0.000
Plant oils & olive oil	3.45	4.64	6.44	1.00	2.50	3.75	0.000
Margarine	0.00	0.00	1.00	0.00	0.41	4.06	0.000
Mayonnaise	0.00	1.00	2.50	0.00	0.31	0.63	0.000
Cereal products	14.70	17.69	20.49	14.06	20.80	27.80	0.000
White bakery products	1.06	2.15	3.41	1.50	5.00	12.56	0.000
Dark bakery products	-	-	-	0.75	2.50	7.50	-
Cornflakes, oat meals, bran	0.00	0.00	0.00	0.00	1.00	3.75	0.000
Rice	8.00	11.20	14.50	0.42	0.88	1.63	0.000
Wheat pasta	0.00	0.45	0.91	0.50	0.78	1.25	0.000
Pizza	0.00	0.00	0.67	0.00	0.25	0.63	0.000
Vegetables	14.97	22.63	33.38	8.63	14.73	25.22	0.000
Color vegetables	7.22	11.56	18.27	4.08	8.09	15.78	0.000
White vegetables	6.88	10.63	15.81	3.68	6.33	11.13	0.000
Pulse	2.25	4.38	7.69	0.00	0.44	1.00	0.000
Potatoes	1.63	2.50	4.50	1.00	1.92	3.00	0.000
Mushrooms	0.63	1.00	2.50	0.13	0.31	0.63	0.000
Fruits	2.25	4.38	7.91	8.13	13.29	20.72	0.000
Nuts & seeds	0.00	0.00	0.63	0.00	0.50	1.25	0.000
Sugar	0.00	0.63	2.50	0.81	3.38	9.38	0.000
Sweets & snacks	6.30	9.58	14.08	2.63	4.92	7.95	0.000
Chocolates	0.63	0.75	1.88	0.25	0.53	1.25	0.000
Cakes	0.63	0.63	1.00	0.48	1.05	2.02	0.000
Salty & savoury snacks	0.00	0.75	1.88	0.12	0.50	1.25	0.000
Sweets	4.04	6.33	9.38	1.13	2.50	4.93	0.000
Coffee, tea	16.80	25.32	38.62	15.00	18.75	33.75	0.000
High-energy drinks	0.00	0.00	1.00	0.00	0.00	0.63	0.840
Low-energy drinks	0.00	0.00	0.00	0.00	0.00	0.63	0.000
Alcohol	0.00	0.00	1.00	0.63	1.35	2.28	0.000
Beer	0.00	0.00	0.00	0.17	0.63	1.00	0.000
Wine	0.00	0.00	0.00	0.00	0.33	0.83	0.000
Vodka/Sake	0.00	0.00	0.63	0.00	0.13	0.63	0.010
Mineral water	0.00	2.50	14.06	4.01	10.42	18.75	0.000
Algae	0.63	1.63	3.50	-	-	-	-

† Only the specific foods which are related to westernization were included, but the total number of servings in each food group reflects all foods of that group included in the FFQs.
‡ Mann-Whitney test.
§ Percentiles.

Three main dietary patterns were identified in both groups. The factors were labeled on the basis of the authors' interpretation of the data, as well as on prior literature. Factor-loading matrixes for all of the factors are listed in Table 4. Among Japanese subjects, the following dietary patterns were found: 'traditional Japanese', 'sweets and beverages' and western', explaining 9.0%, 8.5% and 6.4% of the total variance, respectively. These three factors accounted for 23.9% of the total variance. The 'traditional Japanese' dietary pattern was heavily contributed by vegetables, fish, algae, pulses and rice, and negatively correlated with the consumption of white bakery products. The second dietary pattern, 'sweets and beverages', was associated with the consumption of sweets, fruits, and non-alcoholic beverages, and low consumption of rice. The 'western' dietary pattern was heavily contributed by the consumption of meat, white bakery products, eggs, butter and plant oils.

Among Polish female students the following dietary patterns were recognized: 'prudent', 'western' and 'sweets and alcoholic beverages', explaining 8.2%, 7.7% and 6.4% of the total variance, respectively. These three factors accounted for 22.3% of total variance. The 'prudent' dietary pattern was heavily contributed by vegetables, fruits, cereal flakes, pulses, low-fat milk, and water. The 'western' pattern was associated with the consumption of sugar, white bakery products, butter, pork, high-energy drinks, margarine, potatoes, cream, beef and wheat pasta. 'Sweets and alcoholic beverages' was heavily contributed by sweets, and alcoholic beverages and inversely correlated with the intake of dark bakery products and low-fat milk.

