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SADRŽAJ / *CONTENT*

Hrana u zdravlju i bolesti, znanstveno-stručni časopis za nutricionizam i dijetetiku (2018) 7 (2) 26-30
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A COMPARATIVE SURVEY ON THE PREVALENCE OF PARASITE ELEMENTS IN FRESH VEGETABLES AND READY-TO-EAT SALADS

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original scientific paper

Summary

While highly nutritional, raw vegetables pose a significant health risk of food-borne diseases. Along with their popularity among the consumers, the number of food recalls for ready-to-eat salads around the world is constantly increasing. The study focused on the prevalence of parasite elements in vegetables selected randomly from two fresh food markets and two retail supermarkets from the area of Osijek city between March and June 2018. Four types of vegetables: lettuce (*Lactuca sativa* L.), cabbage (*Brassica oleracea* var. *capitata*), kale (*Brassica oleracea* var. *acephala*) and spinach (*Spinacia oleracea* L.), and ready-to-eat salads (combinations of carrot, different types of lettuce, cabbage, and beetroot) have been analysed. Total of 36 samples from fresh food markets and 17 ready-to-eat salads were analysed by light microscopy. Parasite elements were detected in 3.77% of all tested samples. Total of 33.96% of lettuce and ready-to-eat salads samples contained undefined cysts. The highest increase in detected number of parasitic elements was observed in June. All other types of vegetables analysed were free from parasitic elements. Our research confirms that ready-to-eat salads pose significant health concern for the consumer. More promotional activities are needed to increase consumer's awareness of the potential risks related to consumption of ready-to-eat salads.

Keywords: ready-to-eat salads, fresh vegetables, parasite elements, fresh food markets, retail supermarkets

Introduction

Vegetables are important source of a number of minerals, vitamins, insoluble fibres and many bioactive compounds. Especially potent are dark green leafy vegetables like cabbage, kale, spinach and lettuce varieties. Intake of vegetables (and fruits) is linked to lower risk of cardiovascular diseases, type 2 diabetes, colorectal cancer and many other health conditions which are the lead causes of mortality and morbidity today in the world (Slavin and Lloyd, 2012). Insufficient intake of fruit and vegetables is estimated to cause around 14% of gastrointestinal cancer deaths, about 11% of ischaemic heart disease deaths and about 9% of stroke deaths worldwide (WHO, 2009).

Many types of vegetables are consumed raw, without any thermal processing and as such pose a potential health risk for the consumer (FAO, 2008). One of the main concern is parasitic contamination (Daryani et al., 2008; Erdogrul and Sener, 2005). The hygienic-quality of vegetables depends not only on chemical, but also on biological safety, which includes parasites and bacterial abundance. Special emphasis should be put on ready-to-eat salads and easy-to-prepare products which become more popular among the consumers due to lifestyle changes due to progress of the society (Caradonna et al., 2017). The main sources of vegetable parasite contamination are irrigation water contaminated with sewage, soil contamination, post-harvest handling and low hygienic preparation practice related with home or food service (Beuchat, 2002; Simões et al., 2001; Barjaktarović-Labović et al., 2018). From the aspect of ready-to-eat salads, some types of vegetables, especially lettuce, poses a high risk contamination during production and harvesting. Large surface area and gaps on leaf surface such stomata or veins may keep the parasite elements, cysts or eggs, during washing increasing the contamination level (Robertson, 2017). Foodborne contamination of vegetables caused by parasites has been reported in many countries (Abougrain et al., 2010; Amorós et al., 2010). However, there are limited number of studies related with contamination of ready-to-eat salads by parasites on global level.

Parasites are obligate organisms which cannot multiply without the presence of host organism so for that reason the parasite food control practice is more difficult than bacteriological safety programs (Paniker, 2018). Cysts and spores are infective stages of parasitic protozoa, i.e. resting, nonfeeding and resistant life-forms of protozoa bounded by hard cell wall which protect them from unpleasant environment (Corliss, 1994). In addition, cysts and spores are important for the dispersal of parasites and is critical for their population. After ingestion, cysts undergo the excessive excitation process usually in

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digestive tract, releasing the mobile stage of parasite, sporozoites, which adhere on surface of the intestine (Paniker, 2018). Definitive host releases a huge amount of sporulated cysts by faeces, which may contaminate the environment. Presence of intestinal parasite can trigger the development of different disorders like diarrheal disease (Beyene and Tasew, 2014), megaloblastic anaemia (Vuylsteke et al., 2004), skin allergies (Giacometti et al., 2003; Mehta et al., 2002) and duodenal, gastric or peptic ulcers (Obiajuru and Adogu, 2013).

Climate changes has great impact on the whole ecosystem (IPCC, 2014). The impact of climate on parasite occurrence is mostly seen thought temporal shifts in parasite transition routes which together with the local ecosystem properties may result in radical perturbations in host-parasite interaction (Kutz et al., 2005). For example, temperature oscillations can affect the development and reproduction of definitive parasites ectothermic hosts (fish, crabs or clams) or indirect host organisms (e.g. snails) endangering their health status and persistence in ecosystems (van Dijk et al., 2010). These climate-related changes in parasite dissemination eventually lead to human and animal disease (Mas-Coma et al., 2009).

The aim of this research was to assess the health safety observed through parasitic contamination of vegetables that are most commonly consumed raw, including ready-to-eat salads from the area of Osijek. To our best knowledge, this is the first report of parasitic contamination of ready-to-eat salads in Croatia.

Materials and methods

A total of 36 samples of fresh seasonal vegetables were collected from two fresh food markets and two retail supermarkets, while 17 ready-to-eat salads were purchased in two retail supermarkets. All samples were collected between March and June 2018 from the area of Osijek city. The following vegetables were tested: 15 samples of lettuce (*Lactuca sativa* L.), 6 samples of cabbage (*Brassica oleracea* var. *capitata*), 13 samples of kale (*Brassica oleracea* var. *acephala*) and 2 samples of spinach (*Spinacia oleracea* L.). Ready-to-eat salads were mixtures of carrot, different types of lettuce, cabbage, and beetroot.

The fresh vegetables were chopped into small pieces and 150-200 g of each vegetable was weighted and used for the analysis. In the case of ready-to-eat salads, the cutting procedure was skipped. Samples was stored in polyethylene bags, rinsed in physiological saline solution (0.85% NaCl) (200 mL) with addition of few drops of Tween 80 and agitated vigorously (manually) for about two minutes. Liquid obtained was left to sediment for 24 hours. Sediment was taken (10 mL), centrifuged at 1500 rpm for 3 min and supernatant was discarded (El Said Said, 2012). Smears were prepared with 50 µL of sediment and stained with 50 µL of Lugol iodine solution. For each sample, three slides were made. Parasite elements were detected in sample under a light microscope (Optika B-159) using x10 and x40 objectives. Photographs and measurements of objects were made with Dino-Eye microscope eye-piece camera and the matching software (Dino-Lite Pro). The data for the precipitation from March to June 2018 was obtained from Croatian Metrological and Hydrological Service (DHMZ).

Statistical analysis was conducted with STATISTICA 13.4 (Stat Soft Inc., USA). Chi-square test was used to calculate significance, and where appropriate, McNeimar test was also used. The value of $P<0.05$ was considered statistically significant.

Results and discussion

The prevalence of protozoa cysts was 3.77% in all tested samples (Fig. 1). The prevalence of cysts in infected samples was 33.96% (Table 1).

