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Can You Trust a Box Diet?

Czy można zaufać diecie pudełkowej?

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Abstract: In recent years the pace of human life has increased significantly. Sometimes, overworked people do not have time to prepare five meals a day by themselves, and use the services of catering companies offering ready-made meals that are delivered directly to the client's place of work or residence in the form of a box.. This study aimed to evaluate the diet of individual customers based on the standard diet developed by one of the companies (the company was randomly chosen) engaged in dietary catering based in Lower Silesia. This evaluation was carried out based on menus prepared for ten days. For this purpose, the Diet 6D programme, developed by the Institute of Food and Nutrition in Warsaw, was used. The amounts of basic nutrients in the standard dietary menus adopted by the catering company did not comply with the recommendations for a rational diet. The advantage of the served meals was that the customers were offered a daily variety of meals rich in vegetables and fruit.

Keywords: box diet, nutrition, health, lifestyle.

Streszczenie: W ostatnich latach tempo życia człowieka znacznie wzrosło. Zdarza się, że osoby zbyt zajęte pracą nie mają czasu na samodzielne przygotowanie pięciu posiłków dziennie i korzystają z usług firm cateringowych oferujących gotowe posiłki – dostarczane w pudełkach bezpośrednio do pracy lub miejsca zamieszkania klienta. Badanie miało na celu ocenę sposobu żywienia klientów indywidualnych na podstawie standardowej diety opracowanej przez jedną z firm (wybraną losowo). Firma ta zajmuje się cateringiem dietetycznym i ma siedzibę na terenie Dolnego Śląska. Oceny tej dokonano, opierając się na jadłospisach przygotowanych na dziesięć dni. W tym celu wykorzystano program Dieta 6D, opracowany przez Instytut Żywności i Żywienia w Warszawie. Ilości podstawowych składników odżywczych w standardowych jadłospisach przyjętych przez firmę cateringową nie były zgodne z zaleceniami dotyczącymi racjonalnego żywienia. Zaletą serwowanych posiłków było zaś to, że klientom oferowano codziennie różnorodne posiłki bogate w warzywa i owoce.

Słowa kluczowe: dieta pudełkowa, żywienie, zdrowie, styl życia.

1. Introduction

Food and nutrition are among the most important environmental factors affecting human health. Approximately 80 diseases have been identified as a result of inappropriate nutrition. At the same time, it has been proven that there is a link between improvement in nutrition and the health quality of food and improvement in the population’s health. In Poland, for many years, more than half of all deaths have been the consequence of diseases caused by faulty nutrition, inadequate health quality of food and too low physical activity. These are mainly the following: cardiovascular diseases, diet-related cancers, e.g. colorectal cancer, stomach cancer, pancreatic cancer, oesophageal cancer, breast cancer in women, prostate cancer in men, obesity, lipid metabolism disorders, and insulin-dependent diabetes (OECD/ European Observatory on Health Systems and Policies, 2017; Ostachowska-Gasior et al., 2018; Szczepańska, Białek-Dratwa, Janota, and Kowalski, 2022).

Improvements in lifestyle and nutrition play a fundamental role in reducing the incidence and mortality of diet-related diseases, including cardiovascular disease (OECD/European Observatory on Health Systems and Policies, 2017).

Poland is one of the countries with a high prevalence of chronic nutrition-dependent diseases (Romaniuk et al., 2022). In 2019, 39.44% of causes of death were attributable to cardiovascular diseases and 26.53% to malignancies. These two groups of conditions, therefore, accounted for more than 65% of deaths. The number of deaths from malignant neoplasms in 2009 was over 93.297, and the total number of deaths was over 384,940, with these numbers showing an increasing trend (Figure 1).