Table 4. Factor loading matrixes for the major factors (dietary patterns) in Japanese and Polish female students[†]

	Dietary pattern					
	Osaka, Japan (*n* 400)			Poznan, Poland (*n* 444)		
Food group[‡]	Traditional	Sweets & beverages	Western	Prudent	Western	Sweets & alcoholic beverages
White vegetables	0.77			0.69		
Color vegetables	0.69			0.76		
Fish, fish products & shellfish	0.65		0.35	0.36		
Algae	0.61			-	-	-
Pulses	0.61			0.47		
Mushrooms	0.42			0.33		0.22
Poultry	0.42		0.49		0.29	
Offal	0.35				0.29	
Pork	0.33		0.51		0.53	
Rice	0.33	-0.25		0.30		
Fruits	0.29	0.35		0.51		
Eggs	0.28		0.30	0.37		
Low-fat milk	0.26	0.38		0.46		-0.20
Mineral water	0.24			0.45		
Yoghurt	0.22			0.38		
Beef			0.61		0.37	0.21
Wine			-0.24			0.56
Coffee, tea		0.56	-0.36		0.28	
Vodka/Sake			-0.33			0.53
Beer			-0.34			0.49
Processed meat			0.43		0.55	
Butter			0.29			
Salty & savoury snacks		0.41	0.27			0.58
Nuts & seeds				0.43		
Other cheeses						
Low-energy drinks		0.56	0.20			
High-energy drinks		0.59			0.49	
Plant oils & olive oil		0.24	0.28	0.44	0.25	
Sweets		0.44	0.37		0.22	0.45
Sugar		0.61			0.62	
Cream		0.68			0.40	
Potatoes					0.44	
Mayonnaise		0.21	0.25			0.36
Chocolates		0.61	0.20			0.62
Cakes		0.30	0.29		0.25	0.35
Whole milk		0.21				
Cornflakes, oat meals, bran				0.51	- 0.23	
Wheat pasta					0.37	
Pizza						0.50
Margarine					0.44	
White bakery products	-0.32		0.36		0.55	
Hard cheese	-	-	-		0.25	
Dark bakery products	-	-	-			-0.25
Explained variance [%]	9.00	8.50	6.40	8.20	7.70	6.40
Eigenvalues	4.80	2.80	2.20	3.60	3.40	2.30

[†] Absolute values of < 0.20 are not shown in the table for simplicity.
[‡] Sorted by loadings on Traditional factors for Japanese female students.

DISCUSSION

Some cultural and environmental differences in eating habits were observed between Japanese and Polish female students. The results clearly pointed to the 'traditional and typical' dishes and products of both countries. It was noted that the consumption of fish, fish products and shellfish, rice, pulses, vegetables and algae was higher among the Japanese students. The high intake of rice and pulses could be explained by the fact that rice and bean products are considered to be prime ingredients in traditional Japanese dishes [19]. It is also well known that Japan is a marine and fisheries country surrounded by a long shoreline, which is reflected in the greater availability of marine food, and differs from the Polish culinary tradition. At the same time, the results indicate that different types of bakery products served with the addition of butter or margarine and protein products (hard cheese, processed meat) are typical and staple European (Polish) dishes. This shows the strong conservativeness of the choice of food in each population, which has been restricted by the different culinary traditions of the populations living in different geographical regions characterized by different environmental resources and climate conditions [20].

One still needs to notice that foods typical to a westernized diet [21] were also present in the habitual diet of both studied populations; however, it seems that they contributed more to the diet of the Polish participants (processed meat, hard cheese, butter, sugar and alcoholic beverages) compared to the Japanese participants (red meat, whole milk, mayonnaise, potatoes and sweets and snacks).

The data concerning the frequency of consumption of single foods or food groups does not show the combination of different food items in the habitual diet. To reflect those combinations, factor analysis was conducted and major dietary patterns were derived.

