European Commission

Review of current practices to increase the intake of fruit and vegetables

Health

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This literature review was conducted as part of the EU-funded pilot project "Increasing the consumption of fresh fruit and vegetables in particular in local communities in EU NUTS2 regions in Poland and Hungary with primary household income below 50% of the EU27 average" with a dual purpose: to provide evidence-based guidance to the design and implementation of the project and to guide the scientific evaluation of the intervention.

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Table of content

Abstract

This literature review provides an analysis of what determines the fruit and vegetables intake of children, pregnant women and older people and how this can be improved. It is built on previous reviews of various types of intervention studies and strategies as documented in literature (2000 onwards) focusing on the EU, in particular Hungary and Poland.

Additionally, it identifies effective and promising interventions based on the review of determinants, the aforementioned existing review studies on interventions, and more recent evidence on effective interventions.

Keywords / tags: children, determinants, elderly, fruit (s), vegetable (s), interventions, pregnant women, youth. // Hungary, Poland, Europe, nutrition, food habits, socio-economic status, study (ies), survey.

Review of current practices to increase the intake of fruit and vegetables focusing on the EU, in particular Hungary and Poland

Introduction

Fruit and vegetables vary greatly in composition. The earliest definition of a fruit was "any plant used as food," and a vegetable was a "plant, as opposed to an animal or inanimate object" [Smith et al., 1995].

Nowadays the definition of a fruit was based on its anatomy, whereas that of a vegetable was based on culinary usage. Generally, culinary custom dictates which plant foods are considered vegetables or fruits [Smith et al., 1995; Slavin and Lloyd, 2012].

Most countries have their own dietary recommendations that include fruit and vegetables and health administrations, scientist and nutritionists all agree on the potential health benefits of daily servings of fruits and or vegetables in the prevention of a range of chronic diseases such as obesity, diabetes type II and cardiovascular ailments. (Gerster, 1991; Weisburger, 1991; Block et al., 1992; Maynard et al., 2003). The recommended quantities vary from country to country.The actual intake is closely linked to socio-economic status and educational level. Some guidelines are based on food groups, whereas others provide recommended nutrient intakes, sometimes including nutrient supplementation. (Estaquio C. et al, 2009).

Although dietary recommendations have many similarities, different countries choose different strategies to divide fruit and vegetables into groups. Orange and yellow fruit and vegetables are often high in carotenoids and are placed in a separate category. Yet many dark green vegetables (i.e., spinach) are also high in these components. Dividing fruit and vegetables into color categories makes sense for menu planning but does not correspond with nutrient content. Certain fruit and vegetables are rich sources of vitamin C, but these rich sources (citrus fruits, strawberries, parsley, rose-hip, white potatoes) are spread over many fruit and vegetable categories. Other fruit and vegetables, including avocado, corn, potatoes, and dried beans, are rich in starch, whereas sweet potatoes are mostly sucrose, not starch. Fruits (except bananas) and dark green vegetables contain little or no starch. Often, dietary guidance rules place fruit juices and potatoes in separate categories, because of dietary directives to eat whole fruits and minimise consumption of foods high in fat and sodium [Slavin and Lloyd, 2012]. These categories are important, because they drive policy for programmes such as school lunch and other supplemental feeding programmes.

In most Western countries, large population groups, including children and adolescents, eat far less than the recommended amount of fruit and vegetables (Domel et al., 1996; Contento & Michela, 1998; Gibson et al., 1998; Perry et al., 1998; Baranowski et al., 2000; Lytle et al., 2000; Yngve et al., 2005). Several studies have shown that children's intake of fruit and vegetable tracks into adolescence [9-11] and that those food preferences and eating habits established in childhood and adolescence tend to be maintained into adulthood (Kirby et al., 1995; Domel et al., 1996; Gibson et al., 1998; Perry et al., 1998). Therefore, interventions aiming at fruit and vegetable promotion in children may be an effective way for reducing the burden of chronic disease (e.g. World Health Organization, 1990, 2005; Klepp et al., 2005). This makes increasing fruit and vegetable consumption among children and adolescents an important public health issue. (Rasmussen et al, 2006)

However, several US studies have shown that percentages of youth meeting recommendations ranged from approximately 30% for fruit, grain, meat, and dairy to 36% for vegetables. Sixteen percent of youth did not meet any recommendations, and 1% met all recommendations. The pattern of meeting all recommendations resulted in nutrient intakes above the recommended dietary allowances and was high in fat. Conversely, meeting none of the recommendations resulted in intakes well below the recommended dietary allowances for some nutrients. Total fat and added sugars averaged 35% and 15% of energy, respectively, and levels were similar among most demographic groups.

According to the latest figures from the OECD, in response to a health survey question asking "How often do you eat fruit?", the percentage of adults consuming fruit daily varied from 20% in men in Finland, to more than 90% in Australia and an average 57% of men and 69% of women reported to eat fruit daily. Women reported eating fruit more often than men in all countries (OECD 2013a).

The same study found that persons aged 65 and over were more likely to eat fruit than those in younger age group, with the lowest consumption in people aged 15-24 years and that fruit consumption also varies by socio-economic status, generally being highest among persons with higher educational levels (OECD, 2013a).

For the European Nutrition and Health Report [Elmadfa ed 2009], food consumption in Europe was analysed with data from representative nutrition surveys in 19 countries, which were documented in a database of the European Food Safety Authority. According to this report only in 4 countries: Poland, Italy, Austria and Germany, the consumption of fruit and vegetables exceeded recommended 400 g per day. The consumption of vegetables in Southern Europe (Greece, Italy, Portugal, Spain, Cyprus) as well as in Central and Eastern Europe (Germany, Austria, Poland, Romania, Slovenia, Czech Republic, Hungary) was about 250 g/day and was higher than in Northern Europe (Denmark, Estonia, Finland, Latvia, Lithuania, Norway, Sweden) with 140 g/day. The highest fruit consumption was found in Central and Eastern Europe (209 g/day) as well as in Southern Europe (203 g/day). In Northern Europe, the fruit consumption was 129 g/day and in Western Europe (Belgium and Luxembourg, France, Ireland, The Netherlands, Great Britain) 113 g/day.

Among children,(11-, 13- and 15-year-olds) daily fruit consumption was relatively low in Poland, Sweden, Estonia, and Finland, with rates of around one in four for girls and one in five, or even less, for boys. In all OECD countries, girls were more likely than boys to eat fruit daily. The gap between the fruit consumption of boys and girls was especially large in Denmark, where 56% of girls, but only 34% of boys reported eating fruit each day. Daily vegetable eating was reported by around one in three girls and one in four boys on average across OECD member states in 2009-10 Eating vegetables daily was less common in Austria, Estonia and Spain, as well as in Hungary (girls), and Finland (boys). (OECD, 2013b)

Role of fruit and vegetables in human health

One of the hypotheses about the health benefits of fruit and vegetables is attributed to the synergy or interactions of bioactive compounds and other nutrients in whole foods [Liu, 2004].

About 15% of global disease is attributable to the effects of undernutrition and deficiencies in micronutrients.A similar amount of disease can also be attributed to diet-dependent risk factors such as: overweight, high blood cholesterol, hypertension and low intake of fruit and vegetables [Ezzati et al., 2002]. WHO reports [2002] suggested that up to 2.6 million deaths worldwide and 31 % of cardiovascular diseases may be attributed to inadequate consumption of fruit and vegetables.

Unfortunately, the effect of vegetables and fruits consumption on human health is difficult to measure because it is influenced by many factors, including their large variety

globally, varying dietary patterns, different effects for vegetables compared with fruits, and interactions with other dietary components [Slavin and Lloyd, 2012].

Many consumers, when choosing food products, pay particular attention to their health properties and concentration of bioactive substances, especially antioxidants, which are large group of bioactive food compounds, polyphenols belong to them. Phenolics are the products of secondary metabolism in plants that play vital roles in the reproduction, growth, and metabolism of the plants, act as defense mechanisms against pathological virus and fungus infections, parasites, and predators; and contribute to the color of plants. In addition to their functions in plants, phenolic compounds in our diet may reduce the risk of chronic diseases such as cancer, heart disease, and diabetes [Liu, 2013].

Reactive oxygen species (ROS) in the body can cause lipid and protein oxidation, DNA damage, base modification and modulation of gene expression. What is more, they play an important role in etiopathology of many diseases: atherosclerosis, vasospasm, cancers, stroke, heart attack and liver injury. Imbalance between the amount of ROS and antioxidant capacity of the organism causes oxidative stress. Oxidative stress is caused by antioxidant deficiency in the diets or by increased production of free radicals by stress, smoking, environmental contaminations which immigrate in to the water and food (heavy metals, pesticides nitrates, nitrites, nitrosamines etc.) [Lee et al., 2006].