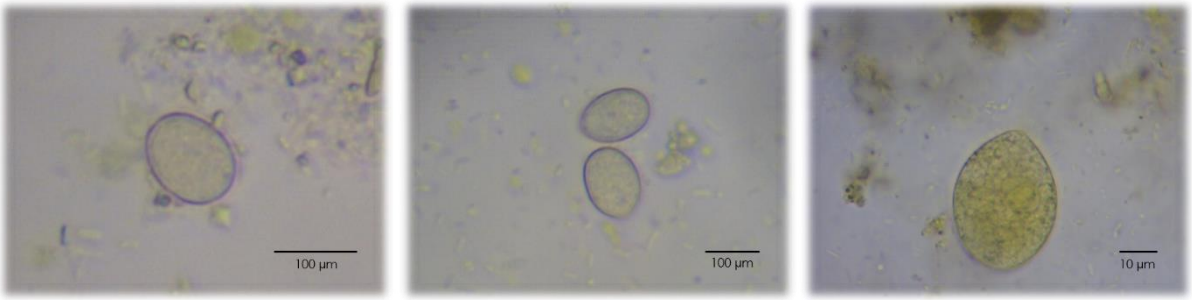

Fig. 1. Unidentified protozoan cysts detected in fresh vegetables under objective magnification x10 and x40, respectively

Table 1. Prevalence of cysts in contaminated samples

Type of vegetable sample	Ready to eat	Lettuce	No.	%No.
Parasite element	17	1	18	33,96

No.: Total number of cysts detected in analysed samples
% No.: Percentage of contamination

Out of all samples taken from two local markets only lettuce samples were positive to cysts (6.7% of contamination) while kale, cabbage and spinach were negative (Table 2). The highest contamination of lettuce can be partially explained with rough surface of the leaves and open-shape of shoot which can be easily reached by cysts in the case of faecal route contamination or watering with contaminated water. Lettuce has tender, soft leaves, sensitive to vigorous washing compared to kale or cabbage which increases the probability to keep cysts more attached to the surface. Contrarily, closed-shoot shape morphology, seen in cabbage, decreases the probability of parasitic contamination (Damen et al., 2007). The connection between morphology of vegetables and parasite prevalence was observed for lettuce (45%) and rocket (*Eruca sativa* L.) (46.7%) (El Said Said, 2012). Additionally, lettuce was the most commonly contaminated vegetable in other studies. The rate of contamination was 40% (Damen et al., 2007), 45.5% (Eraky et al., 2014) and 96% (Abougrain et al., 2010). Another reason may be frequent watering of the plant to maintain freshness, therefore increasing consumer's interest into buying and consuming it.

Table 2. Prevalence of cysts in different vegetables from two fresh food markets

Sample	No.	No.C.	% No.
Cabbage	6	0	0
Spinach	2	0	0
Kale	13	0	0
Lettuce	15	1	6.67
Total No.:	36	1	2,78

No.: Number of examined samples
No. C.: Number of contaminated samples
% No.: Percentage of contamination
Total No.: Total number of examined and contaminated samples and percentage of contamination

We found that ready-to-eat salads have significantly higher rate of contamination than other vegetable samples (x^2 =0.027). Poor food handling and processing, and low hygienic practice can explain these findings. According to Little and Gillespe (2008) poor hygiene practice of salad vegetables was the major cause of health problems. Furthermore, the food handling from farm to market may also be one of the possible route of parasite contamination in these products (Kwabena et al., 2014). The protozoan parasite contamination of ready-to-eat salads was also recorded across Europe. In Italy, mixed packaged salads contained the oo/cysts of *Giardia duodenalis*, *Cyclospora cayatanensis*, *Toxoplasma gondii* and *Criptosporidium* sp. (Caradonna et al., 2017). In the same study 4.2% of salads had one protozoan species while in 0.6% of samples two parasite elements were detected. Contamination of fresh salads with parasite cysts was found in Turkey (Erdogrul and Sener, 2005), Poland (Lass et al., 2012), Spain (Amoros et al., 2010) and Norway (Robertson and Gjerde, 2001).

Comparing the contamination prevalence during time, in June the number of protozoan cysts was significantly higher than in May (x^2 = 0.006), April (x^2 = 0.02) or March (p<0.001), respectively (Table 3). Higher contamination of packaged salads with *T. gondii* was noticed in Summer and for *G. dudendalis* greater occurrence was in Spring and Autumn (Caradonna et al., 2017). El Said Said (2012) reported higher parasitic contamination in Spring and Summer than in Autumn or Winter. We also found that leafy vegetables have significantly higher probability for contamination in June in comparison to March (p=0.041, McNeimar test). While we found no correlation with the rainfall for respective months for the study area, it is visible that highest rainfall was measured in June (Table 3). We presume that increased precipitation facilitated the dispersal of parasites, therefore increasing the number of contaminated samples. The connection between increased rainfall and parasite transmission was reported in numerous studies (Hunter, 2003; Patz et al., 2000; Sterk et al., 2013).

Table 3. Prevalence of cysts in vegetable samples and ready-to-eat salads from March to June 2018

Month	Precipitation (mm)	No. C.	Total No.
March	83	0	19
April	21	0	14
May	26.7	1	13
June	126.8	15	7

No. C.: Number of cysts detected in analysed samples
Total No.: Total number of examined and contaminated samples and percentage of contamination

Conclusions

Our data is the first report of parasite presence in vegetables from retail markets and fresh food markets from the area of Osijek. Consumption of tested

samples of vegetables can be potentially hazardous, and of special concern are ready-to-eat salads because the customers are instructed that no washing prior consumption is needed (written on the package). More promotional activities by the local health providers are needed to increase consumer awareness of potential health-related hazards of consumption of uncooked vegetables.

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MANGANESE POLLUTION IN AGRICULTURAL SOILS WITH IMPLICATIONS FOR FOOD SAFETY

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Summary

Introduction and objective: Manganese (Mn) is an essential element for the plant and it is necessary for maintain physiological processes, notably photosynthesis, but its higher content in the soil may negative affect the plant, and consequently human health. The objective of this study was to examine the Mn accumulation in edible parts of tested food crops growing on soils near two Mn ore deposits in Bužim municipality (active Mn mine Bužim and Mn ore deposits Radostovo). *Methods:* Atomic Absorption Spectroscopy (AAS) was used to determine Mn content in soils and edible parts of different food crops; onions, cabbage strawberry, garlic, potato, pepper, beans and raspberry. *Results:* The content of Mn available forms, and accumulation in edible parts of examined food crops was significantly higher in soils in the area around Mn mine Bužim although the content of the total Mn in the soils at the site Radostovo were much higher. Considering that soils in the area around Mn mine Bužim are much more acidic than soils at the site Radostovo, it is evident that soil pH is one of the key factors in the assessment of Mn availability in soil. The results of study also showed that the content of Mn in edible parts of all tested food crops did not exceed the toxic value for Mn in plants (400 mg/kg). *Conclusions:* From the point of view of soil pollution with Mn, both examined sites can be considered suitable for production of healthy food.

Keywords: ore deposits, fruits, vegetables, health

Introduction

Bužim is a town and municipality situated in the northwestern part of Bosnia and Herzegovina. Agriculture plays a strategic role in the process of economic development of this municipality, which is largely a result of the existing climatic and pedological features that provide favorable conditions for different types of agricultural production.

The wide geological diversity, diverse range of lithologies, and the peculiar hydrological conditions resulted in pronounced pedosphere heterogeneity in this area, with the accentuated representation of the following soil types: eutric cambisol, kalkocambisol, kalkomelanosol, rendzina, and in lowland areas hydromorphic soil (Čićić and Bašagić, 2001).

These soils, with their physical, chemical and biological properties, represent the appropriate medium for the cultivation of food crops, but the success of plant growth on them largely depends on the mineral composition of the lithological structure i.e. the parent material on which these soils are formed. The lithological structure is highly complex at the area of Bužim municipality (Čićić, 2002). In the complex formations of that parent material characterized by limestones, dolomites, and the basic igneous rocks there are also Mn ore deposits that greatly affect the chemical properties of the soil, and thus the possibility of cultivating food crops. At the area of Bužim municipality, there are few large deposits of Mn ore, and the largest among them is active Mn mine Bužim in the local community Vrhovska, located approximately 8 km northeast of the Bužim town.

Mn is essential for many plant functions, particularly for photosynthesis as part of the structure of photosynthetic proteins and enzymes playing an important role in water-splitting system of photosystem II (Mousavi et al., 2011), and for antioxidant defense system in plants as an enzyme antioxidant-cofactor (Millaleo et al., 2010). Contrarily, the excess of Mn in plants resulting in a reduction of biomass and photosynthesis, and biochemical disorders such as oxidative stress (Lei et al, 2007).

Given the above, the objective of this study was to examine the Mn accumulation in edible parts of tested food crops growing on soils near two Mn ore deposits in Bužim municipality.