Among Japanese students the following dietary patterns were identified: 'traditional Japanese', 'sweets & beverages' and 'western', and among the Polish participants, 'prudent', 'western' and 'sweets and alcoholic beverages'. The first of the patterns in the Japanese population was labeled 'traditional Japanese' because of the significant contribution of core Japanese foods, such as fish, fish products and shellfish, algae, pulses, rice and vegetables to this particular pattern. It is noticeable that the discussed dietary pattern also consisted of meat, such as poultry, meat organs and pork. However,

poultry and pork in particular were more heavily correlated with a 'western' dietary pattern. Okubo et al. [22] in a group of Japanese female dietetic course students aged 18-20 years, found three main dietary patterns, including the 'traditional Japanese' pattern, contributed to by rice, miso soup and soy products. Mizoue et al. and Guo et al. in a group of Japanese men aged 38-59 years characterized the so-called 'Japanese' dietary pattern as being associated with the consumption of soybean products, seaweeds, pickles, green tea, vegetables and fish [23, 24]. Similar groups of products were associated with the 'Japanese' dietary patterns, as described by Kim et al. and Okubo et al., in a group of Japanese men and women aged 40-55 years [25, 26]. Additionally, these authors, as in the presented study, characterized this as being inversely correlated with the consumption of bakery products. A big resemblance can be noted between previously described 'Japanese' or 'traditional Japanese' dietary patterns and the one found in this study. As may be observed, on the basis of the above-mentioned examples from prior literature as well as the presented study, the 'Japanese' or 'traditional Japanese' pattern is still very popular among diverse Japanese population groups, regardless of the generation. The core Japanese foods had and have contributed greatly to daily food rations to the present day. The gradual changes of traditional eating habits among the Japanese can be observed in those who have emigrated from Japan, as described by Takata et al. in a group of Japanese women living in Hawaii, USA [27].

The 'traditional Japanese' dietary pattern recognized among the Japanese students in the presented study can be compared with the 'prudent' dietary pattern found among the Polish students. The term 'prudent' pattern describes a diet that is a combination of the following foods and food groups: coloured vegetables, white vegetables, fruits, cereal flakes, pulses, low-fat milk, water, plant oils and olive oil, nuts and seeds, yoghurt, eggs, fish, fish products, mushrooms and rice [28, 29]. The so-called 'prudent' pattern has previously been identified by other authors in various population groups, for example, that found by Fung et al. In a group of 466 US male health professionals, a subgroup of the Health Professional Follow-up Study (HPFS), the 'pruden't diet was contributed by fruits, vegetables, whole grains, legumes, poultry and fish [17]. A similar description of a 'prudent' dietary pattern was given by Hu et al. [16, 30], and Paradis et al. in a group of 326 men and women aged 18-55 years from Quebec, Canada [31].

'Traditional Japanese' and 'prudent' dietary patterns can be perceived as having a favourable impact on health, and it is a consolation that these single patterns explain the highest percentage of total variance in both groups. However, the existence of two other less or even not at all recommended dietary patterns needs to be stressed.

The first such pattern in the Japanese participants of the presented stady was the 'sweets and beverages' pattern, containing sugar, high- and low-energy drinks, chocolate, sweets, salty and savoury snacks, fruit, cakes, coffee and tea, and inversely correlated with the frequency of consumption of rice. The pattern can be compared to the 'sweet-fruit' pattern found by Guo et al. in a group of Japanese men [24], which was connected with the consumption of ice cream, cakes, fruit, dairy products, and cola. Some conformity occurred between the 'sweets and beverages' pattern present among the Japanese students and 'sweets and alcoholic beverages' present among the Polish participants. The 'sweets and alcoholic beverages' pattern was the third one found among the Polish subjects, characterized by a positive correlation with the frequency of consumption of chocolate, salty and savoury snacks, wine, vodka, pizza, beer, sweets, mayonnaise and cakes, and inversely correlated with the frequency of consumption of dark bakery products and low-fat milk.

The second of the not recommended patterns was the 'western' dietary pattern, recognized in both studied groups and which explained 6.4% and 7.7% of the total variance among the Japanese and Polish students, respectively, compared to 9.0% and 8.5% for 'traditional Japanese' and 'sweets and beverages' among the Japanese participants, and 8.2% and 6.4% for 'prudent' and 'sweets and alcoholic beverages' among the Polish participants. The greatest impact on the 'western' pattern in both populatons came from poultry, pork, beef, processed meat and white bakery products. Among the Polish students, the contribution of sugar, high-energy drinks, cream, potatoes, and margarine to the 'western' pattern was also quite high. Other authors, in the previously mentioned subgroups of HPFS [16, 17] and in the group of Canadian men and women [18], characterized the 'western' dietary pattern as positively correlated with the consumption of processed meat, red meat, butter, high-fat dairy products, refined grains, French fries, sweets and desserts. The progression of western eating habits can be observed even in populations with strong culinary traditions, e.g. Mediterranean countries. Bibiloni et al. in adolescents in the Balearic Islands identified two dietary patterns, 'western' and 'Mediterranean', explaining 13.4% and 10.6% of total variance, respectively [21].