Antioxidants and other chemical bioactive compounds detoxify ROS and prevent from causing damage to cellular macromolecules and organelles through multi-mechanisms [Zhou and Yu, 2006]. In human body exist several mechanism to defend from free radicals (for example antioxidant enzymes: catalase, gluthatione peroxidase, superoxide reductase, gluthatione reductase), however in some cases we need more substances which will fight with them. Fruit and vegetables are good dietary sources of chemical bioactive compounds which protect against harmful free radicals and reduce risk of oxidative stress, and its consequences such as inflammation and chronic diseases. It has been reported that changes in dietary patterns and lifestyle, such as increasing the consumption of fruit and vegetables and more balanced intakes of meat and plant foods, are a practical and effective strategy for reducing the incidence of chronic diseases, such as cardiovascular disease, cancer, diabetes, cataracts and age related functional decline [Willett, 2002; Zhang and Hamuzu, 2004].

In addition, recent research suggests that the benefits of bioactive compounds in fruits, vegetables, and other plant foods may be even greater than is currently understood because in vitro and animal studies suggest that they have multiple mechanisms of action beyond antioxidant activity [Liu and Finley, 2005].

Fruit and vegetable juices may play an important role in delaying the onset of Alzheimer's disease, particularly among those who are at high risk for the disease. These results may lead to a new avenue of inquiry in the prevention of Alzheimer's disease [Dai et al., 2006; Morris et al., 2006].

Cardiovascular diseases are the most common diseases of the XXI century. The development of cardiovascular diseases can be slower and even partially stopped by changing of lifestyle and wrong nutritional habits. Important part of healthy daily diets should be food products rich in bioactive compounds [Lutomski, 2001]. Several studies showed that fruit and vegetables and their bioactive compounds may be used in prevention of these diseases. Additionally epidemiological studies indicate that in areas where these products are consumed regularly, the incidence of cardiovascular disease is lower [Borida et al., 1996; Preuss et al., 2001; Durak et al., 2004]. Many observational and experimental studies have since examined the relation between dietary fibre or fibre rich foods (specifically from cereal or vegetable sources and rich in insoluble type fibre) and total cardiovascular risk or cardiovascular risk factors—such as hypertension, central obesity, insulin sensitivity, and elevated plasma cholesterol [Truswell, 2002; Van Horn et al., 2008]. In addition to fibre, many other potentially beneficial compounds within high fibre foods could have protective effects. For example, compounds such as antioxidants, hormonally active lignans, phytosterols, amylase inhibitors, and saponins have all been

shown to influence risk factors for coronary heart disease, and the combination of compounds within grains could be responsible for their protective effect [Slavin, 2004].

Antiatherogenic effect of some vegetables has been confirmed both in vitro and in vivo studies. Vegetables reduce many risk factors that play a key role in the formation and development of atherosclerosis: has anti-inflammatory properties, lowers total LDL cholesterol, increases HDL cholesterol, reduces triglycerides and fibrinogen levels may also inhibit uptake, degradation of LDL by macrophages [Lutomski, 2001, Gonen et al., 2005].

Vegetables (especially brassica vegetables e.g. broccoli, cabbage, cauliflower, Brussels sprouts and kale) contain high levels of bioactive components which include phenolics, glucosinolates, vitamin C, vitamin E, carotenoids, and selenium. They are available throughout the all year. These vegetables are among the most important vegetables consumed in Europe and all over the world owing to their availability at local markets, cheapness and consumer preference [Herr and Büchler, 2010]. Phytochemicals from brassica vegetables may act on different and complementary levels. They prevent oxidative stress, induce detoxification enzymes, stimulate immune system, decrease the risk of cancers, inhibit malignant transformation and carcinogenic mutations, and reduce proliferation of cancer cells [Herr and Büchler, 2010; Kestwal et al., 2011]. Some authors suggest that addition to the diet glucosinolates obtained from Brassicea may decrease not only oxidative stress but also inflammation [Wu et al., 2004; Noyan-Ashhraf et al., 2005].

The prevalence of pre-obesity and obesity has been rising in recent decades in European countries. Overweight or obesity occurs disproportionately often in individuals that have unfavourable socioeconomic indicators regarding education, income, and professional position [Helmert and Strube, 2004]. Overweight occurs if energy intake is higher than energy expenditure. Compared with many other foods, the volume of vegetables and fruit in relation to the energy content is larger. Due to the favourable volume to energy ratio of vegetables, and fruit, satiety signals can emerge without consuming a large amount of energy [Prentice and Jebb, 2003]. Some studies showed that an increase in vegetable and fruit consumption might be a suitable measure to facilitate initial weight loss and subsequent weight stability [WHO, 2000].

Osteoporosis is a debilitating and painful condition of low bone mineral density (BMD) and high fracture risk. Flavonoids, found in a wide diversity of plant foods from fruit and vegetables, herbs and spices, essential oils, and beverages, have the highest potential of dietary components for promotion of bone health beyond calcium and vitamin D. In a large observational study in Scotland, total flavonoid intake was positively associated with BMD and increase in BMD of the spine and hip. The relationship between flavonoid intake and bone health was stronger in general than what has been reported previously for fruit and vegetables [Chen et al., 2006; Prynne et al., 2006; Hardcastle et al., 2011; Weaver et al., 2012].

From a scientific point of view, national campaigns to increase fruit and vegetable consumption are justified. The promotion of vegetable and fruit consumption by nutrition and health policies is a preferable strategy to decrease the burden of several chronic diseases in Western/developing societies [Boeing et al., 2012].

Fruit and vegetables consumption in Poland

According to Central Statistical Office (CSO) of Poland and National Research Institute of Agricultural and Food Economics the consumption of vegetables (excluding potatoes) and fruits in Poland fell down from 306.1 g/person/day in 2005 to 275.2 g/ person/day in 2012 (data gathered according to analysis of home budgets). This means that Poles eat only 68.8 % of the recommended amount of vegetables and fruits. That is why the educational programmes focusing on the increase in fruit and vegetable consumption are very important in the aspect of prevention of diseases related to unbalanced nutrition. Several educational programmes have been or are held in Poland. They are mainly designed for children, for example "Fruits in school" (promoted by Agencja

Rynku Rolnego), "Time for tomato, that is there is no way not to like polish vegetables and fruits", "Eat vitamins, get well soon". However, some programmes are also guided to either children or adults: several editions of "5 servings of vegetables, fruits or juice", "Extraordinary properties of ordinary fruits", "Don't be a beetroot – eat vegetables" (play on words – in Polish beetroot is also a term for someone ill-mannered and stupid). There are also some programmes concerning nutritional education concerning different topics, such as POL-HEALTH program for 2007-2011.

According to research the most preferable fruits for Poles are apples (37 % of all fruits) and tropical fruits (30 %), mainly citrus and bananas. From vegetables the highly consumed are tomatoes (17 % of all vegetables), cucumbers (12 %), carrots (11 %) and cabbage (11 %). Even though these vegetables and fruits are mostly preferred by Poles its consumption is lower than in countries leading in high consumption of vegetables and fruits like Italy or Greece. The main difference in the structure of consumption between those countries and Poland is higher consumption of tropical fruits and tomatoes [Trajer and Dyngus, 2013].

Many studies report that various subpopulations and populations in Poland do not have proper nutritional habits, usually the consumption of fruit and vegetables is too low.

Fruit and vegetables consumption in Hungary

In the first decade of this century several nutrition surveys of smaller size were implemented. In Hungary, the National Institute for Food and Nutrition Science (NIFNS) *organized such surveys in 2003-2004 and 2009*. The number of investigated and finally evaluated persons was 1179 and 1131, respectively. The results contained the estimated amount of fruit and vegetables consumption. Therefore it is possible to compare the consumed quantity and the threshold recommended by WHO. The average consumption level in 2009 seems to be acceptable (Figures 1 and 2) (Rodler I., Biró L., Greiner E., Zajkás G., Szórád I. et al. 2005; Sarkadi Nagy E.,Bakacs M.,Illés É., Zentai A.,Lugasi A., et al. 2012).