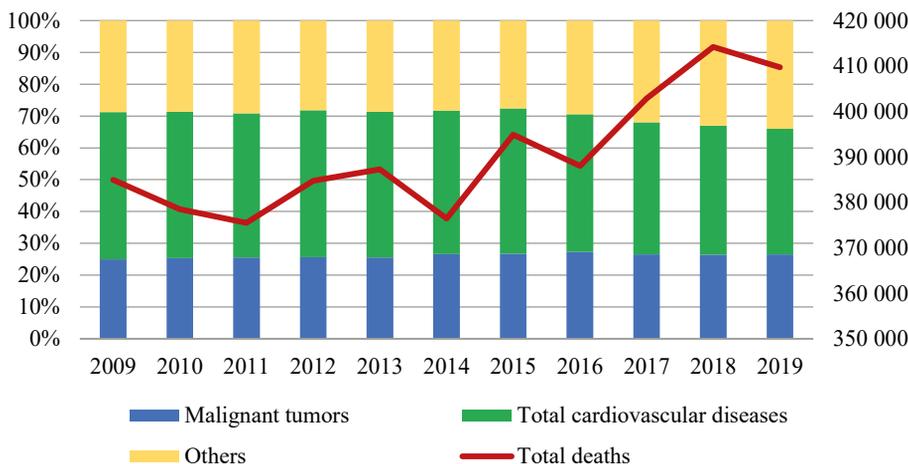


Figure 1. Causes of death in Poland

Rys. 1. Przyczyny śmierci w Polsce

Source/Źródło: (Główny Urząd Statystyczny, n.d.; Statistics Poland..., n.d.)

Being overweight and obese occupy a special place among health problems. It was shown that 53% of the adult population of the European Union was overweight in 2019, including 58% in Poland (Eurostat – overweight..., n.d.). Obesity is a disease of civilization spread on a large scale (Figure 2).

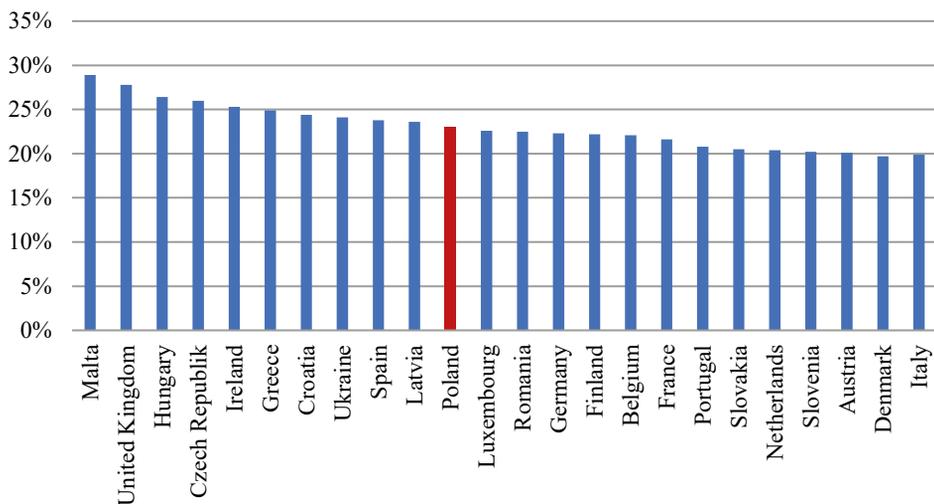


Figure 2. Obesity in European countries in 2019

Rys. 2. Otyłość w krajach Europy w 2019 roku

Source/Źródło: (Eurostat – overweight..., n.d.).

In 2019, the level of obesity among adults in Poland was 23.1%. A higher level of obesity was reported in people living in Malta (28.9%) and the UK (27.8%) (Figure 2). Obesity is linked to the most prevalent and costly medical problems, including type 2 diabetes, hypertension, coronary artery disease, many forms of cancer, and cognitive dysfunction (Llewellyn, Simmonds, Owen, and Woolacott, 2016). Therefore, combating the causes of chronic non-communicable diseases related to improper nutrition and low physical activity (including obesity, cardiovascular diseases, type 2 diabetes, and malignant neoplasms) has become the main priority of the activities of the World Health Organization (WHO) and the European Union, hence human nutrition has a significant impact on one's health.

It is essential that a diet is arranged in accordance with the rules of composing menus and that the amount of nutrients complies with the applicable standards and recommendations. In recent years, the pace of human life has increased significantly, and busy people mostly do not eat properly. Instead of cooking healthy meals at home, they often eat highly processed dishes (Marino et al., 2021). More and more companies on the market offer preparing and delivering ready-made meals in boxes

to houses or offices, and operate under the category of dietary catering. Usually, on the websites of companies offering boxed diets, one can find information that diets are tasty and healthy. The word 'healthy' should ensure that these meals contain the right amount of nutrients. The study aimed to estimate the nutritional value of the meals offered to individual customers by a company dealing in dietary catering based on daily menus prepared for a standard diet.

2. Materials and methods

The dietetic catering box used for analysis was provided by a Lower Silesia company, which was kept anonymous.

