Dietary practices for older adults in institutional and non-institutional gerontological care: A systematic report of Croatian experiences

Manuela Maltarić[1]*, Darija Vranešić Bender[2], Branko Kolarić[1], Tajana Pavić[3], Jasenka Gajdoš Kljusurić[4]

[1] Andrija Štampar Teaching Institute of Public Health, Mirogojska 16, Zagreb, Croatia
[2] University Hospital Centre Zagreb, Department of Internal Medicine, Unit of Clinical Nutrition, Kišpatićeva 12, 10000 Zagreb, Croatia
[3] Sestre milosrdnice University Hospital Center, Department of Gastroenterology and Hepatology, Vinogradska 29, Zagreb, Croatia
[4] Faculty of Food Technology and Biotechnology, University of Zagreb, Pierottijeva 6, 10 000 Zagreb, Croatia

*Corresponding author: manuela.maltaric@stampar.hr

Abstract

The aging process dictates the daily energy needs of the elderly (aged 65 years and older) and their food intake, which depends on basic physiological needs, physical activity, individual needs of the elderly and many other factors, where monitoring of gerontological public health indicators is extremely important for health protection. This is precisely why this work is focused on reviewing the role and compliance of positive health behavior related to healthy diet of the elderly, geronto-tropometric characteristics of nutritional assessment, assessment of nutritional status via the NRS 2002 web service, assessment of energy needs of the elderly in relation to age, physical activity, morbidity, ratio of intake of macronutrients and micronutrients and the importance of the eight dietary rules for the elderly population. The main causes of mortality in the population aged 65 and over were singled out, and the main dietary norms from the manual "Nutritional-gerontological norms/menus in homes for the elderly and gerontological centers of institutional and non-institutional gerontological care" were singled out. The results state the adequacy of the quality of the menus (according the health status), as well as the importance of compliance with the energy and nutritional needs of the elderly, which will result in a healthy body mass (normal body mass index). Such achievements require an interdisciplinary approach that mainly contributes to the preservation of functional ability, disease prevention and improvement of health and quality of life in old age.

Keywords: healthy diet, interdisciplinary approach; nutritional and gerontological norms; elderly

Introduction

In 2020, the global population aged 65 and older was 728 million, according to United Nations data, and it is expected that in 2050 this figure will reach 1.5 billion (Eurostat, 2022; Kolarić et al., 2020). When the population aged 65 years and older in a country or region exceeds 7% of the total population, one enters an aging society; and when that share exceeds 14%, one enters a deeply aging society, according to UN standards (UN, 2023). It is precisely because of the necessity of overcoming the challenges associated with aging that governments pay great attention to it and undertake a number of initiatives. Thus, in China, as one of the most populated countries, a number of initiatives have been taken, such as: China's medium- and long-term plan for the prevention and treatment of chronic diseases (2017-2025) (State Council, 2017), Action for a healthy China (2019-2030) (State Council 2019) and a draft related to the health management of the elderly: the Healthy China 2030 Plan (Yao et al., 2023), In the West, in the United States of America, the Older Americans Act is in effect (Bangerter et al., 2019). The concept of "the need to care for the elderly" becomes an extremely important factor in the world, because it has been shown that the effective solution to the issue of population aging has a positive impact on society as well (Eurostat, 2022; Chen, 2021). Increased life expectancy is associated with a decrease in physical and metabolic functions and the probability of diseases (Fuchs and Whelton, 2020), the most common of which are chronic diseases such as heart disease, type 2 diabetes, arthritis, cancer and dementia (Sánches-Sánchez et al., 2020). As a result of the abovementioned, it is clear that dealing with aging in health management is extremely important, and in many countries, there is an emphasis on funding aging research with the aim of health management (Eurostat, 2022). Nutrition in health and illness plays an extremely important role, so the Mediterranean diet has taken the leading place among the healthiest eating patterns (Yan et al., 2019), and it is also precisely diet therapy that is a companion in various therapies for certain diseases (Bales, 2002; WHO, 2023).