Figure 1

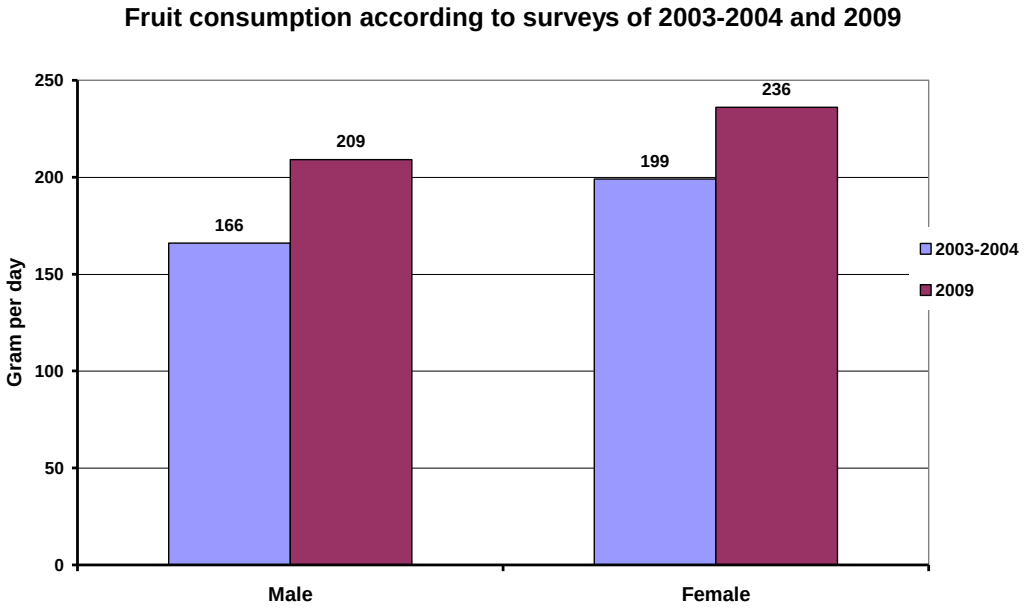
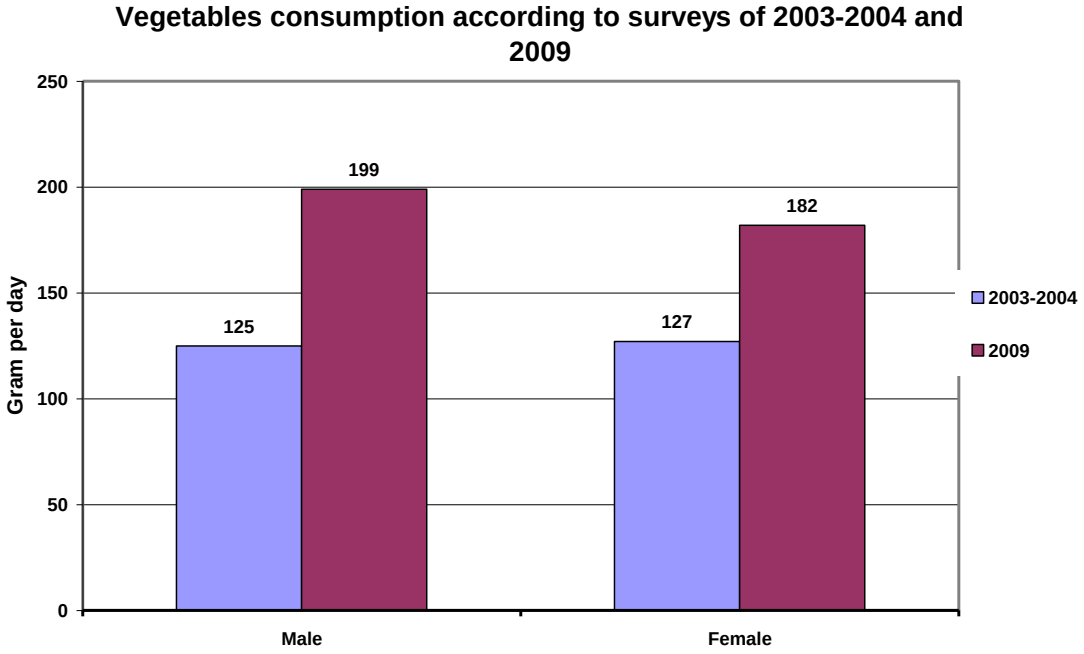


Figure 2



The *Hungarian Food Safety Office (HFSO) conducted in 2009* a food consumption survey as a base for estimation of intake of potential harmful xenobiotics via food. The results include some information about the fruit and vegetables consumption (unpublished data, by courtesy of Lajos Biró). The data are shown in the Table 1.

Table 1.

Fruit and vegetables consumption of children and adults, gram per day – Results of the HFSO survey, 2009

Denomination	**Number of people**	**Mean g/d**
Children		
Vegetables, nuts, pulses except vegetable soups	871	189.5
Fruits	728	153.1
Fruit and vegetable juices	490	72.5
Adults		
Vegetables, nuts, pulses except vegetable soups	3074	197.9
Fruits	2535	146.3
Fruit and vegetable juices	905	186.1

Data from the Hungarian Statistical Office (HSO

In every year the HSO collect characteristic data from a representative group of households, among them that of dietary pattern. The Table 2 contains an overview from 1997 to 2011. A slight decrease of consumption is shown in both fruit and vegetables.

Table 2.

Daily average quantity of individual fruit and vegetables consumption according to the representative household surveys, gram/day

Denomination	9997	2006	2009	2011
Nuts	.	3.3	3.3	30
Preserved fruits	..	0.3	0.3	0.3
Fruit, total	123.3	122.2	115.6	104.4
Fresh vegetables	147.9	129.6	124.4	120.0
Preserved vegs	20.5	18.1	17.0	17.5
Vegetables, total	168.5	147.7	141.4	137.5

The commerce-based, long-term statistics provides an interesting picture: up to year 2000 the consumption increased and the first decade of this century the consumed fruit amount quickly decreased, that of vegetables would prefer to persist (Table 3).

Table 3.

Consumption of fruit and vegetables in Hungary, annual average quantity, kg per capita

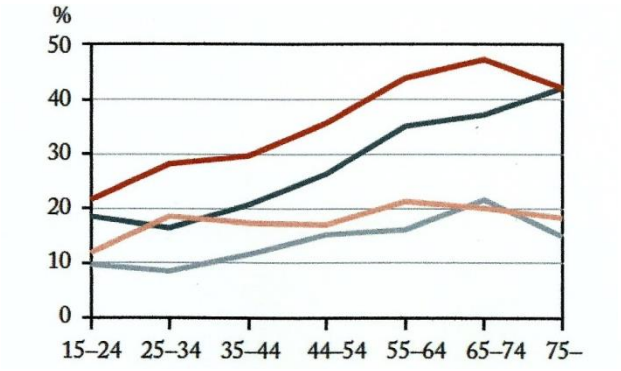
Denomination	1985	1990	1995	2000	2005	2010	2011
Fruit	71.0	72.3	58.3	108.5	82.7	84.7	66.2
Vegetables	75.6	83.3	91.6	109.2	112.1	105.3	111.7

Source: Hungarian Statistical Yearbooks

The HSO published a short Societal Situation Report on the health status of population and on the public health conditions, including the nutrition and the fruit/vegetables consumption (Gárdos É. 2010). Regarding the age groups, the fruit consumption was increasing in older age but the vegetables consumption fluctuated approximately about a same level (Figure 3.).

Figure 3.

Percentage of subjects consuming fruit and vegetables more than once per day



Age, years. Source: Gárdos É. 2010.

Focus on fruit and vegetables consumption in the Hungarian nutrition surveys

The First Hungarian Representative Nutrition Survey (Biró Gy. 1993) was carried out between 1985 to 1988 and leaded by the National Institute for Food and Nutrition Science (NIFNS). The number of investigated person approximated the 0.2 per cent of the adult population: males 7042, females 9599, together 16641 subjects. There were included in the research nutritional interview, repeated 24-h recall, history recording, anthropometric measurements, laboratory tests, socioeconomic questionnaire. The data from food frequency sheets were disposable; the amount of consumed fruit and vegetables was not registered (Tables 1 and 2). We have to note that the potatoes are not included in the vegetables consumption.

Table 1.

Frequency of fruit consumption: results from the First Hungarian Representative Nutrition Survey (1985-1988)

Gender	Never		1-3 times per month		1-3 times per week		4-7 times per week		Several times per day	
	n	%	N	%	N	%	n	%	n	%
Fresh fruit in summer and autumn										
Males	186	2.7	364	5.3	1669	24.3	3215	46.9	1422	20.7
Females	184	2.0	338	3.6	1770	18.9	4522	48.2	2559	27.3
Fresh and deep frozen fruit in winter and spring										
Males	974	14.2	998	14.6	2277	33.2	2225	32.5	378	5.5
Females	1216	13.0	1122	12.0	2754	29.4	3571	38.1	706	7.5
Citrus fruits										
Males	2407	35.2	3068	44.8	1153	16.8	197	2.9	19	0.3
Females	2756	29.5	4315	46.1	1835	19.6	410	4.4	35	0.4

Source:Biró Gy.1993.

The bulk of investigated subject consumed fruit 4-7 times or 1-3 times per week, what's more several times per day in summer and autumn. In that time there was a scarcity of citrus fruits, for this reason their consumption remained on a lower level.

Table 2.

Frequency of vegetables consumption: results from the First Hungarian Representative Nutrition Survey (1985-1988)

Gender	Never		1-3 times per month		1-3 times per week		4-7 times per week		Several times per day	
	n	%	n	%	n	%	n	%	n	%
Vegetable dish										
Males	541	7.9	1201	17.5	4684	68.3	421	6.1	6	0.1
Females	461	4.9	1286	13.7	6675	71.2	938	10.0	16	0.2
Raw vegetables in summer and autumn										
Males	344	5.0	413	6.0	2595	37.9	2890	42.2	610	8.9
Females	422	4.5	485	5.2	3491	37.3	4092	43.7	878	9.4
Raw preserved vegetables winter and spring										
Males	484	7.1	653	9.5	3410	49.8	2114	30.9	191	2.8
Females	744	7.9	909	9.7	4750	50.7	2709	28.9	260	2.8

Source: Biró Gy. 1993.