Dietary catering offers meals composed according to the following diets: standard, sports, gluten-free, lactose-free, vegetarian, paleo, diabetic, and junior. For each of the diets (except for the sports diet, for which the energy value of the diet is 2500 kcal), the company offers five caloric levels: 1200 kcal, 1500 kcal, 1800 kcal, 2000 kcal, and 2500 kcal, spread over five meals a day.

A standard diet of 1800 kcal was adopted for the analysis, consisting of five meals: breakfast (600 kcal), 2nd breakfast (100 kcal), lunch (600 kcal), afternoon tea (200 kcal) and dinner (300 kcal). Based on the Diet 6D program, developed by the Food and Nutrition Institute in Warsaw (Computer program Diet 6D, 2018), the energy value and the content of such nutrients as protein, fat, carbohydrates, minerals (sodium (Na), potassium (K), magnesium (Mg), calcium (Ca), iron (Fe) and vitamins A and C, thiamine (B₁) and riboflavin (B₂) in the diets of ten consecutive days were estimated. Next, the arithmetic mean was calculated and compared with the current nutritional standards for women aged 31-50 (average body weight 55 kg), with low physical activity (PAL = 1.4) (Jarosz, Rychlik, Staś, and Charzewska, 2020). The consumption values equal to 100% of the norm were considered correct.

Energy standards were set at the level of average demand (Estimated Energy Requirement). The Reference Intake ranges, expressed as a percentage of the energy requirement, were defined for fat and carbohydrates, whereas the standards for protein, selected minerals (calcium, phosphorus, magnesium, iron, zinc, copper) and vitamins (thiamine, riboflavin, vitamins A and C) were set at the Recommended Dietary Allowance; other nutrients (sodium, potassium) at the level of sufficient consumption (Adequate Intake) (Jarosz et al., 2020).

3. Results and discussion

3.1. Menus' compliance with the rules of arrangement

The meals offered by a dietetic catering company were varied and not repeated for ten days. The energy distribution for individual meals differed slightly from the recommendations (Table 1).

Table 1. Distribution of energy for meals served by dietetic catering**Tabela 1.** Rozkład energii racji pokarmowej na posiłki serwowane przez catering dietetyczny

Meal type	*Recommendations [%]	Energy distribution among meals** (n = 10 days)
Breakfast	25-30	32.24
2nd breakfast	5-10	6.00
Lunch	30-35	32.69
Afternoon tea	5-10	11.05
Dinner/supper	15-20	18.02

* (Jarosz et al., 2020).

**The values are the arithmetic mean for meals from 10 different days.

Source/Źródło: own research results/wyniki badań własnych.

The energy value of breakfast and afternoon tea was slightly too high. The amount of energy from the 2nd breakfast, lunch and dinner was correct (Table 1).

For breakfast, the most common was wholewheat bread, eggs in various forms (fried and boiled eggs, egg paste, omelettes) and vegetables (e.g. tomatoes, mushrooms, green cucumbers, pickled cucumbers, canned vegetables, olives, celery, spinach, peppers). In addition, poultry pate, fish, cottage cheese and legume pastes were served. For the 2nd breakfast, there was always an apple or juice (e.g. apple-pear, apple-carrot) or a smoothie (e.g. apple-kiwi-orange, apple-blueberry, orange-pear). Lunch consisted of one dish, based on meat or fish with potatoes, groats or rice, and vegetables (boiled or raw). As for the cooking technique, no frying was used. Afternoon tea was often served as a sweet dessert in fruit cocktails based on coconut milk, chia puddings, muffins, fruit pies and yoghurts.

Dinners/suppers offered meat (quesadilla and chicken stew), pizzas, pasta dishes with pesto, casseroles and salads made of raw and baked vegetables. Fruits were an addition to the dishes mentioned above. Dairy products were also served, usually various kinds of cheese (mozzarella, brie, feta, parmesan), and occasionally also yoghurt.

All the meals were planned so as not to be repeated; they were varied and colourful. On every menu (except two), all the dishes served contained a variety of vegetables and/or fruits. The meals consisted of cereal products (basmati rice, barley, buckwheat, pearl barley, bulgur, millet, quinoa, whole grain pasta and bread). The meat dishes were prepared mainly based on poultry; pork and beef were sometimes served. The menus also included dishes prepared with the use of legumes, for example chickpeas and lentils. Oils were used to prepare the dishes (e.g. rapeseed oil, linseed oil, olive oil).