Materials and methods

Study area

The experiment was carried out during 2018 at two sites in the Bužim municipality.The first study site was the area around the active Mn ore mine Bužim, located in the local community Vrhovska. At this site, the research involved three soil plots that were located at a very close distance from each other (up to 500 m).

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According to Soil Taxonomy, examined soils were classified as Cambisol (FAO, 1998), and characterized by the following physical properties: medium-texture without gravel and stones, fine crumb structures in the upper horizons that provide good soil aeration, permeability and water-holding capacity in root zone. The depth of the arable soils profile was 30 - 40 cm, and the food crops sampled on these soils were as follows: *Allium cepa* L. (onions), *Rubus idaeus* L. (raspberry), *Brassica oleracea* L. var. *capitata* (cabbage) and *Fragaria viridis* Weston (strawberry).
The second study site included three soil plots near the Mn ore deposits Radostovo, located approximately 1 km northeast of the Bužim town. According to FAO Soil Taxonomy, examined soils were classified as kalkocambisol, and characterized by the following physical and chemical properties: moderately fine texture, good water-holding capacity, neutral to slightly acidic with good availability of nutrients. The depth of the arable soils profile at this study site was 40 - 50 cm, and the food crops sampled on these soils were as follows: *Allium sativum* L. (garlic), *Solanum tuberosum* L. (potato), *Capsicum annuum* L. (pepper), *Phaseolus vulgaris* L. (young beans) and *Rubus idaeus* L. (raspberry).

Soil sampling and chemical analysis

The soil samples were taken from the tested soil plots before cultivation at a depth of 0 - 30 cm using a soil sampler probe. Average sample from each test soil was prepared by mixing of five individual samples. The chemical analyses of average soil samples were carried out at the laboratory of the Faculty of Agriculture and Food Sciences, University of Sarajevo, and the following parameters were analyzed: soil acidity, humus content, content of available forms of phosphorus (P_2O_5) and potassium (K_2O), as well as the most important parameter: the amount of total and available forms of Mn in the soil.
Soil acidity was determined by pH meter in accordance with ISO 10390 method (ISO, 2005), humus content by sulfochromic oxidation method (ISO, 1998), content of available forms of potassium and phosphorus by AL - method (Egner et al., 1960), and the total and available forms of Mn by atomic absorption spectrophotometer (AA-7000, Shimadzu, Japan) according to the instructions specified in the ISO 11047 method (ISO, 1998).

Extraction of total Mn from soil

Extraction of total Mn from the soil sample was carried out using aqua regia solution in accordance with ISO 11466 method (ISO, 1995) as follows: 3 g of the air-dried soil was placed in 250 ml round bottom flask, 28 ml of aqua regia (21 ml 37% HCl and 7 ml 65% HNO_3) was added and then the flask was covered with a watch glass and allowed to stand 16 h (overnight) in the digester. After, the flask with mixture was heated on hotplate under reflux for 2 h, cooled to room temperature, and after the mixture was filtered through quantitative filter paper into 100 ml flask and diluted to the mark with deionized water.

Extraction of available forms of Mn from soil

The extraction of available forms of Mn was performed using the EDTA solution (Trierweler and Lindsay, 1969) as follows: 10 g of air-dried soils were placed into 100 ml plastic bottle then 20 ml EDTA solution (0.01 mol dm^{-3} ethylenediaminetetraacetic acid (EDTA) and 1 mol dm^{-3} $(NH_4)_2CO_3$, adjusted to pH 8.6) was added. The bottle was shaken 30 min in an orbital shaker at 180 rpm, then the mixture was filtered through quantitative filter paper into 25 ml flask and diluted to the mark with deionized water.

Plant sampling and analysis

Edible parts of plants from the examined soil plots were collected at the stage of commercial maturity in a quantity of approximately 300 g for each food crops. The content of Mn in the dry plant samples was also determined by atomic absorption spectrophotometer (AA-7000, Shimadzu, Japan) according to method ISO 11047 (1998).
Previous extraction of Mn from the plant samples was performed using HNO_3-H_2SO_4 solution (Lisjak et al., 2009) as follows: 1 g of dry matter was placed into 100 ml round bottom flask, and 10 ml 65% HNO_3 and 4 ml 95-98% H_2SO_4 were added. The flask was covered with a watch glass, allowed to stand for few hours in the digester and then heated gently on a hot plate for 30 min. After cooling to room temperature, the mixture was filtered through quantitative filter paper into 50 ml flask and diluted to the mark with deionized water.

Statistical analysis

All measurements were done in triplicate. Statistical analysis was performed using Microsoft Excel 2016 and differences between means were tested using the least significance difference (LSD) test at $P < 0.05$.

Results and discussion

A summary of soil chemical properties near the active Mn mine Bužim and Mn ore deposits Radostovo is given in Table 1.

Table 1. Soil chemical properties at the examined sites

Parameter	Active Mn mine 'Bužim'			Radostovo			$LSD_{0.05}$
	Soil 1	Soil 2	Soil 3	Soil 1	Soil 2	Soil 3	
pH H_2O	5.8^{d}	5.9^{d}	6.0^{d}	7.1^{ab}	7.0^{abc}	7.2^{a}	0.41
pH KCl	5.0^{d}	5.2^{d}	5.1^{d}	6.4^{a}	6.2^{abc}	6.3^{ab}	0.43
Humus (%)	1.88^{abc}	1.92^{ab}	1.98^{a}	1.57^{e}	1.67^{de}	1.72^{d}	0.14
P_2O_5 (mg/100 g)	1.53^{d}	1.78^{d}	2.12^{d}	16.94^{a}	12.11^{b}	11.87^{bc}	2.08
K_2O (mg/100 g)	9.7^{d}	11.3^{d}	9.7^{d}	13.1^{bc}	16.11^{ab}	18.12^{a}	3.14
Total Mn (mg/kg)	1072.3^{d}	1011.5^{d}	1043.6^{d}	1914.9^{ab}	1998.1^{a}	1897.3^{abc}	254.2
Available Mn (mg/kg)	27.57^{a}	24.11^{b}	23.65^{bc}	19.78^{d}	18.97^{d}	19.11^{d}	2.67

Each value is a mean of three replicates. Different letters in each column represent significant difference ($P<0.05$)

The soils near the active Mn mine Bužim were acidic, with low content of available forms of phosphorus and potassium. Contrarily, the soils at the site Radostovo had higher pH pH (in H_2O 7 or slightly above), and moderate levels of available forms of phosphorus and potassium. The content of organic matter in all examined soils was moderate i.e. in the same categorization according to Egner et al. (1960). In accordance with results of soil chemical analysis, for all investigated soil plots were made appropriate nitrogen-phosphprus-potassium (NPK) fertilizers recommendation, which were carried out during food crops cultivation.

In the present study, the total Mn content of soils in both examined sites was above the average Mn content of 437 mg/kg dry mass reported by Kabata-Pendias and Pendias (2001). Kastori et al. (1997) noted that total Mn in the soil usually ranges from 200 to 2000 mg/kg, while some scientists mentioned lesser or higher values for the Mn content in the soil, from 134.79 to 247.62 mg/kg as reported by Shah et al. (2013) and 2500 mg/kg as reported by Pavilonis et al. (2015) respectively.

According to Škorić (1991), the content of Mn in soils differs considerably, primarily depending on the parent material from which soils have developed through the processes of pedogenesis. He also reported that Mn is more present as mineral in metamorphic and igneous rocks, and less in sedimentary rocks.

Although the high Mn presence in the soil may have a negative effect on the plants, and thus on humans (Gupta and Gupta, 1998), the legislature in Bosnia and Herzegovina does not establish the limit value of Mn which would indicate the pollution of soil by Mn, primarily because Mn is not considered as health hazard element. Regardless of the fact that this issue is not regulated, the value of 1000 mg/kg among scientists is taken as the permissible value for the Mn content in agricultural soils (Vukadinović i Lončarić, 1998).

As shown in Table 1, Mn total content of soils in both examined sites was higher than the previously mentioned limit value, and that was expected since the examined soil plots were located near the Mn ore deposits. These results indicate that all examined soils in this study have the potential to contaminate the agricultural crops with Mn.