In the case of vegetable dishes the majority of responders consumed them 1-3 times per week and 1-3 times per month, the raw vegetables most frequently occurred 1-3 times and 4-7 times per week in all the four seasons.

Fruit and vegetables in the health promotion

Whenever effective, promotion of fruit and vegetables consumption can significantly contribute to a well-balanced diet. This importance was outlined and emphasised also in the WHO Technical Reports entitled "Diet, Nutrition, and the Prevention of Chronic Diseases" published in 1990 and 2003. Numerous authors go into the details of this topic, among them Boeing, H., Bechthold, A., Bub, A., Ellinger, A., Haller, A. et al. (2012) report on a convincing evidence of the decreasing risk for hypertension, coronary heart disease and stroke and a probable evidence for cancer, overweight, type 2 diabetes mellitus and some other disorders as a result of increased fruit and vegetables consumption. Higher intake of fruit and vegetables may help protect against oxidative damage, thus lowering cancer and cardiovascular disease risk (Genkinger, M., Platz, E.A., Hoffman, S.C., Comstock, G.W., Helzlsouer, K.J. 2004) and we already have pointed this out.

Daucher, Let al. (2004) investigated the incidence of coronary heart disease (CHD) in France and Northern Ireland and they found a negative correlation between the citrus fruit intake and the CHD risk.

Such findings support the general health recommendation to a comprehensive fruit and vegetables promotion programme.

Fruit and vegetables consumption during pregnancy

The recommended intake of vitamins and minerals during pregnancy and lactation is much higher than before it. It is also important to deliver proper amounts of bioactive non- nutrients compounds like polyphenolic compounds and dietary fiber. That is why those women should choose nutritionally dense food for proper development of the child. Institute of Mother and Child in Poland recommends eating 300 g of vegetables and 300 g of fruits per day during Ist trimester and 400 g of vegetables and the same amount of fruits per day during IInd and IIrd trimester [Świątkowska, 2013].

The report from the research conducted by Chief Sanitary Inspectorate [2010] in Poland with the cooperation with voivodship and district sanitary inspectorates showed that the main change in the women's diet after realizing they are pregnant is more frequent consumption of fruit and vegetables (81.91 % of women). During pregnancy 58.8 % of women consumed salads few times per week, and 30.0 % of those women ate it few times a day. Fruits are consumed few times a day by 69.2 % of women and juices are drank few times a day by almost a half of women (45.6 %).

Bojar et al. [2006] evaluated the nutritional habits of pregnant women from Lublin. Women decreased intake of fruit and increased consumption of vegetables. Albeit the authors did not specify how many times per day these product were consumed or what was the amount of eaten food.

Szczepaniak et al. [2004] performed studies with 235 girls and 129 pregnant women from town Krynica Zdroj and its region. They found that about 50% of girls and women consumed fruits 3-5 times per day, 40% once per day, 10% 3-4 times per week. The frequency of consumption was strongly connected with preferences. Girls and women declared that they preferred and frequently consumed strawberries, grapes, mandarins, peaches and apples.

Research conducted by Przybyłowicz et al. [2012] revealed that high number of pregnant Polish women eat raw vegetables (82 %) and fruits (89%) every day. According to Godala et al. (2012) over a half (51 %) of the pregnant Poles participating in the research ate fruits a few times a day and 23 % ate it once a day. 34 % of those women consumed vegetables few times a day, and 32 % once a day. Almost a half (49.6 %) of fruit and vegetables is consumed raw, 40.5 % boiled and 9.9 % oven-cooked. Similar results were obtained by Hyżyk and Sokalska [2011]. The study showed that 46 % of women ate fruits every day, 50 % few times a week and 4 % once a week. As to vegetables, 58 % of women consumed them every day, 28 % - several times a week and 14 % only once a week. The mostly preferred vegetables were: tomatoes and carrots (44 %), cucumbers (28 %), broccoli (22 %), salads and lettuce (20 %), pepper (12 %) and cauliflower (10 %).

Kamelska et al. [2011] evaluated nutritional behaviours according to fruits consumption in a group of 50 pregnant Polish women. From among polish national fruits pregnant women most preferably chose apples (48 %). High percentage of women declared also eating grapes (16 %) and strawberries (13 %). Pears were eaten by 8 % of women and sweet cherries by 6 %. The fewest women chose cherries (2 %), plums (1 %), wild strawberries (1 %), raspberries (3 %) and gooseberries (2 %). From among tropical fruits pregnant women most frequently chose bananas (25 %), oranges (28 %), mandarins (17 %). Lower consumption accounting for 8, 5, 5, 7 %, was for kiwi fruit,

peaches, nectarines and grapefruits, respectively. The lowest consumption was noted for pineapples, lemons and watermelons (1, 2, 2 %, respectively).

Ramón et al. [2009] reported that frequency of consumption of vegetables during pregnancy is strongly connected with anthropometric measurements of newborns. The study was performed in Valencian community among 840 pregnant women during first and third trimesters. The daily consumption of fruit and vegetables was 293±216.1 and 213.3±121.0 gram per person, respectively. These authors have found that higher frequency of consumption of vegetables by women in first trimester of pregnancy, was strongly connected with higher body mass of newborn child.

Crozier et al. [2009] performed the studies with 12,572 non-pregnant women (20–34 years old) from Southampton, UK, of whom 2270 and 2649 became pregnant. Pregnant woman completed food frequency in early and late pregnancy, respectively. Consumption of fruit and fruit juice increased during the pregnancy. On the other hand intake of vegetables, cooked potatoes decreased.

Guelinckx, et al. (2010) performed studies with 195 obese pregnant women. They were randomly divided into 3 groups: a group that received nutritional advice from a brochure, a group that received the brochure and education by nutritionist, and a control group. Nutritional habits were assessed in each trimester of pregnancy using dietary records. They found that intake of vegetables significantly increased in all groups. In control group the intake of vegetables increased from 118 g/day in first trimester to 128 g/ day in third trimester. In group which received nutritional guidelines from brochure consumption of vegetables increased from 148 g/day to 164 g/day. In group which was under the control of nutritionist the intake of vegetables increased from 142 g/day to 167 g/day.

Miyake et al [2010] reported that higher intake of yellow and green vegetables as well as citrus fruit by pregnant from Japan was strongly associated with reduced risk of eczema in children. They reported that average intake of vegetables per day was 185.9 g per person and fruit 177.0g per person.

Fruit and vegetables (F&V) consumption among children in the pre-school age

In preschool age the organism of children develops intensively. Children need well balanced diet rich in protein, carbohydrates, properly composed fat, vitamins and minerals. At this stage of development they also should learn proper nutritional habits from parents and other members of family but also from teachers and nannies. In Polish and foreign literature there are information concerning the frequency of the consumption of fruit and vegetables by children in pre-school age. Usually consumption of these food products is too low. Kozioł-Kozakowska et al. [2007] reported that children aged 3-6 years from rural and urban area of Krakow, Poland consumed fresh fruits and fruit juice 3-4 times per week. Fresh vegetables were consumed only 1-2 times per week. Cooked vegetables were consumed by children with the same frequency. These authors also have found that fruits were consumed more frequently as the snacks.

Kolarzyk et al. [2008] assessed the nutritional habits of pre-school children from Krakow, Poland. These authors did taken under consideration not only nutritional habits but also the relationship between body mass index (BMI) and preferences of consumption of various food products including vegetables and fruits. Children with low BMI index preferred sweets, children with obesity preferred fruits. Vegetables were recognized by children as the neutral group of food products. Parents of children were asked about the consumption of snacks. Children consumed more frequently sweet dairy products than fruit and vegetables.

Gacek [2012] reported that children aged 3-6 years from kindergartens located in Krakow preferred to consume more frequently fruits than vegetables. 63.5 % of children acknowledged the vegetables as the don't liked food products. The following percentage

of children declared frequency of consumption of fruit few times per day 20.6% of children; once per day 30.2 %, few times per week 35 % and seldom 13.5 %. In case of consumption of vegetables, children declared that: 8.7 % eat vegetables few times per day; 32.5 % once per day; 39.7 % few times per week and seldom 19.1%.

Roszko-Kirpsza et al. [2012] performed the study with children aged 2-3 years old living in rural areas. They found that only 14.1 % of children have eaten fruit and vegetables with every meal. Fruit and vegetables were consumed twice per day by about 68.9 % children. Rarely than two times per day these products were consumed by 17 % of children.