The trend of diet westernization in the Japanese and Polish populations may also be observed when comparing data concerning food intake and macronutrient composition of the diet over the past fifty years in both countries. In Japan between 1950 – 2000, an increase in the intake of western-type foods, such as milk, meat, eggs, fat/oil and fruit was observed, simultaneously with a decrease in the intake of rice and potatoes [32, 33]. The increase in western-type food intake was followed by changes in the macronutrient composition of the diet. Lands et al. mentioned that the structure of the macronutrient intake of the Japanese changed between 1960-1985, even though the average total daily calorie intake remained stable [34]. In 1960, the percentage of energy from protein, fat and carbohydrates was 13%, 11%, 75%, respectively. In 1985, protein provided 14%, fat 25% and carbohydrates 61% of total energy, whereas in the United States, the macronutrients provided 16%, 37%, 45% of energy, respectively. These data indicate that dietary habits in Japan are rapidly becoming similar to those in the United States. Similar changes in the macronutrient intake pattern was also noted by Iwanaga [35].

In Poland, in the long-term, the intake of cereal products and potatoes has declined, although there was an increase in the consumption of meat and offal, animal and vegetable fat (margarine), and sugar. On the other hand, there were some favorable changes in food consumption, such as an increase in the consumption of fish and fish products (especially freshwater species), vegetables and fruits. Changes in the consumption level of particular food items were the reason for the changes in the macronutrient composition of the diet. From 1950 – 2000, the percentage of energy from protein and fat increased about 2.8%, and 14.4%, respectively [6, 36].

It can be concluded that the above-described long-term changes in dietary habits among the Japanese, as well as

among the Polish population, are reflected by the occurrence of the so-called 'western' dietary pattern in both of the populations of female students studied here.

The fact of the unification and westernization of eating habits is even more alarming when it concerns participants having only a broad nutritional knowledge. The situation is not exclusive for the groups in the presented study. As mentioned earlier, Okubo et al., in a group of dietetic female students, found four main dietary patterns which, apart from 'traditional Japanese', included 'healthy', 'western' and 'coffee and dairy products' dietary patterns [22]. The percentage of total variance explained by the 'western' dietary pattern was 6.1% in their study, which was only slightly lower compared to the 6.4% observed among the Japanese participants in the presented study. The westernization of habitual food intake tends to be apparent, even in nutritionally educated subgroups from different world regions, and seems to be the reason for the gradual diminishing of the role of particular regionsal culinary traditions in food choices.

The revealed trend of diet westernization in young Japanese and Polish females may be alarming from the viewpoint of public health. As stated in the Introduction, the westernization of eating habits seems to be one of the major reasons for the great prevalence of non-communicable chronic diseases. This fact is supported by the results of recent well-controlled studies on insulin resistance and type 2 diabetes development. Weicert et al. noticed that a high–protein diet, contrary to an isoenergetic high-cereal-fibre diet, may contribute to impaired insulin sensitivity [37]. The adverse effect of a high-protein, high-fat diet on one's health was indicated recently by Newgard, who linked dietary profile with the development of metabolic dysfunction in multiple tissues [38].

Study limitations. Since data was collected through a self-reported questionnaire, selection bias or subjective disparity, due also to the difference between culinary items in the different cultures, was virtually unavoidable. The reproducibility of the results in other populations is questioned because both of the studied groups were female students with a broad knowledge of human nutrition and dietetics. This is why the dietary patterns found in these two groups may not entirely correspond to dietary patterns occurring in the general population of female Polish and Japanese students. Nevertheless, the study shows that even those more familiar with knowledge of nutrition groups are susceptible to the influences of a western-style diet. Future longitudinal studies in different population groups to identify changes in dietary patterns, their range, and relation to environmental and health status indicators in both societies are needed.

CONCLUSIONS

It was concluded that foods linked with a so-called westernized diet were present in the habitual diet of both studied populations of young women, and that the 'western' dietary pattern was found in both groups. The percentage of total variance explained by that pattern was 6.4% among the Japanese students, and 7.7% among the Polish students. In the Japanese group, it was recognized as the third, and in the Polish group as the second of three main dietary patterns. It may be assumed that the process of diet westernization was more discernible in the Polish participants, but was not exclusive to them. The diet of the Japanese students diet seemed to undergo the unification process to a smaller extent because of their strong traditional food habits, and conformed less to the typical diet of western countries.

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