The meals offered by the dietetic catering company contained superfoods, including blueberries, goji berries, quinoa, chia seeds, and black cumin. This food is characterised by a high nutritional value, improves the immunity of the human body, and promotes the achievement and maintenance of normal body weight (Singh, Soni,

Bhamra, and Mittal, 2021). Superfoods slow down the ageing process of the human body thanks to their content. The complex of polysaccharides and phenolic acids reduces the risk of cancer (Daniel and Sadowska, 2016; Dochniak and Ekiert, 2015).

3.2. Compare menus with standards

Table 2 shows the demand for energy and nutrients according to the current norms for women in the age range of 31-50 years. The average nutritional and energy value of meals is estimated based on ten menus. The average energy value of the daily food ration was 1812.59 kcal, thus covering 100.69% of the norm (Table 2). The protein and fat content in the analysed diet slightly exceeded the recommendations (Table 2). Following a high-protein diet over a long time puts a strain on the liver and kidneys and can cause illnesses such as gout, rheumatism and arthritis (Delimaris, 2013; Jarosz et al., 2020).

Table 2. Energy and nutrients in food rations

Tabela 2. Wartość energetyczna i składniki odżywcze w racjach pokarmowych

Energy and nutrients	Mean values \pm standard deviation (n = 10)	Norm	Norm realization (%)
Energy (kcal)	1812.59 ¹ \pm 118,00	1800	100.69
Protein (g)	75.83 ² \pm 5.84	41-72*	105.32
Fat (g)	76.41 ³ \pm 6.35	40-70* (20-35% energy value)	109.16
Carbohydrates (g)	212.86 ³ \pm 27.33	202.5-292.5 (45-65% energy value)	
Fiber (g)	26.43 ⁴ \pm 2.01	25	105.72
Salt (g)	7.52 ⁴ \pm 0.92	max. 5	150.4
Sodium (mg)	3007.68 ⁴ \pm 264.44	1500	200.51
Potassium (mg)	3063.47 ⁴ \pm 198.44	3500	87.53
Calcium (mg)	629.6 ² \pm 52.13	1000	62.96
Magnezium (mg)	342.74 ² \pm 41.68	320	107.11
Iron (mg)	13.58 ² \pm 0.87	18	75.46
Vitamin A (μ g)	1372.72 ² \pm 78.41	700	196.1
Vitamin B ₁ (mg)	1.20 ² \pm 0.02	1.1	109.77
Vitamin B ₂ (mg)	1.74 ² \pm 0.06	1.1	158.02
Vitamin C (mg)	142.43 ² \pm 17.42	75	189.9
Cholesterol (mg)	440.23 \pm 38.88	300	146.74
% energy from protein	18.23	10-20	
% energy from fat	37.32	20-35	
% energy from carbohydrates	41.36	45-65	

¹ Estimated Energy Requirement (EER); ² Recommended Dietary Allowance (RDA); ³ Reference Intake ranges (RIs); ⁴ Adequate Intake (AI).

Source/Źródło: own research results/wyniki badań własnych.

Although the amount of protein consumed exceeded the recommended standards, the percentage of protein in the energy value of the food ration was correct at 18.23% (Table 2). However, the fat percentage in the energy value of the food ration was too high, at 37.32% (Table 2). Meals provided an average of 212.86 g of carbohydrates per day, in accordance with the standards. However, the percentage of energy from carbohydrates was incorrect as it was below the recommendations, at 41.36%. The results presented here indicate a need to change the energy structure of the dietary ration to reduce the content of fats and increase the number of carbohydrates in the diet.

The analysed menus covered the mineral requirements (sodium, potassium, calcium, magnesium, iron) to varying degrees compared to the standards. The analysed menus were deficient in iron, calcium and potassium (Table 2). The average dietary Fe, Ca and K content was 13.58 mg, 629.6 mg and 3063.47 mg, respectively (against the recommended standard of 18 mg, 1000 mg, and 3500 mg) (Table 2). The low supply of calcium in the analysed rations was determined by the low supply of milk and dairy products (e.g. cottage cheese, kefir, buttermilk), which are a group of products constituting an essential source of calcium in the diet.