Cooke et al. [2004] showed that intake of fruit and vegetable by children aged 2-6 years have depended on mother's education, children age and gender. Additionally parental consumption, time of breast- feeding and proper time of introduction of fruit and vegetables had strong relation with consumption of these products by assessed children. In other studies these authors reported that lower consumption of fruit and vegetables was associated with neophobia in children aged 4-5 years from London [Cooke et al., 2006].

Wardle et al. [2005] reported that consumption of fruit and vegetables by 2- to 6-year-old children from London nursery schools was strongly correlated with parent control and their eating habits.

Thorsdottir et al. [2006] performed a study with 6 year old children in Greater Reykjavik area. They found that consumption of fruit, vegetables and fruit juice was on average 194±126 g/ day/child. Additionally they have found that amount of consumed fruit and vegetables was positively associated with concentration of vitamin C and β-carotene in serum of assessed children.

Fruit and vegetables (F&V) consumption among school aged children

Nutritional habits and food frequency consumption were also assessed in children in school age. During this period of life the adolescents usually stop listen to parents and teachers. They also change nutritional habits and select the food which is usually unhealthy.

Wołowski and Jankowska [2007] reported that adolescents do not eat frequently fruit and vegetables. Assessed students from Gdansk declared that 10 % of them have eaten fruit or drink fruit juice for breakfast. 67 % of students have eaten fruit as the snack and only 15.7 % consumed vegetables.

Piórecka et al. [2007] reported that of secondary school students in Malopolska, frequent consumed of fruits at least once a day. Kołłajtis-Dołowy et al. [2007] showed that snacking between meals declared about 95 % of children aged 11-12 years. These authors showed, that the largest amount of respondents e.g. 60 % chose fruit and vegetables, and 22 % chips and fried potatoes.

Urbańska and Czarniecka-Skubina [2007] assessed the possibility of buying healthy food products in grocery shops located in schools (primary schools, secondary and high schools). They have found that in many shops students could not buy fresh fruit or vegetables. It caused that during the breaks students consumed soft drinks, chocolate bars, salty snacks.

Dzielska et al. [2008] performed the study under the programme "Health Behavior in School-aged Children: A WHO Cross-National Collaborative Study" in years 2002-2006, with students in age 11-15 years. They found that consumption of fruit and vegetables decreased with age of children. Frequency of consumption of these products has depended also on economic status of family. Adolescents from families with lower income consumed fruit and vegetables rarely than students from families with higher incomes.

Wajszczak et al. [2008] assessed the nutritional habits of students from Warsaw. They found that snacking was popular between major meals. 20 % of girls and 10.9 % of boys selected fruit for snacks. These authors assessed also the quality of major meals (5 meals). The major factors were presence of protein and fruit or vegetables. They found that 64.1 % of girls and 66.9 % of boys consumed dinner (lunch) containing these products. In case of breakfast only 30.3 % of girls and 22.9 % of boys consumed proper meal.

Similar tendency in consumption of F&V was reported by Marcysiak et al. [2009]. These authors found that 36 % of adolescents selected fruit for snacking and only 15% of them declared that they consumed F&V five times per day.

Additionally other authors [Czarnocińska et al., 2007; Wojdyła-Buciora and Marcinkowski, 2010; Wolnicka et al., 2011] reported similar tendency.

What is more in these studies all authors indicated that such low intake fruit and vegetables may increase risk of non-communicable diseases in the future.

In Hungary, during the first semester of the school year 2005/2006 the scientists of NIFNS conducted a study in 16 primary school of the capital. They investigated the eating habits and the food consumption, nutrient intake, frequency ofconsumption of different fruit and vegetables in 875 (449 boys and 426 girls) schoolchildren aged 11-14 years (Biró L. et al. 2007). The results are summarised in Table 3: the girls consume fairly often and more fresh fruit and vegetables than the boys. The consumption of both items looks to be low: about the half of investigated children eat fresh fruit more than once per day and in the case of vegetables it amounts to one fifth or lesser only, consequently the consumption is not in the neighbourhood of the recommended level.

Table 3.

Percentage of fruit and vegetables consumption frequency in schoolchildren aged 11-14 years

[n=449 (boys) and 426 (girls)]

Denomination	Never		1-3 times per month		1-3 times per week		4-7 times per week		Several times per day	
	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl
Fresh fruit	4.3	2.4	6.5	3.6	15.8	11.1	32.2	27.0	41.2	55.9
Dried fruit	55.3	55.6	23.5	22.1	11.2	12.0	7.4	7.7	2.7	2.6
Preserved fruit	19.0	21.7	28.1	28.5	26.5	27.3	18.8	15.7	7.7	6.8
Vegetable dish	19.5	18.3	27.7	28.8	33.1	36.2	15.9	13.8	3.9	2.9
Fresh vegetables	9.5	6.5	16.1	14.6	30.6	27.6	27.4	29.3	16.3	22.1

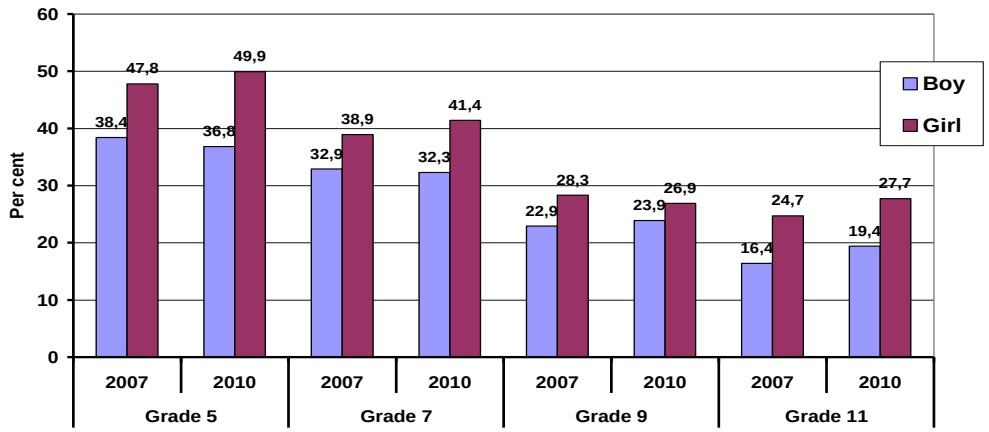
Source: Biró .L, Regöly-Mérei A., Nagy K., Péter Sz., Arató Gy. 2007.

On the base of National Children Health Institute researchers from four Hungarian institutions formed a task-force, the target of which was to carry out the WHO cross-national programme on the investigation of health status and behaviour of school-aged children. [Health Behaviour in School-aged Children a WHO-collaborative Cross-National Study (HBSC)] Two studies have been attained in 2006 and 2010 (Németh Á. 2007; Németh Á., Költő A. 2011). According to the study-reports "41 member countries are involved in it: mainly from Europe (included all EU countries except Cyprus) as well as Canada, US and Israel. The main goal of this project is to investigate young people's health

in psychosocial context, thus it focuses not only on health and health behaviour indicators, but on individual features and on social settings (i.e. family, peer group, school, socio-economic environment) as well." At the first occasion, in April-May 2006 the researchers studied the children in 264 classes of 137 schools and they evaluated the data of 5470 questionnaires (2815 boys, 2635 girls). The mean age was for grade 5 11.7, for grade 7 13.6, for grade 9 15.7 and for grade 11 17.6 years. The second stage succeeded in February-May 2010. In this case the pupils of 416 classes of 358 schools were interviewed, together 8096 questionnaires were evaluated (3957 boys and 4139 girls). The number of children eating fruit daily does not reach the one third of investigated subjects, moreover in the case of vegetables the one fifth. The girls consume more both items but the consumed amounts are lesser in higher grades. It is an important and favourable fact that the consumed amounts are higher in 2010 than in 2007. The detailed results comparing the both stages are shown on Figures 4 and 5.

Figure 4.

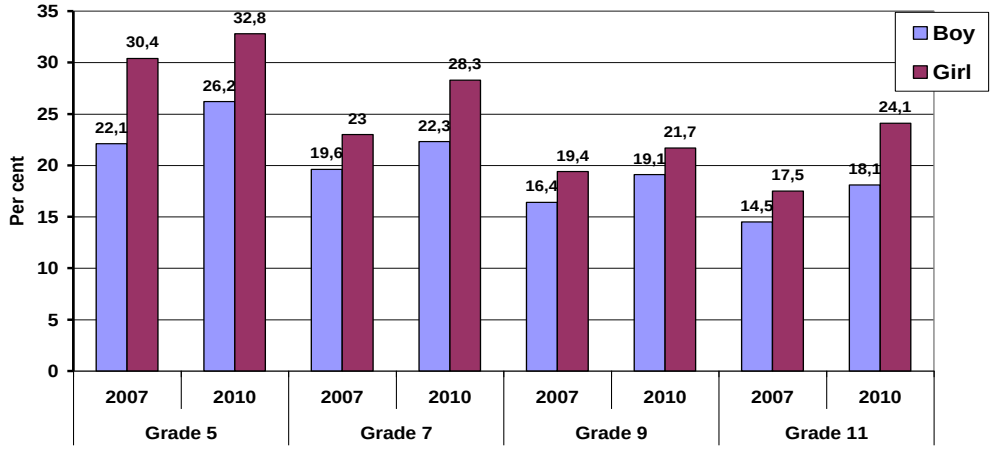
Percentage of adolescents consuming fruit daily in HBSC 2007 (n=5393) and 2010 (n=8026)



Source: Német Á. 2007; Németh Á., Költő A. 2010

Figure 5.