If compared the results of total Mn in soils between studied sites it can be observed that the content of total Mn in soils at the site Radostovo was almost twice higher than the content of total Mn in soils around Mn mine Bužim, but the content of available forms of Mn in these soils were lower. These data suggest that Mn dynamics in soils is very complex, and that the higher content of the total Mn in the soil does not automatically mean the increased availability of Mn and thus toxicity to plants (Rengel, 2015).

Xiang and Banin (1996) reported that the Mn availability to plants is regulated by different factors, most notably the redox potential and soil pH. Namely, the release of most available Mn forms (Mn^{2+}) from Mn oxide minerals is much more pronounced in acid soils and under anaerobic conditions (Vukadinović and Vukadinović, 2011). As shown in Table 1, results related to pH value confirm the previously mentioned hypothesis that the soil pH greatly affects the availability of Mn in soil. Namely, the soils near the active Mn mine Bužim had significantly lower pH compared to soils at the site Radostovo, but also higher content of available forms of Mn, although the content of the total Mn in the soils at the site Radostovo were much higher, indicating that the Mn availability increases with the decrease of pH value (Marschner, 1995). The availability of Mn in neutral and alkaline soils is significantly reduced due to the formation of hard soluble Mn oxides, hydroxides and salts (Dučić and Polle, 2005; Khabaz-Saberi and Rengel, 2010). Vukadinović and Lončarić (1998) reported that the high presence of cations Ca^{2+} and Mg^{2+}, and higher Zn and Cu content in soils also negatively affect the Mn availability to plants, while Fageria at al. (2002) noted

that the Mn phytoavailability increases in conditions when oxygen is depleted from the growing medium as result of waterlogging or very high organic matter content in soils.

The availability of Mn in soil also largely depends on the physical properties of the soil (Bradl, 2004). Millaleo et al. (2010) reported that the deficiency of Mn is particularly pronounced in sandy soil where the prevailing aerobic conditions, while in heavy soils Mn availability is generally higher, and such observations were also mentioned in numerous other studies (Kogelmann and Sharpe, 2006; Sharma et al., 2016).

It is assumed that medium-texture of soils around the active Mn mine Bužim with dominance of silt and less air space contributed to higher Mn solubility and thus their availability for plants.

In addition, uptake of Mn and generally heavy metals by plants root, as well as their accumulation in the edible parts of food crops is also dependent on plant genetic potential (Sajwani et al., 1996).

The content of Mn in edible parts of food crops that have been grown in soils near the active Mn mine Bužim and Mn ore deposits Radostovo is given in Table 2 and 3.

Table 2. Mn content in edible parts of food crops grown on soils near the Mn mine Bužim

Plant species	Mn content (mg/kg dry mass)
strawberry	26.23 ± 2.02^{a}
raspberry	24.78 ± 2.11^{ab}
cabbage	24.04 ± 2.66^{abc}
onion	19.31 ± 2.34^{d}
$LSD_{0.05}$	2.289

Values expressed as main ± standard deviation. Different letters in each column represent significant difference (P<0.05)

Table 3. Mn content in edible parts of food crops grown on soils near the Mn ore deposits Radostovo

Plant species	Mn content (mg/kg dry mass)
garlic	5.34 ± 0.26^{c}
pepper	6.89 ± 3.45^{c}
young beans	10.42 ± 1.81^{ab}
potato	5.45 ± 1.02^{c}
raspberry	12.52 ± 3.00^{a}
$LSD_{0.05}$	2.228

Values expressed as main ± standard deviation. Different letters in each column represent significant difference (P<0.05)

As shown in Table 2 and 3, the food crops grown on soils near the Mn mine Bužim had higher content of Mn in the edible parts as compared to food crops from soils at the site Radostovo. Considering that soils around Mn mine Bužim had a higher content of Mn available forms, these results were expected. Moreover, Mn content in the fruits of raspberries from these soils was even twice higher in comparison with fruit of raspberry grown in soils at the site Radostovo. The results of the present study also showed that the Mn content in edible parts of strawberry, raspberry and cabbage grown on the soils around Mn mine Bužim did not differ significantly. The exception was only the onions, where the content of Mn was significantly lower compared to all other tested food crops. Interestingly, the lowest Mn content at the other studied site (Radostovo) was determined in edible parts of garlic. These results lead to the conclusion that some plants such as garlic or onions have evolved mechanism to translocate the high amont of Mn to upper part of plant or to reduce Mn entry into the plant roots which may also represent some adaptive mechanisms of plant to stress caused by high Mn content in soil.

Angelova et al. (2003) studied the absorption of heavy metals at several food crops (beans, lentils, chickpeas and soybeans) and they observed that the examined species, grown under the same agroecological conditions, differed considerably in their ability to absorb heavy metals from soil. Also, many scientists have found significant differences in the content of Mn and other heavy metals in different parts of the same plant (Cataldo et al., 1981; Guala et al., 2010; Skorbiłowicz et al., 2016). The data from the scientific literature indicate that Mn mostly accumulates in leaves, then in roots, and much less in the stem and fruits of plants (Goor and Wiersma, 1974; Page et al., 2006).

The results of this study also showed that the accumulation of Mn in edible parts of all tested food crops was not even close to the critical limit value for Mn in the plant, which according to Kastori (1993) is 400 mg/kg of dry mass.

Conclusions

The Mn availability, its absorption and accumulation in edible parts of food crops was considerably higher in acid soils, suggesting that soil pH is one of the key factors in determining the Mn dynamics in the 'soil - plant system'. Since the content of Mn in all tested food crops did not exceed the toxic value for Mn in plants, both examined sites from the point of view of contamination of the soil with Mn can be considered suitable for production of healthy food.

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DIFFERENCES IN CONSUMPTION OF MILK AND DAIRY PRODUCTS IN ADOLESCENT DIET ACCORDING TO THE GENDER AND THE PLACE OF RESIDENCE

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original scientific paper

Summary

There is accelerated growth in adolescence, increase of muscle mass, the maturation and increased physical activity. Milk is a complete food which contains many nutrients and meets needs for calcium, magnesium, selenium, riboflavin, vitamins B12 and B5. The protein in cow milk is of high-quality (defined as protein that supports maximal growth), containing a good balance of all the essential amino acids, including lysine. Because of the above mentioned a survey has been conducted about the consumption of milk and dairy products among adolescents in the Canton of Sarajevo. The study included 630 participants, 60 boys and 73 girls from the rural and 264 boys and 233 girls from the urban part of the Canton of Sarajevo. The participants were 13-15 years old. The used questionnaire is classified as a semi-quantitative, which involves the amount and the frequency of consumed foods and which represents a modified questionnaire used in a similar research among adolescents in the Canton of Sarajevo. The data were statistically analyzed using SPSS 22.0. The results by the place of residence show that milk consumption is more present in urban rather than in rural areas. The quantities of milk/yogurt/cheese and the living area are statistically independent. When considering the gender and the place of residence, the test has showed that there is a difference in the distribution of daily quantity of consumed milk between urban and rural areas, within adolescent girls. Taking into account only the gender, adolescent boys more frequently consume milk and dairy products than adolescent girls.

Keywords: adolescents, gender, place of residence, consumption of milk/dairy products, growth and development

Introduction

There is an accelerated growth in adolescence, the increase of muscle mass, the maturation and increased physical activity. Physical activity doesn't have to be increased but total energy needs are higher because of a bigger body size. With higher energy, there is needs also needs in protein, vitamins and minerals increase. During adolescence, 50.0% of weight and 20.0% of height is gained (Spear, 2002). Monitoring of nutrition and the nutritional category of children and adolescents is a good indicator of the nutritional state of the community (Eveleth & Tanner, 1990). If adequate nutrition is not achieved in this period of life, there is the potential postponement of sexual maturation and lower linear growth (Story, 1992). Monitoring of growth and development enables the evaluation of body development individually and it also serves for tracking trends according to the effect of ecological factors during the specified time period (Eveleth & Tanner, 1990; Antonić-Degač, 1999). Regarding the world level, there are big differences in height, weight and age of puberty among individual populations. The genetical growth factor is similar for the most people and the existing differences are more the result of the effect of ecological factors (Eveleth & Tanner, 1990). The research shows hat differences in height and weight of children with different ethnic origin are relatively small according to the differences among children of different social class (Buzina, 1977; Matsumoto, 1982).In European countries, the highest boys and girls are in Netherlands and Sweden. The height increase follows the increase of body mass (Eveleth & Tanner, 1990; Prebeg, 1994).