The results indicate that the amount of iron and potassium in the diet should be increased. The analysed menus should therefore be enriched with products that are sources of iron, i.e. edible insects (e.g. house cricket, mealworm) (Orkusz, 2021), meat, broccoli, peppers or parsley (Computer program Diet 6D, 2018). Iron deficiency can cause anaemia (Domellöf, Thorsdottir, and Thorstensen, 2013), brittleness of hair and nails, cavities at the corners of the mouth, impaired physical performance and concentration, as well as inflammation and bleeding (Besarab and Hemmerich, 2018). The effects of potassium deficiency are not clearly proven, however studies show that potassium deficiency can affect lower blood pressure, cause ischaemic heart disease and cause myocardial infarction (Jarosz et al., 2020). The intakes of the other analysed minerals (sodium and magnesium) in the menus were too high in relation to the standards (Table 2). Sodium was found to be more than twice the norm. Such a high sodium intake indicates the need to limit the addition of salt to dishes and the elimination of processed products with a high salt content (e.g. cold meat products). Excessive sodium intake can cause impaired insulin secretion, insulin resistance, and hyperglycaemia. In addition, excess sodium in the diet also increases the risk of stomach cancer, weight gain, body fat, and abdominal circumference (Jarosz et al., 2020).

The menus showed an excess of all the analysed vitamins (B₁, B₂, A, C). The mean content of thiamine, riboflavin, vitamin A and vitamin C in the diet was 1.20 mg; 1.74 mg; 1372.72 µg and 142.43 mg, respectively, thus covering 109.77%, 158.2%, 196.1%, 189.9% of the standard (Table 2). These results indicate that the content of these nutrients in the diet should be reduced. Excess vitamin A can cause a decrease in bone mineral density and hypervitaminosis A, which manifests as headaches, excessive excitability, and enlargement of the liver (National Institute of Health,

2022; Wrzochal, Gładys-Jakubczyk, and Suliga, 2019). Up to now, no negative symptoms resulting from the excessive consumption of vitamin C, thiamine and riboflavin have been reported due to the limitation of their absorption and increased excretion with urine in the body (Scientific Committee on Food, 2001; Zemleni, Galloway, and McCormick, 1996).

Irregularities in salt content were found in all the analysed menus. Its content in rations was 7.52 g, exceeding the recommended intake level (Table 2). Excessive intake of salt causes water accumulation and retention in the body, increases the risk of cardiovascular disease, and can cause obesity and gastric cancer (Strnad, 2010; Hu, La Vecchia, Morrison, Negri, and Mery, 2011). There is no doubt that salt consumption should be reduced.

The cholesterol content in the analysed meals was too high regarding the recommendations (Table 2). Along with an increase in the concentration of cholesterol and its main carrier, i.e. low-density lipoproteins (LDL cholesterol), it can increase the risk of ischemic heart disease. This can make the blood flow harder, leading to a heart attack or a stroke (Jarosz et al., 2020).

It should be emphasised that on its website the company described its diets as healthy, while, at the same time, the offered portions that were not properly balanced. It is therefore necessary to make consumers aware that a diet catering service does not always cover all nutritional requirements.

4. Conclusions

The analysis of dietary catering menus showed that they contained some deficiencies.

The percentage of energy from carbohydrates was found to be too low and from fats too high. The main shortcomings of the offered meals were too low amounts of calcium, potassium and iron and too high contents of sodium, salt and cholesterol. It should be noted that the energy value of meals was consistent with the company's assumptions, covering the energy demand of women aged 31-50 with low physical activity. It is worth emphasising that the meals were varied and rich in vegetables and fruits, wholegrains, fish and superfoods.

References

- Besarab, A., and Hemmerich, S. (2018). Iron-deficiency anemia. In R. Provenzano, E. Lerma, L. Szczech (Eds), *Management of anemia*. New York, NY: Springer. https://doi.org/10.1007/978-1-4939-7360-6_2
- Computer program Diet 6D. (2018). *Independent laboratory of epidemiology and nutrition standards*. Warsaw, Poland: Institute of Food and Nutrition.
- Delimaris, J. (2013). Adverse effects associated with protein intake above the recommended dietary allowance for adults. *ISRN Nutrition*, (1-6). <https://doi.org/10.5402/2013/126929>.
- Daniel, I., and Sadowska, J. (2016). Anticancer effects of plant products – exotic superfoods and products from the Polish food pyramid. *Kosmos*, 65(3), 371-381.