Percentage of adolescents consuming vegetables daily in HBSC 2007 (n=5360) and 2010 (n=7996)



Source: Német Á. 2007; Németh Á., Költő A. 2010

Fruit and vegetables (F&V) consumption among students and adults

Frequency of consumption of F&V by students is also too low. Szczęsna et al. [2005] reported that students from Agricultural University in Wroclaw, living in students houses consumed F&V few times per month. Additionally the frequency of consumption of these products was strongly connected with financial status and year of study. First or second year students consumed fruit and vegetables rarely than colleagues from fourth or fifth year. More frequent consumption of these products showed few year later in Wroclaw [Seń et al. 2012]. These authors reported that 1-3 times per day fruit and vegetables consumed 63% of students of the Wroclaw Medical University, 55 % of students from the Wroclaw University of Environmental and Life Sciences and 41 % from Wroclaw University of Technology. In medical universities located in Gdansk, Gdynia and Sopot only 34 % of female students declared that they consume fruit and vegetables once per day [Walentukiewicz et al., 2013].

Bugaj et al. [2013] reported that fresh fruit and vegetables every day consumed 25 % of female students and only 6.3 % male students form selected Universities located in Krakow. Additionally 12.5 % of men did not eat these product at all.

Similar results in consumption of F&V by students were published by other authors [Skibniewska et al., 2009; Szponar and Krzyszych, 2009; Szczepańska et al., 2010; Spanos and Hankey, 2009].

Frequency of consumption of F&V by adults is also too low. Cieślik et al., [2004] reported that respondents from Beskid Sądecki region (Malopolska, Poland) aged 16-70 years consumed fruit and vegetables rather rarely. 18 % of them ate fruit few times per day, 35.5 % once per day and 35.5 % several times per week. Only 7 % of adults declared that they consumed vegetables few times per day, 26 % once per day and 57.5 % several times per week.

Sikora et al. [2009] assessed the changes in daily supply of food products in years 1989-2004 based on data from Central Statistical Office, Poland. These authors found that supply of fruit increased about 25 %. Supply of vegetables, potato and legumes did not changed.

Too low consumption of fruit and vegetables, fresh or cooked, declared also sportsmen training sport shooting, canoeing, football and other sport disciplines with high physical activity level [Farajian et al., 2004; Iglesias-Gutierreaz et al., 2008; Nowacka et al., 2010; Kopec et al., 2013].

Gajewska et al. [2013] showed that patients (aged 24-91 years) with essential hypertension declared that they eat fruit and vegetables according to the recommendations in prevention of hypertension. These authors showed that 57 patients ate vegetable every day; 20 – 3-4 times per week; 5 – 1-2 times per week; 1 – 1-2 per month and 3 – never. Everyday consumption of fruit declared 55 patients; 3-4 times per week – 20 patients; 1-2 times per week – 9 patients; 1-2 times per month and never – 1 person.

Kiczorowska and Samolińska [2014] reported that men which are in risk group of cardiovascular diseases declared frequent consumption of fruit.

Fruit and vegetables consumption among older population

Most developed world countries have accepted the chronological age of 65 years as adefinition of 'elderly' or older person. At the moment, there is no United Nations standard numerical criterion, but the UN agreed cutoff is 60+ years to refer to the older population.

The World health Organisation has also underlined that the improvement in living conditions, nutrition and healthcare is beneficial to longevity and has brought about an increase in the percentage of elderly people in the whole world (World Health Statistics,

2006). Age is one of the most important predictors of people's attitudes towards health. We may expect that an interest in health increases along with increased disease burden and body ageing. Numerous studies have shown the influence of age on nutritional habits and food consumption by people (Ezzati et al., 2004; Larrieu et al., 2004; Szponar et al., 2003). Population ageing sets new challenges for food producers and retailers, as the elderly are consumers with specific needs. They are usually burdened by numerous health problems and have limited economic capabilities. Elderly people is quite heterogeneous group because most of them are suffering different diseases. Various treatments and disease itself may have impact on the dietary habits. Moreover the vast majority of elderly people is physically inactive or their activity is lower than before. Such factors as: low income, low educational attainment, low occupational status, smoking have been linked with lower F&V consumption. In Poland elderly people have the lowest level of education. Over 50 % of elderly people finished only primary school and had bad economic situation. Moreover bad physical health, often present in the elderly, leading to the reduced appetite and the ability to shop and cook can also influence F&V consumption. Furthermore people having greater variety of social and physical activities, higher life satisfaction and fewer problematic life events have more adequate diets [Johnson et al., 1998]. Varied diet in the elderly age is often hard to accomplish because of worsening of taste and smell, tooth loss, mouth disorders, diseases, depression and loneliness [Niedźwiedzka and Wądołowska, 2010].

Over 80% of Polish seniors suffer from chronic diseases, and the mean number of diseases per person exceeds three. Poland is one of the countries with high metabolic syndrome risk because of widespread overweight and obesity, high blood pressure, lipid disorders, smoking and alcohol abuse (Stan zdrowia. . ., 2006; Popowa et al., 2007; Wysocki and Zejda, 2007; Zatonski, 2000; Zdrojewski et al., 2006). According to the WHO, the disease burden resulting from high blood pressure is estimated in Poland at 25% of the disability-adjusted life years (DALYs), resulting from high cholesterol level to 13% of the DALYs, and overweight and obesity – 12% of the DALYs (Powles et al., 2005).

According to CSO of Poland the average consumption of fruit and vegetables (excluding potatoes) among retired people was higher than in general population and accounted for 388 g/person/day. From all fruits retired people prefer eating apples (40.2% of all fruits), exotic fruits (28.4 %) and berries (12.9 %). Most frequently eaten vegetables are: tomatoes (16.5 % of all vegetables), cabbage (11.4 %), cucumbers (11.2 %) and carrots (10.2 %) [CSO 2013].

According to Goluch-Koniuszy and Fabiańczyk [2010], people in older age (49-60 years) eat vegetables and fruits mainly during dinner (95 % of women and 88 % of men) and supper (46 % of women and 50 % of men).

Analysis of elderly people's (in the age of 60-86) diets from Kraków [Gacek, 2008] with the use of questionnaire showed that majority of elderly Poles eat raw vegetables a few times per week (54.5 % of women and 35.3 % of men). Only 6.0 % of women and 11.8 % of men eat raw vegetables few times per day. Moreover 60.6 % of women and 64.7 % of men eat fruits once a day. On the other hand different research [Suliga, 2010] regarding people aged 50 years and more revealed that 34.9 % of people consume vegetables once a day and 27.8 % of people eat them a few times a day. Moreover fruits are consumed once a day by 31.3 % of people and a few times a day by 30.7 % of people. Research has also shown that the more varied dietary pattern of elderly people, the more fruit juices, vegetable juices, bananas, kiwi and citrus fruits, berry fruits, stone fruits, sauerkraut and cucumber and vegetables from Brassicaceae family is consumed [Niedźwiecka and Wądołowska, 2010].

Older people suffering from diet-related diseases may modify their diet. Studies conducted among people in the age between 75 and 80 years indicated that 30 % of people included intentionally certain products in their diet. Those products were raw vegetables and fruits, vegetable and fruit juices and also fermented milk beverages and lean meat [Wierzbicka and Roszkowski, 2004]. Włodarek and Głąbska [2010]

demonstrated that people with diabetes mellitus type 2 (mean age 63.6 ± 7.6 years) eat only one serving of vegetables and one serving of fruits per day. The mostly preferred raw vegetables are tomato, cabbage, carrot, cooked vegetables are carrot, cauliflower and cabbage, and fruits are apples. Elderly people less often eat pepper than younger people and women eat broccoli and beetroot more often than men.

Interventions aiming at vulnerable groups

National F&V programmes and promotion initiatives have been established worldwide. Food-based intervention studies have been conducted. The findings of these suggest that the majority of the intervention result in an increase of F&V consumption, although none of the studies have focused on meta-analysis that could quantify the effectiveness. (Pomerleau J. et al, 2005, copyright WHO)

According to "A systematic review of the effectiveness of individual, community and societal level interventions at reducing socioeconomic inequalities in obesity amongst adults" (F C Hillier-Brown et al., 2014), interventions can be categorized into:

- individual level interventions which included individualised/one-to-one health promotion, education, advice, counselling or subsidy andare conducted in a health care or research setting, or in participant's homes.
- Communitylevel interventions which are defined as group-based health promotion, education, advice, counselling or subsidy only interventions, or interventions conducted in a community setting (for example a workplace, community centre, sports centre and shop).
- Societal level studies that aresplit into two sub-groups: Societal-environment level interventions are those that included a change in environment or access to environment; and Societal-policy level interventions as macro-level policies such as taxation, advertising restriction or subsidies.