Hormonal changes in adolescence have an effect on characteristical changes in body size, body composition (muscles, bones, fat), skeleton and sexual maturation. Those changes are basis of increased needs for nutrients at that age. Unlike children's adolescents' nutrient needs are different according to gender and it continues in the adult age (Stanga et al., 2005).

Adolescents have special nutritive demands because of the rapid growth and maturation linked to the onset of puberty. The research related to the nutrition shows that adolescents do not take

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adequate amount of folats, calcium, iron, zinc, magnesium, vitamins A, E, B1, B2, B6 (Skiba et al., 1997; Stallings, 2006). Dietary fiber intake is also very low.

Cca. 99.0% of calcium in the body is in the bones and teeth. The adequate calcium intake during childhood and adolescence is important for proper mineralization of bones, gaining the bone mass and reducing the risk of one fracture and osteoporosis in adulthood (Food and Nutrition Board, IOM, 2011). Certain vegetables and cereals are also rich in calcium but their availability is lower than in dairy products. In the case of not being able to reach the recommended intake of calcium, it is necessary to use supplements alog with the proper nutrition, also the intake of other nutrients can be achieved in that way (Kaplan Seidenfeld et al., 2004).

One of the most significant predictors of food behaviour in adolescence is the place of residence, i.e. wheter the adolescents live in the urban or in the rural area (Hodgkin et al., 2010; Wang et al., 2002). Urbanization is an inevitable outcome of the economic behaviour and it refers to the transition from the rural society to another one which most of the population lives in the cities. The pozitive relation between the economic prosperity and urbanization is strong and often demonstrated. Eating patterns are often dependent on the urbanization status and linked to the urban-rural differences in health and nutritional status (Holmboe-Ottesen, G., 2000; Popkin et al., 1993; Popkin, 2001; Yamauchi et al., 2001). However, this trend is not uniform. There are reports about the higher intake of energy, fat and micronutrients among the rural population (Mennen et al., 2000; Mazengo et al., 1997), the typical trend of the increased lipid and calorie intake and the reduction of micronutrient intake which comes with urbanization (Qu et al., 1997; Nakatsuka et al., 1999; Qu et al.,2000; He et al.,1996). The rural-urban differences in the micronutrient intake can vary in different parts of the world. Those differences are understandable if urbanization is regarded as a linear phenomenon. The administrative demarcation does not separate population in two homogenous groups and in each official category there are differences in wealth and/or style of life which can make certain groups more urban than the others. In addition, the wealth and cultural background can also intervene to check or promote the adoption of certain components of the urbanized life. Food intake can vary between different urban and rural groups and tendency to the undernutrition does not have to be linked to the urbanization. It is important to identify the specific food inadequacy in any group and to understand differences in different urban and rural groups (Hakeem et al., 2002).

To sum up the aim of the study was to explore if gender and place of residence have an effect on the habit of consuming milk and dairy products among adolescents.

Subjects and methods

The study included 630 participants, 133 adolescents from the rural area (60 boys and 73 girls) and 497 adolescents from the urban area (264 boys and 233 girls) of the Canton of Sarajevo. Participants were 13-15 years old. The distribution of participants is presented in accordance to the demographic data of the Federal Bureau of Statistics of the Canton of Sarajevo (Federalni zavod za statistiku, www.fzs.ba (2013). The research was conducted in twelve primary schools located in nine municipalities of the Canton of Sarajevo during five months (February till June) and the Protocol was approved by the Ministry of Education, Sciences and Youth of the Canton of Sarajevo. Adolescents were introduced to the research protocol and they participated voluntarily. Taking into account that the Urbanistic Studies of the Sarajevo Canton are still undergoing it's development process in the division of the Canton of Sarajevo by the type of settlement (urban and rural area) was done according to the Spatial Plan of the Canton of Sarajevo for the period 2003- 2023 (Zavod za planiranje razvoja Kantona Sarajevo 2006).

The questionnaire used for investigating milk and dairy consumption is classified as a semi-quantitative, which involves the amount and the frequency of consumed foods, and it also represents a modified questionnaire used in a similar research among adolescents in the Canton of Sarajevo previously done by the first author (Taljić, 2015; Hodžić & Smajić, 2012).

Results and discussion

The sample is approximately equally distributed by the gender and the living area.

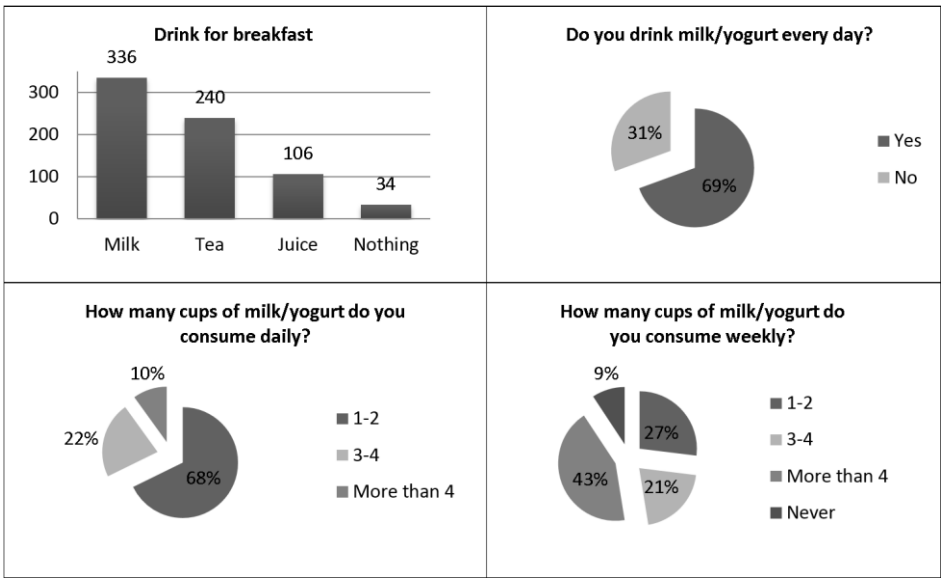

Fig. 1. The structure of the sample according to the habit of consuming milk or yogurt

According to the results shown in Fig. 1, 336 (53%) of adolescents choose milk as a drink for breakfast, while 69% of them consume milk every day. Breakfast consumption is very important and skipping it may cause concentration failure and obesity. Many studies have found higher milk consumption among adolescents who eat breakfast (Bowman, 2002; Ortega et al., 1998). Considering the amount, most of the adolescents (68%) consume 1-2 cups of milk/yogurt every day, while, on a weekly basis most of them (43%) consume more than 4 cups.

Aiming to explore if gender and place of residence have an effect on the habit of consuming milk and dairy products, the differences in patterns and amounts between adolescent boys and girls and between rural and urban areas were tested.

Considering that all of the variables are categorical, chi-square tests of independence or association in the joint responses for two categorical variables were performed (Resić et al., 2010).

Table 1. Consuming milk and dairy products according to the gender

		Boys (%)	Girls (%)	χ^2	*p*-value
Milk for breakfast	Yes	58.3	48.0	6.700	0.010
	No	41.7	52.0		
Milk/yogurt, every day	Yes	74.0	64.6	6.535	0.011
	No	26.0	35.4		
Cups of milk/yogurt, daily	1-2	62.2	74.6	9.887	0.007
	3-4	24.4	19.7		
	More than 4	13.4	5.7		
Cups of milk/yogurt, weekly	1-2	23.2	31.1	10.983	0.012
	3-4	18.8	22.3		
	More than 4	50.0	35.9		
	Never	8.0	10.7		
Cheese, weekly	1-2 times	49.1	55.1	6.547	0.088
	3-4 times	23.5	22.8		
	More than 4 times	15.7	9.2		
	Never	11.7	12.9		

According to the results of the chi-square test (Table 1), there are different patterns in choosing milk for breakfast (p=0.010) and consuming milk or yogurt every day (p=0.011) between adolescent boys and girls. The amounts that adolescent boys and girls consume on a daily (p=0.007) or a weekly basis (p=0.012) are also different. Generally, the adolescent boys more frequently consume milk and dairy products than the adolescent girls. The difference in a weekly habit of consuming cheese, between adolescent boys and girls, is not confirmed (p=0.088).