- Dochniak, K., and Ekiert, M. (2015). Superfoods: Perfect addition or unnecessary supplement? *Pielęgniarstwo i Zdrowie Publiczne*, 5(4), 401-408. doi: 10.17219/pzp/60915
- Domellöf, M., Thorsdotir, I., and Thorstensen, K. (2013). Health effects of different dietary iron intakes: A systematic literature review for the 5th Nordic Nutrition Recommendations. *Food & Nutrition Research*, 57(21667). doi: 10.3402/fnr.v57i0.21667
- Eurostat – overweight and obesity – BMI statistics – Statistics Explained. (n.d.). Retrieved from europa.eu Główny Urząd Statystyczny. (n.d.). Kategoria: Populacja; grupa: Urodzenia i Zgony; podgrupa: Zgony według śmiertelności i zgony z przyczyn. Retrieved from <https://bdl.stat.gov.pl/BDL/metadane/metryka/3171>
- Hu, J., La Vecchia, C., Morrison, H., Negri, E., and Mery, L. (2011). Canadian Cancer Registries Epidemiology Research Group. Salt, processed meat and the risk of cancer. *European Journal of Cancer Prevention*, 20, 132-139. doi: 10.1097/CEJ.0b013e3283429e32.
- Jarosz, M., Rychlik, E., Stoś, K., and Charzewska, J. (2020). *Normy żywienia dla populacji Polski i ich zastosowanie*. Warszawa: Narodowy Instytut Zdrowia Publicznego – Państwowy Zakład Higieny.
- Llewellyn, A., Simmonds, M., Owen, C. G., and Woolacott, N. (2016). Childhood obesity as a predictor of morbidity in adulthood: A systematic review and meta-analysis. *Obesity Reviews*, 17, 56-67.
- Marino, M., Puppo, F., Del Bo', C., Vinelli, V., Riso, P., Porrini, M., and Martini, D. A. (2021). Systematic review of worldwide consumption of ultra-processed foods: Findings and criticisms. *Nutrients*, (2778). <https://doi.org/10.3390/nu13082778>.
- National Institute of Health. (2022). Vitamin a and carotenoids. *Fact Sheet for Consumers*, (1-3).
- OECD/European Observatory on Health Systems and Policies. (2017). Poland: Country health profile 2017, state of health in the EU. OECD publishing. Brussels: Paris/European Observatory on Health Systems and Policies. <http://dx.doi.org/10.1787/9789264283510-en>
- Ostachowska-Gasior, A., Kolarzyk, E., Majewska, R., Gasior, A., Kwiatkowski, J., and Zaleska, I. (2018). Diet and physical activity as determinants of lifestyle chosen by women from Southern Poland. *International Journal of Environmental Research and Public Health*. Sep 22; 15(10):2088. doi: 10.3390/ijerph15102088
- Orkus, A. (2021). Edible insects versus meat – nutritional comparison: Knowledge of their composition is the key to good health. *Nutrients*, 13(4). <https://doi.org/10.3390/nu13041207>.
- Romaniuk, P., Kaczmarek, K., Brukało, K., Grochowska-Niedworok, E., Łobczowska, K., Banik, A., Vandevijvere, S. (2022). On Behalf of the Pen Consortium The healthy food environment policy index in Poland: Implementation gaps and actions for improvement. *Foods*. June, 2(11), 1648. doi: 10.3390/foods11111648
- Szczepeńska, E., Białek-Dratwa, A., Janota, B., and Kowalski, O. (2022). Dietary therapy in prevention of Cardiovascular Disease (CVD) – Tradition or modernity? A review of the latest approaches to nutrition in CVD. *Nutrients*, 14(2649). <https://doi.org/10.3390/nu14132649>
- Scientific Committee on Food. (2001). *Opinion of the Scientific Committee on Food on the tolerable upper intake level of vitamin B1*. Retrieved from http://europa.eu.int/comm/food/fs/sc/scf/out93_en.pdf
- Singh, P. M., Soni, K., Bhamra, R., and Mittal, R. K. (2021). Superfood: Value and need. *Current Nutrition & Food Science*, XXXX, XX, (1-4).
- Statistics Poland. Category: Population; Group: Births and deaths; subgroup: Deaths by mortality and deaths by causes. (n.d.). Retrieved from <https://bdl.stat.gov.pl/BDL/metadane/metryka/3171>
- Strnad, M. S. (2010). Salt and cancer. *Acta Med Croatica*, (64), 159-61.
- Wrzochal, A., Gładys-Jakubczyk, A., and Suliga, E. (2019). Evaluation of diet in preschool-age children with Down syndrome – preliminary examination. *Medical Studies*, 35, 128-138. doi: <https://doi.org/10.5114/ms.2019.86332>
- Zempleni, J., Galloway, J. R., and McCormick, D. B. (1996). Pharmacokinetics of orally and intravenously administered riboflavin in healthy humans. *American Journal Clinical Nutrition*, 63, 54-66.

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