The same review statesthe effectiveness of tailored weight loss programmes amongst deprived groups. Community based programmes show as well a short term effectiveness. At societal level, very few evaluations can be listed. Hence, for long term effects, little evidence could be provided (F C Hillier-Brown et al., 2014).

A review lead by Contento et al. confirms that specific programmes of behavioral change process (including self-assessment and goal-settings), individually tailored education and counseling and benefitting from social support (peers, family) were most effective. As for environmental interventions, like point of purchase information, they were short term effective. Interventions in schools, worksites and communities were keys of success for a long term behavior change.

Ammerman et al. analysed about 24 interventions to modify fruit and vegetables uptake in North-America, Europe and Australia. They concluded that 3 factors have a significant impact on the increase of fruit and vegetables intake: goal-setting, food-related activities and theoretical basis.

Burchett, who reviewed primary-school-based nutrition intervention studies in the United States concluded that the three main factors influencing F&V consumption among schoolchildren were: availability, preparation skills for eating and cooking F&V, taste preferences of children for vegetables.

According to Pomerleau J. et al. 2005, the studies that have been reviewed targeting primary school intervention, parental involvement is an essential component (e.g. by the mean of "Parent Packs"). So were school food-service staff and teachers.

Rasmussen et al. 2006 (http://www.ijbnpa.org/content/3/1/22) have reviewed 98 papers treating about potential determinants of fruit and vegetable intake in children and adolescents.The conclusions highlight the potential determinants that may have an

influence (positive or negative) on F&V consumption among children and adolescents (table 4 http://www.ijbnpa.org/content/3/1/22/table/T4) and the infrequently tested determinants.

Lakerveld J. et al, 2013, pursued the aim of exploring which factors could be relevant to assess the implementation of social and physical environmental interventions in underprivileged neighborhoods. 6 factors appear to be statistically relevant:

- Target group involvement during process planning
- Target group involvement during implementation
- Inventory during development
- Communication with target group before implementation
- Rivalry with similar interventions
- Intervention staffing

The Shepherd approach (1989)divides food choice factors into three main groups: (i) productrelated factors, which rely on physical and chemical properties, sensory attributes (taste, aroma, texture, visual appearance), functional factors (packaging, accessibility, convenience), nutrient content, etc.; (ii) consumer-related factors, including personality (age, gender, education level), psychological factors (personality, experience, mood), physiological effects (satiety, hunger, appetite),etc.; (iii) environment-related, which include economic (price, incomes), cultural (beliefs), and social factors (fashion,society).

As concerns food choice motivation, food preferences and food frequency, women and girls more often have pro-health eating behaviours, both in choice factors, preferences and behaviour, i.e., food intake. Consumers with prohealth food choice motives both more often consumed fruit, vegetables and low-fat dairy products and had higher preferences of those products. A parallel correlation between preferences and intake frequency of those products was revealed for respondents not interested in health:low food preferences were connected with low eating frequency (L. Wadołowska et al. (2008) 122–134).

Interventions targeting pregnant women

As concerns pregnant women, research in gestational diet and nutrition has traditionally focused on preventing nutritional deficiencies in the maternal diet and ensuring adequate neonatal growth (Abu-Saad & Fraser, 2010). There is, however, growing interest in the potential for dietary changes among pregnant women with gestational diabetes mellitus or obesity to minimise the risk of macrosomia and associated adverse outcomes, including the risk of obesity in the child in later life (Crowther et al., 2005; Metzger et al., 2008; Landon et al., 2009).

Dietary change focused on a reduced intake of saturated fat and high-sugar foods, as well as increased fruit and vegetable consumption is consistent with UK national guidance for healthy eating in pregnancy (Department of Health, 2009).

Several behaviourally-based pregnancy interventions have been described based on the provision of dietary 'counselling' (Gray-Donald et al., 2000; Kinnunen et al., 2007; Asbee et al., 2009; Shirazian et al., 2010; Luoto et al., 2011). However, the term 'counselling' can refer to a variety of behaviour change techniques (Michie et al., 2011). Although some interventions have focused primarily on identification of barriers to healthy eating (Kinnunen et al., 2007; Shirazian et al., 2010), the results of the 'Psychological predictors of dietary intentions in pregnancy' (Gardner et al, 2012) study indicate that bolstering expectations of positive outcomes for both mother and child associated with adopting a healthier diet may have more impact. The under-emphasis of the benefits of

healthy diet in interventions tested to date may reflect an assumption that pregnant women are aware of the implications of gestational diet (secondary: Gardner et al., 2011 in Gardner et al., 2012).

Changing dietary choices in pregnancy may require efforts to ensure that pregnant women consistently prioritize the benefits of healthy eating over beliefs that support consumption of unhealthy foods (Gardner et al, 2012)

Gardner et al. found that benefits of action for mother and baby were associated with intentions to eat more F&V and less high-fat food.Participants who perceived greater benefits of adopting more healthy eating patterns are more likely to intend to do so. *In terms of intervention design, there is a benefit to provide ample information on the benefits of F&V consumption for both mother and baby.*

The Healthy Start Programme in the UK. Based on the assumption that it is difficult for low-income families to prioritize spending on healthy food, the initiative provides distribution of vouchers for fruit, vegetables, milk, and vitamins to low-income families. The result of the intervention (Alison McFadden et al., 2014) shows that

- It increased the quantity and range of fruit and vegetables consumed
- it improved the quality of family diets, and established good habits for the future.
- Barriers to registration included complex eligibility criteria, inappropriate targeting of information about the programme by health practitioners and a general low level of awareness among families

Interventions designed for children and adolescents

The evaluation of the 'Grab 5!" showed that increases in fruit and vegetable consumption were more often accompanied by changes in attitudes, knowledge and beliefs, possibly indicating an holistic approach within those schools. (Edmunds, Jones & Dalmeny, 2003).

School-based health and nutrition education intervention studies in Europe and the USA have had mixed results in effecting physiological changes (De Bourdeaudhuij et al, 2000; Manios Y et al., 2002). The majority of trials have been conducted in the USA, and there are doubts whether these can be extrapolated to the great diversity of the European area (Anderson et al., 1998). New and modern tools for health promotion in adolescents need to be developed focusing on this specific population and considering gender differences. Adolescence is a unique period in life. Health promotion should not force models of behaviour onto individuals or groups.

Adolescents need a food culture based on foods to eat, rather than foods to avoid, and an understanding of suitable weight-control measures (Nowak, 1998) Computer-tailored nutrition and physical activity education is an innovative, promising and cost-effective tool to motivate people to make healthy dietary and physical activity changes. It provides respondents with individualised feedback about dietary behaviour and physical activity. The available evidence indicates that computer-tailored education is more effective in motivating people to make changes than general nutritional and physical activity education (Brug et al., 2003)

Until now most computer-tailored nutrition programmes have focused on one or a few aspects of nutrition behavior such as fat intake or fruits and vegetable intake and most programmes are aimed at adults.

The Hungarian school fruit programme.

It started in 2012. The details of the programme were prescribed in the rule No. 50/2012 (V. 25.) VM (Magyar Közlöny – Hungarian Official Gazette – 2012, Issue 62). The pupils of the first six grades in primary schools were cost free supplied with fruit or vegetables 2-4 times per week. During the school year 2012/2013 more than three-quarters of primary schools participated in the programme which went through with the financial support of the European Union. The basic rule mentioned above was made up-to-date in 2014 (Rule No. 55/2014. [V. 25.] VM., Magyar Közlöny – Hungarian official Gazette, 2014. Issue 60; "A program bemutatása" – "Presentation of programme", 2014). The size of portions is shown in the table 8.

Table 8.

Portion size in school-fruit programme

Denomination	Portion
Fruit	
Apple, whole	1 piece
Apple, sliced	8 decagram
Pear	1 piece
Peach	1 piece
Nectarine	1 piece
Plum	4 piece
Strawberry	8 decagram
Cherry	8 decagram
Fruit juice, 100%	2 decilitre
Vegetables	
Tomato	1 piece
Carrot	10 decagram
Green pepper	1 piece
Kohlrabi	10 decagram
Vegetables juice, 100%	2 decilitre

Children catering

A task-force of the National Institute for Food and Nutrition Science investigated in 2009 and 2013 the catering in 948 and 251 kindergartens, respectively. According to the countrywide average of the first survey the 75271 children aged 2-6 years got fresh vegetables or fruit only in 54 per cent of kindergartens. The quantity prescribed in rules was provided up to 88 per cent in the case of vegetables and up to 74 per cent in the case of fruit but the range appeared rather large. In 2013 it was shown an improved condition: the menus contained raw fruit or vegetables at least once per day, the frequency of vegetables doubled and there was no kindergarten in the sample where the children did not get fruit. (Bakacs M., et al. 2014.)