Table 2. Consuming milk and dairy products according to the place of residence

		Rural (%)	Urban (%)	χ2	*p*-value
Milk for breakfast	Yes	49.2	57.1	3.975	0.046
	No	50.8	42.9		
Milk/yogurt, every day	Yes	61.3	76.7	17.622	0.000
	No	38.7	23.3		
Cups of milk/yogurt, daily	1-2	68.7	67.1	4.061	0.131
	3-4	24.6	20.6		
	More than 4	6.7	12.3		
Cups of milk/yogurt, weekly	1-2	27.2	26.7	2.725	0.436
	3-4	23.0	18.0		
	More than 4	41.8	44.8		
	Never	8.0	10.5		
Cheese, weekly	1-2 times	53.9	50.3	5.228	0.156
	3-4 times	20.5	25.5		
	More than 4 times	11.1	13.9		
	Never	14.5	10.3		

The independency between the consumption of milk or yogurt and the living area was also tested. he results indicate that there are statistically significant differences between the urban and the rural areas in choosing milk for breakfast and the consumption of milk or yogurt every day (p=0.000). In both cases, milk consumption is more present in the urban rather than in the rural areas. The quantities of milk/yogurt/cheese and the living area are statistically independent (Table 2).

Table 3. Consumption of milk and dairy products according to the place of residence (Boys)

		Rural (%)	Urban (%)	χ2	p-value
Milk for breakfast	Yes	53.2	63.1	3.225	0.071
	No	46.8	36.9		
Milk/yogurt, every day	Yes	65.8	81.5	10.381	**0.001**
	No	34.2	18.5		
Cups of milk/yogurt, daily	1-2	63.6	65.2	4.762	0.092
	3-4	27.1	18.7		
	More than 4	9.3	16.1		
Cups of milk/yogurt, weekly	1-2	21.9	24.5	3.103	0.376
	3-4	21.9	15.8		
	More than 4	50.4	49.6		
	Never	5.8	10.1		
Cheese, weekly	1-2 times	55.8	42.9	6.831	0.077
	3-4 times	18.6	28.0		
	More than 4 times	13.4	17.8		
	Never	12.2	11.3		

The independency of the amount of consumed dairy products and the place of residence lead to the idea of testing the relation between the place of residence and habits of dairy product consumption within groups of boys and girls, separately (Tables 3 and 4). The test has shown that there is a difference in the habit of consuming milk/yogurt every day among boys living in a different place of residence (Table 3). The test has also shown that there is a difference in the habit of consuming milk/yogurt and in the distribution of a daily quantity of the consumed milk between urban and rural areas, in regard to the adolescent girls (Table 4). In the study made by Colić-Barić et al. (2001), the girls from the rural area consumed milk less on daily basis than the urban adolescents and the rural boys.

Table 4. Consumption of milk and dairy products according to the place of residence (Girls)

		Rural (%)	Urban (%)	χ^2	p-value
Milk for breakfast	Yes	44.8	50.9	1.160	0.281
	No	55.2	49.1		
Milk/yogurt, every day	Yes	56.3	71.8	7.911	**0.005**
	No	43.7	28.2		
Cups of milk/yogurt, daily	1-2	87.1	71.8	9.612	**0.008**
	3-4	11.9	20.6		
	More than 4	1.0	7.6		
Cups of milk/yogurt, weekly	1-2	33.1	29.1	1.603	0.659
	3-4	24.2	20.5		
	More than 4	32.2	39.4		
	Never	10.5	11.0		
Cheese, weekly	1-2 times	51.8	58.0	4.216	0.239
	3-4 times	22.7	22.8		
	More than 4 times	8.5	9.9		
	Never	17.0	9.3		

Conclusions

The results show that half of the participants have a habit of consuming milk and choose it as a breakfast drink. On a daily basis, milk/yogurt is consumed in 1-2 cups and on a weekly more than 4 cups. Generally, adolescent boys more frequently consume milk and dairy products than adolescent girls. Statistically significant differences are shown between the urban and the rural areas in choosing milk for breakfast, especially if we take into account the urban area. When it comes to testing the relationship between the place of residence and the habits of dairy product consumption within groups of boys and girls separately, the test has shown that there is a difference in the habit of consuming milk/yogurt in both genders and in the distribution of a daily quantity of the consumed milkbetween the urban and the rural adolescent girls.

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ENTERAL NUTRITION OF PATIENTS WITH PERCUTANEOUS ENDOSCOPIC GASTROSTOMY

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original scientific paper

Summary

Nutrition and the intake of necessary nutrients is the basic need of every organism and indispensable for normal functioning of every living creature. The problem arises if there are constraints or inability to adequately take in food to meet all the nutritive needs of the organism and thus the risk of the development of malnutrition. In such situations, enteral nutrition practices are often used as an artificial feeding method, and if the need for such nutritional support is longer-lasting, it is advisable to set an indication for placement of percutaneous endoscopic gastrostomy (PEG) as one of the most effective ways of enteral nutrition. This is the procedure where a specially adapted probe is placed through the abdominal wall directly into the stomach. Applications are numerous, and given that this is a long-term artificial nutrition method, it is most often used in chronic, neurological or oncological patients. The aim of this paper is to demonstrate the importance of adequate enteral nutrition as the main segment in prevention and treating malnutrition. In particular, specificities of enteral diet via PEG are presented as the most effective and safest method of artificial nutrition, which is accompanied by the results of the monthly monitoring of the nutritional status and the manner of feeding, as well as the clinical status of the person with PEG. In this case report results were compared before and after implantation of PEG.

Keywords: enteral nutrition, malnutrition, percutaneous endoscopic gastrostomy

Introduction

The importance of optimal nutrition has been declared since the time of the Hippocrates, who said that "medical science would not have been discovered or found and would not become the subject of research if the same dish and drink were appropriate to a sick and healthy man" (Živković, 2002). In patients who cannot eat enough or at all orally to satisfy all the nutritional needs of the organism for macronutrients and micronutrients, we turn to enteral diet, as you can see in Fig. 1 (De Bruyne et al., 2008).

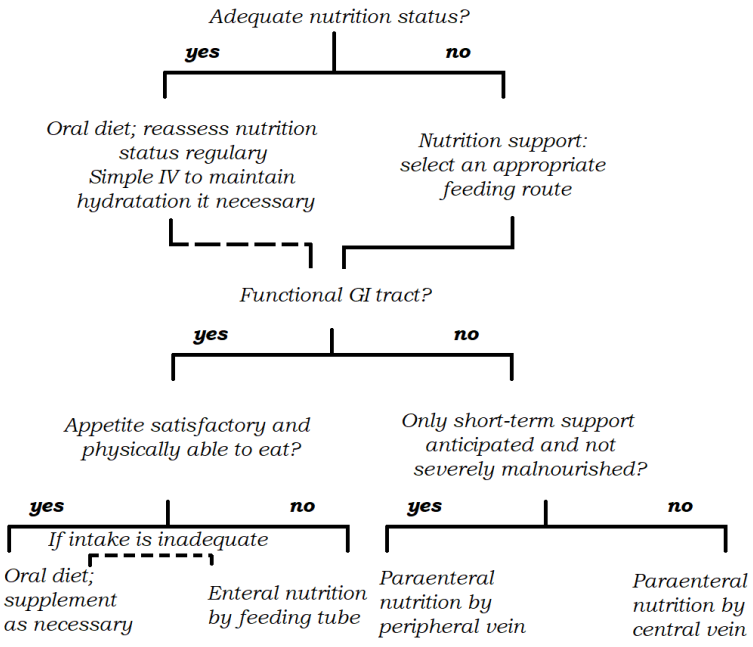

Fig. 1. The feeding options depending on nutrition status of patient, scheme (De Bruyne et al., 2008)

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This enteral diet involves the intake of food and/or commercial nutrient supplement using nutritional probes in stomach, duodenum or jejunum. In Fig. 2 and Fig. 3 the percutaneous endoscopic gastrostomy on patient and the feeding procedure is documented.

Fig. 2. Thepercutaneous endoscopic gastrostomy on patient (author, 2018)

Fig. 3. Feeding by percutaneous endoscopic gastrostomy (author, 2018)

There is a possibility of parenteral nutrition for these patients, but almost always when it is possible, the advantage is in the enteral feeding mode. The main precondition is structurally (at least 100 cm of small intestine) and a functional digestive system (Krznarić, 2006), and the main postulate of clinical nutrition today is: "If the intestine is in function, use it (Štimac et al., 2014)". Today, a wide range of finished enteral preparations is available, which can be used by oral intake, but also can be applied by different types nazoenteral tubes via percutaneous endoscopic gastrostoma (PEG) (Blumenstein et al., 2014). Numerous studies that validated enteral nutrition by nasogastric probes and PEG, gave PEG superiority, as it provides greater nutrition energy utilization and preserving albumin levels a longer period of time (Zalar et al., 2004; Kumagai et al., 2012; Cristian et al., 2015). PEG is a safe method with a lower risk of aspiration and aspiration pneumonia and is associated with a higher survival rate (Kumagai et al., 2012). The use of nasogastric probe is associated with a greater number of complications and greater need for re-insertion of the probe (Blumenstein et al., 2014). One of the studies,

comparing the patients with nasogastric probe and patients with PEG, shows that there is three times the probability of aspiration pneumonia in patients with nasogastric probe (Azzopardi and Ellul, 2013). Older age, neurological disorders and cerebrovascular diseases also increase the risk of aspiration pneumonia (Patel and Thomas, 1990). Except from hospitalized patients, PEG can be applied at home – Home Enteral Tube Feeding (HETF), which has been steadily increasing over the past few years (Ojo, 2012; Madigan et al., 2002). One of the most common reasons for introducing enteral nutrition is malnutrition, which is defined as a nutritional status disorder due to reduced or excessive intake of nutrients (Cederholm et al., 2019; Živković, 2002). The first step in evaluation of nutritional status of patients and detect individuals with a tendency to develop nutritional deficit / malnutrition is malnutrition risk screening. It is a simple and fast procedure using the one of a validated screening tool known as Nutritional Risk Screening (NRS, 2002) (Kondrup et al., 2003). The final diagnosis of malnutrition is defined by clinical examination according to the Cederholm et al. (2019), anamnestic and heteroanamnestic data of the patient and several diagnostic criteria such as unintended weight loss, low BMI, inadequate food intake, loss of muscle mass and low FFMI (Fat Free Mass Index). Calculation of BMI is based on body mass and body height; BMI is the body mass ratio in kilograms and body height in meters and it is the indicator of the degree of nutrition. (WHO, 2019) Values of recommended BMI are the same for both sexes, ranging from 18.5 to 24.9 kg / m2 according to the World Health Organization's Classification for the European Population.

Any unintended change in body mass is important and the cause must be determined. Loss of 5% of body weight indicates a mild, and more than 10% of a serious nutritional and health problem (Štimac et al., 2014). If an enteral diet is planned for more than three weeks or if there are conditions in the patient status that include disabled swallowing and food intake due to oropharyngeal and esophagus dysfunction / stenosis / obstruction, PEG insertion is the main priority. If there is no local tissue reaction, such as redness, swelling or nausea, diarrhea, vomiting, abdominal pain and cramps, after localization of PEG, the planned dietary enteral diet can be started after 24 hours after the PEG implementation. In hospitals and clinics, patients are educated about care of PEG, feeding by PEG and other relevant data. After they go home, the multidisciplinary team of primary health care provides necessary support, although the necessary clinical control and evaluation of PEG (Madigan et al., 2002).

Methods

In this paper it is used the case study method. It is used the analysis of documents, interviews of medical staff and observation. Since it was a person with mental disabilities, the informative written consent to the study and the publication of the work was given by the legal guardian of the patient. In the end results before and after were compered.

Case study

N.N. is female, 54 years old, lives in Home for persons with physical, intellectual or sensory disability. Her diagnoses are psychomotor retardation, secondary epilepsy and secondary dysphagia with implanted percutaneous endoscopic gastro stoma on October 13, 2016. She has a history of hypothyroidism, osteoarthritis, and thoracolumbar scoliosis.

Status (November 2017)

In consciousness, partially oriented, poor verbal contact according to the nature of the illness (provides only basic information about herself, whether yes or not), immobile, all physiological needs are performed in bed with the maximum help of medical staff, slowed down, the muscular strength of both arms reduced. Body height 174 cm, body weight 62.7 kg. In the previous months there was a constant decrease in body weight (Fig. 4). From heteroanamnestic data of a nurse from her home, it is known that the person is otherwise calm, cooperative, occasionally has epilepsy attack and because of these she has been hospitalized several times at University Hospital Centre where she takes regularly control at the Center for Epilepsy.

Clinical status and course of treatment

From her medical documentation (March, 2015) she was hospitalized several times in the General Hospital due to repeating aspiration pneumonia with acute respiratory insufficiency, poorly general condition and somnolence. She was mainly fed *per os* with the porridges and hydrated by tea or water. During hospitalization she was fed by a nasogastric probe. This method is continued by releasing home until the satisfactory oral intake. The tube was occasionally placed during noncooperation and food rejection. In diet are introduced enteral supplements (4 x 200 mL = 1000 kcal) plus hydration / water / tea / juice (1000 mL) by using a bolus feeding method.

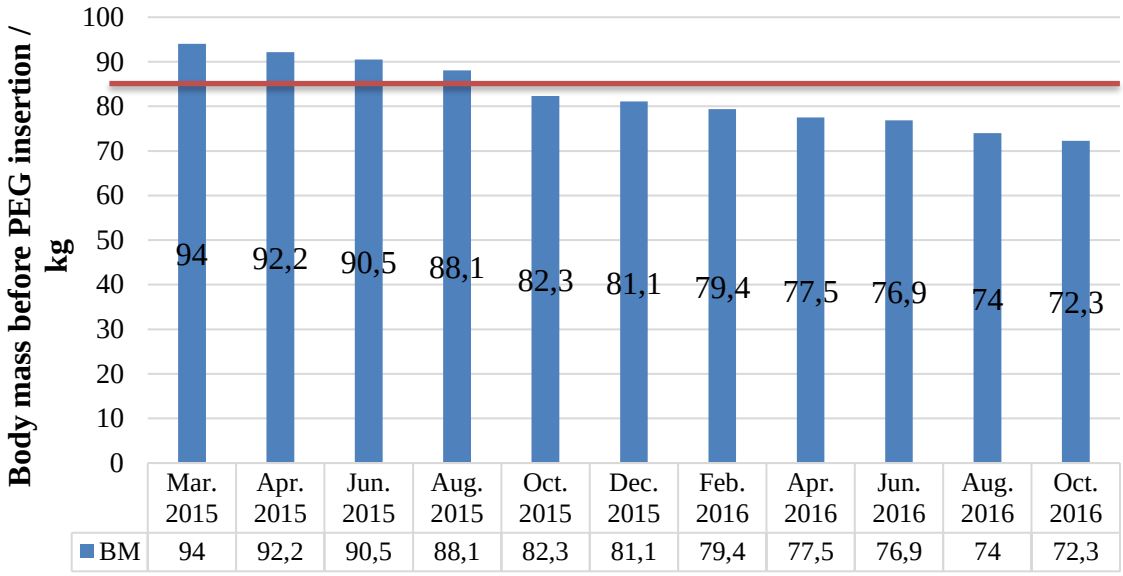

Fig. 4. Body mass (BM) tracking from 3/2015 to 10/ 2016, the red line indicates loss of 10 % of body weight (author, 2018)

When she was placed to Homefor persons with physical, intellectual or sensory disability, her body weight at the beginning of March 2015 was 97.6 kg (BMI 32.2 kg/m^2 - 1st degree of obesity) and after first hospitalization at the end of March was 94 kg (BMI 31 kg/m^2 - 1st degree of obesity). Further data on body mass were obtained from a home monitoring list whose measurements were carried out every two months according to their own regular protocol. According to the Fig. 4 from March 2015 to September 2016, there is a permanent loss in body weight. The total weight loss in the 19-month period was 25.3 kg, which is a loss of almost 26% of the total body mass. The patient was predominantly fed *per os* with porridges and by nasogastric probe performed by nurse. According to body weight monitoring results, such an intake did not satisfy the nutritional needs of the body. Visible continuous loss of body mass, risk of continuity of the same and development of protein energy malnutrition (PEM), relapses of aspiration pneumonia, increasingly severe oral deficiency, to a person for the purpose of ensuring long-term enteral intake, on October 13, 2016 was implanted percutaneous endoscopic gastrostoma, Freka PEG 20 Fr, and on February 9, 2018, a person receives a transmissible pump for enteral nutrition with associated enteral systems. Home porridges were replaced by the factory enteral formulation.