Similar overviews were carried out by the NIFNS on the school refectories. In 2008 the work crew collected data in 3099 schools; they evaluated the menu of ten days. Vegetables were included in menu by 27 per cent of schools in average 0-3 times during

ten days. 30 per cent of school cafeterias sold fruit. In little bit more than one tenth of these schools the pupils got fruit free of charge. In 2013 a significant improvement is shown: during ten days raw vegetables or vegetable dish occurred 13 to 31 times, in average 22 times, the occurrence of fruit was 5.2 within ten days. The number of cafeterias selling fruit diminished, that of cafeterias selling vegetables increased. (Greiner E.et al. 2014.)

Interventions designed for older people

Older adults' eating habits are heterogeneous, and the determinants of fruit and vegetable intake among older adults are complex. With population aging, the number and intensity of barriers in accessing and consuming fruit and vegetables increase. The literature suggests that fruit and vegetable intake is influenced by numerous group- and individual-level predictors. Many of these are unique to situations and circumstances in older adulthood. The following predictors have been found to influence the access to—and consumption of—fruit and vegetables among older adults in the U.S.: (a) health status, (b) geographic/physical environment, (c) gender, marital status, and household composition, (d) social support, (e) race/ethnicity, (f) socioeconomic status, and (g) dietary knowledge. (Nicklett E. J. et al., 2013).

As a consequence and according to the same authors, it is particularly important that interventions be planned and tailored specifically for older adults to improve their knowledge or access. More effective interventions also incorporate an individual's desire or readiness to change dietary behaviors. Nutritional screening can help raise awareness, identify needs, and target limited resources for those in need. More systematic screening of the older adult population can help identify older adults in need of nutrition-related resources.

No interventions aiming at increase of F&V consumption in Poland and in Hungary have been conducted.Educational programmes are held for example as a part of University of Third Age) and aim generally at improving the dietary patterns. They do however not evaluate effectiveness of such education.

Conclusions and guidance for further research

The effect of vegetables and fruits consumption on human health is difficult to measure since it is influenced by many factors, including their large variety globally, varying dietary patterns, different effects for vegetables compared with fruits, and interactions with other dietary components [Slavin and Lloyd, 2012].

Nevertheless, WHO reports [2002] suggested that up to 2.6 million deaths worldwide and 31 % of cardiovascular diseases may be attributed to inadequate consumption of fruit and vegetables.

In most Western countries, large population groups, including children and adolescents, eat far less than the recommended amount of fruit and vegetables (Domel et al., 1996; Contento & Michela, 1998; Gibson et al., 1998; Perry et al., 1998; Baranowski et al., 2000; Lytle et al., 2000; Yngve et al., 2005).

Several studies have shown that children's intake of fruit and vegetable tracks into adolescence [9-11] and that those food preferences and eating habits established in childhood and adolescence tend to be maintained into adulthood (Kirby et al., 1995; Domel et al., 1996; Gibson et al., 1998; Perry et al., 1998).

Food programmes and promotion initiatives have an important role to play. They have been developed worldwide and the studies show that they do most of the time result in the increase of F&V, at least in the short term.

But to date, nutrition education campaigns have only been moderately successful in promoting a sustained consumption of adequate amounts of fruit and vegetables (Davis et al., 2000; Klepp et al., 2005). Interventions aiming to improve health-related behaviours should be tailored to the most important determinants or mediators of these behaviours in order to be successful (Baranowski et al., 1999; Brug et al., 2005a).

In general, in terms of food habits, the reviewed studies tend to be descriptive rather than comprehensive.

- Pregnant women

To prevent nutritional deficiencies in the maternal diet and ensuring adequate neonatal growth, behaviourally-based pregnancy interventions usually rely on the provision of dietary 'counselling'. Expectations of positive outcomes for both mother and child are associated with adopting a healthier diet. To make healthy products more accessible by distributing vouchers for fruit and vegetables effectively increased consumption of those products in the long run.

Further types of interventions towards that target group should be developed, surveyed and promoted at a large scale.

- Children and adolescent

The consumption of fruit and vegetables of children aged 2-6 is controlled by their parent and determined by their eating habits. Adolescents often stop listening to parents and teachers, and change their nutritional habits, often selecting unhealthy food.

Numerous school based health and nutrition programmes have been implemented in Europe and worldwide. Such programmes should focus on specific populations and consider gender differences. Tailored programmes show better results in terms of behaviour changes in individuals or groups. Combined with physical activity they are an innovative, promising and cost-effective tool to motivate people to eat healthier and exercise more. It provides respondents with individualised feedback about dietary behaviour and physical activity.

Such initiatives, that are already widespread for adults, should be adapted for younger people.

- Older people

Older people are often burdened by numerous health problems and some have limited economic capabilities.

There is an abundance of literature about health benefits, but literature is lacking consequent studies or reviews regarding interventions and their potential effectiveness.

Thus, the present review confirms that intervention efforts are indeed needed to promote fruit and vegetable intake across childhood and adolescence. Furthermore, interventions to promote fruit and vegetable intake should especially be aiming at reaching youth from lower SES groups, and specific targets like pregnant women and older people.

Such interventions improve preferences for fruit and vegetables and improve their availability. This review might conclude that interventions towards pregnant women and older people tend to be more effective whenever they are personalised, adapted and tailored to each individual needs.

But there is a need for further internationally comparative studies. At best, these should be theory-based multi-level studies in which both personal and environmental factors (family, school, local community, and national factors) are considered within a longitudinal design although we do realize that exploring such a broad range of potential determinants comes with measurement problems (e.g. long questionnaires or single item assessment of various constructs). Such future research will though generate

- more information on determinants and mediators of fruit and vegetables consumption among pregnant women, children and adolescents and older people on which coming interventions should be tailored
- more information concerning product-related, consumer-related and environmental-related factors which determine food choices

The present review observed a lack of intervention programmes, related studies and surveys among older people, and to a less extent among pregnant women. Efforts should be made to raise awareness, and educate these particularly vulnerable target groups.

Focus on Poland and Hungary

The literature review showed that fruit and vegetables are not frequently consumed by various populations or subpopulation in Poland, however however older people consume the highest amount (388 g/day). The most preferred fruit is apple and vegetable is tomato.

In Hungary there is a tendency showing some favourable phenomena in terms of fruit and vegetables consumption, e.g. the satisfactory mean values of a group of surveyed subjects in 2009. However, the average population does not take advantage of the daily intake of this food group. They are missing comprehensive intervention programmes, but for the school-fruit programme.

Cardiovascular diseases (CVD) and malignant tumours are the leading causes of death in Hungary (similarly to the other developed countries) and the factors that may reduce their incidence/prevalence, would lead to possible improvement in health situation.

There is a need for more education projects for Polish and Hungarian citizens of every age on how important it is to consume these groups of food products 5 times per day.

There is an urgent need to emphasise the benefits of a higher consumption of fruit and vegetables, because of the significant role they play in the prevention of CVD and cancer. Fruit and vegetables can also diminish the amount of food consumed, mainly the quantity of fat. Thus they contribute to the prophylaxis of overweight or obesity. Moreover a diet characterised by high intakes of some subgroups of fruit and vegetables is associated with better cognitive function, less cognitive decline lower risk for development of mild cognitive impairment and Alzheimer's disease (Nooyens, A. C. J., et al. 2011; Ye, X., et al. 2013).

Methodology

Sources

For the English and French articles, an initial google scholar search was conducted looking for articles since 2000 that corresponded to combinations of the key words of the EU's intervention: "Pilot project: increasing the consumption of fresh fruit and vegetables in particular in local communities in EU NUTS2 regions in Poland and Hungary with primary household income below 50% of the EU27 average" to orient the researcher in the body of literature.

The next search sifted through several databases of scientific literature: PubMed, Web of Knowledge, IBSS (international bibliography of the Social Sciences); Psychinfo and ERIC (Educational Resources Information Center).

Since the ongoing project takes place in Hungary and in Poland, researchers from the University of Krakow, Poznan University of Life Sciences, Semmelweis University in Budapest and the Hungarian National Food and Nutrition institute were invited to conduct a search within the body of literature that existed in their respective countries and languages. Their focus was primarily on papers that had not been translated.

A last category that has been taken into account are papers looking at specific EU-funded initiatives, in particular the school-fruit scheme and the milk scheme.

112 publications were included in the present review.

Competing interests

The author(s) declare that they have no competing interest.

Authors' contributions

ProPager directed the overall literature survey and compiled the manuscript by incorporating critical inputs from all authors. The Scientific Committee, under the guidance of ProPager, conceived the study. Members of the Scientific Committee conducted the literature search. ProPager received regular suggestions of articles by DG Health and Food Safety and participated in the selection and analysis of included papers. All authors contributed to the design of the analysis. All authors read and approved the final manuscript.

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