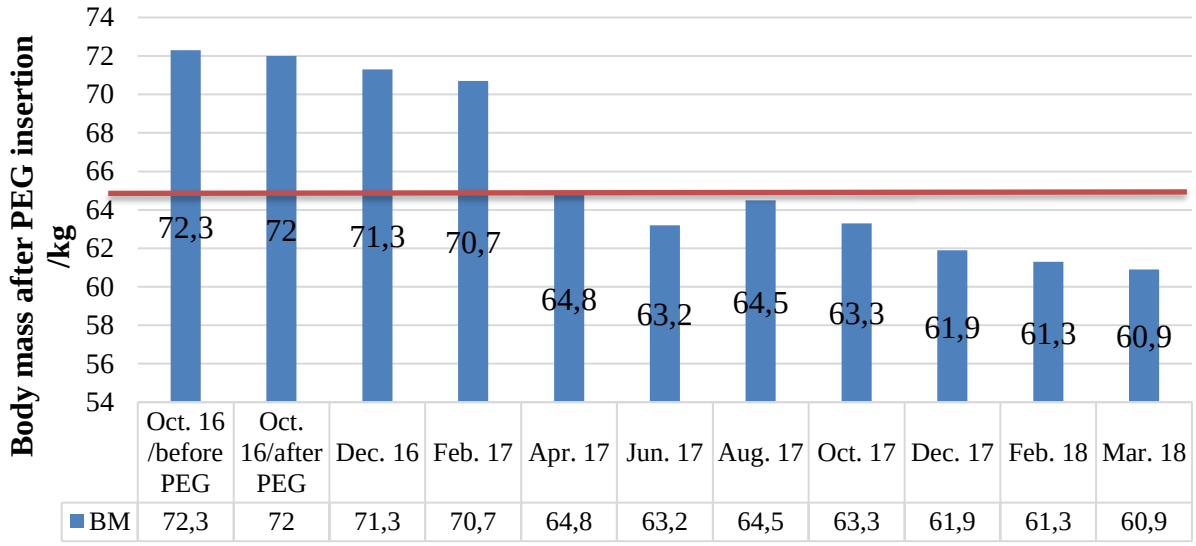

Fig. 5. Body mass tracking by PEG insertion until March 2018, the redline indicates loss of 10 % of body weight (author, 2018)

Body mass in October 2016 was 72.3 kg. After the PEG implantation and patient return from hospital on October 14, 2016, the body weight was 72 kg (BMI 23.8 kg/m^2 - normal body weight). The total weight loss from PEG implantation up to March 2018, for 17 months, was 11.4 kg, which is 15.7 % of total body mass (Fig. 5).

Discussion and conclusion

According to Fig. 6 and Fig. 7, there is a continuous body mass deficiency, but comparing the figures it is important to point out the difference in body mass loss that significantly deviates. Before the PEG implantation, a person lost 25.3 kg (26%) in the 19-month period. The weight loss ranged from 0.6 kg to 5.8 kg with the highest losses after hospitalization with an average loss of 2.3 kg. After PEG implantation, there is still a noticeable decrease in body weight although for a shorter period of time, namely 17 months, but a significantly smaller one. The weight loss was 11.4 kg or 15.7%. The weight loss range was from 0.3 kg to 5.9 kg with an average loss of 1.3 kg but also with one positive result of +1.3 kg. The biggest loss of 5.9 kg was recorded in April 2017 due to the lack of adequate nutritional support regarding the clinical condition of a person - she had consecutive grand mal attacks a few days in row. By providing adequate nutritional support via PEG, loss of body weight was reduced and decreased, risk of dehydration decreased and she was not hospitalized by aspiration pneumonia or respiratory insufficiency as it was the case when she was fed *per os* or by nasogastric probe. The greatest body weight loss is visible due to hospitalization which has been reduced after the PEG has been set up. This body weight differences is not strange since it has also been proven in research that include amyotrophic lateral sclerosis patients who were fed by PEG (Mazzini et al., 1995).

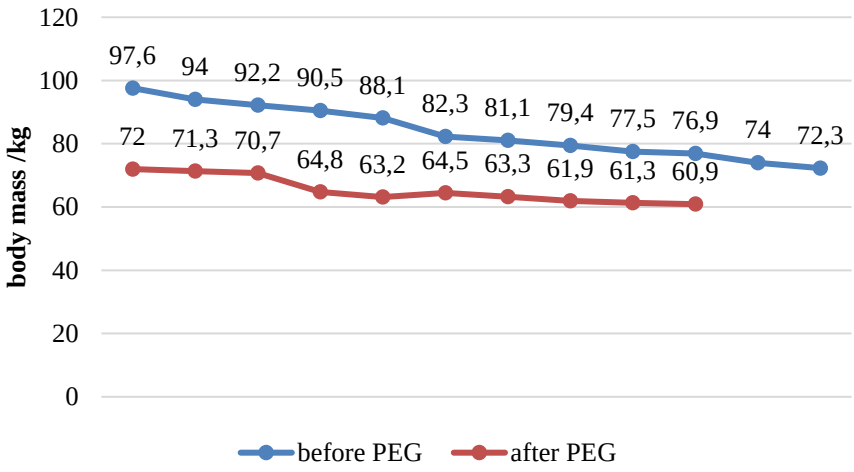

Fig. 6. Comparison between body mass tracking before and after the implementation of PEG (author, 2018)

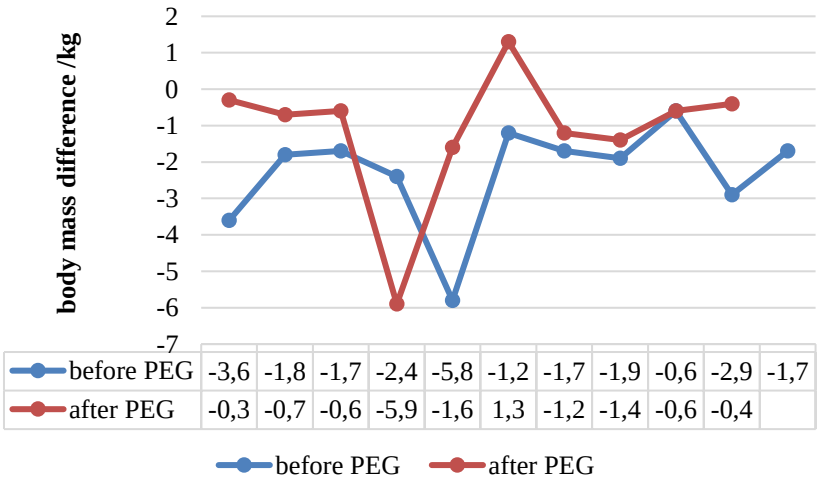

Fig. 7. Comparison between body weight differences before and after the implementation of PEG (author, 2018)

The importance of adequate accommodation in the home, adequate health care and care by an expert, educated staff, as well as adequate, individual access, personalized communication with a person with an existing cognitive deficit provided by nurses has to be prioritized to sustain health in the patient.

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