The connection of the legal system and supervision with an interdisciplinary approach to preserving the gerontological-health standards, with the help of modern information methods for monitoring and predicting diseases in the elderly is a key symbiosis in solving the problem of population aging (Cox, 1958). The increase in the share of elderly people in the general population is one of the leading public health, social and economic challenges today (Volkert et al., 2019). The demographic transition in the Republic of Croatia warns of the progressive aging of the population and ranks the Republic of Croatia among the top ten countries with the largest proportion of people aged 65 years and older (Kondrup et al., 2023). According to the criteria of the World Health Organization, the chronological age of 65 years is accepted as the age limit in the definition of an elderly person and is divided into three main groups; (i) youngest-old (65 – 74 years), (ii) middle-old (75 – 84 years) and (iii) oldest-old (85 years and older) (Lee et al., 2018). At the age of over 65, the health problems and mortality increase, which is supported by the data presented in Tables 1 and 2. Table 1 shows the mortality of people aged up to 65 years and older, for US citizens in 2019 and the Republic of Croatia in 2021.

Table 1. Total mortality among people aged up to 65 years and older in the Republic of Croatia (Eurostat, 2022; CDC, 2023)

	US*		Croatia	
age group	Population (N)	Percentage (%)	Population (N)	Percentage [%]
0 – 65 year > 65 years	566 000 2 million	22.1 77.9	9 765 52 951	15.6 84.4
Total number of deaths (year 2021)	2.566 million	100	62 712	100

*data from 2019

World Health Organization (WHO, 2023) offers on their website an overview of the most common causes of mortality in the countries of the time, and the data for the Republic of Croatia were separated and compared with the data for the United States of America. In doing so, an overview was given for the previously mentioned age groups and a conceptual color representation was used, where for each age group, within the same country, the lowest mortality is shown in dark green, and the highest in dark red. Mortality is expressed as the number of deaths in a population sample of 100,000. The aforementioned is shown in Table 2, the white fields are an indicator that the specified disease does not appear among the first 10, and the diseases are categorized as (i) injuries, (ii) Communicable, maternal, perinatal and nutritional conditions; other diseases or (iii) Non-communicable diseases (WHO, 2023a).

Causes of death in the elderly population are the main driver of health protection and the main indicator of the nutritional status of the elderly in the Republic of Croatia (Miličević et al., 2021). Total mortalities among persons aged 65 years and older, according to groups of causes of death in a sample of 52,951 people in the Republic of Croatia for the year 2021 are listed below, and the five most represented groups are: (i) diseases of the circulatory system (39.8%); (ii) neoplasm diseases (19.6%); (iii) codes for special purpose (COVID-19) (13.7%); (iv) endocrine diseases, nutritional diseases and metabolic diseases (8.3%) and (v) diseases of the respiratory system (4.2%).

Food intake and healthy diet and nutritional menus for the elderly

Aging is a normal physiological, highly individual phenomenon that is not necessarily associated with functional disability and disease (Zuilani et al., 2006). During the aging process, the structure and function of organs and organ systems gradually decreases, which consequently affects the absorption, transport, metabolism, and excretion of nutrients (Brownie, 2006).

In order to achieve energy balance, the need for energy and macronutrient intake decreases, and the need for micronutrients is equal to or greater than the need in adulthood. A reduction in energy intake may have negative effects on the nutritional status of the elderly if they do not consume foods of high nutritional value (Keller, 2019). A healthy and balanced diet for the elderly includes the intake of whole grains, legumes, white meat and fish, dairy products with reduced milk fat content, olive oil, nuts and seeds, seasonal fruits and vegetables, and a limited intake of red meat, meat products and industrially processed food with a high content of trans fat, saturated fatty acids, simple sugars and salt.

Depending on individual daily energy needs, a certain number of servings that should be consumed during the day is recommended for each of the six food categories (bread and substitutes; fruits; vegetables; milk and substitutes; meat and substitutes; fats and substitutes). The categories are designed to balance the daily intake of foods that are similar in composition and importance in the diet (Bellisle, 2014).

As people age, they change their eating patterns by choosing different foods and very often eating less. A number of studies indicated a connection between changes in diet and health status (Bangerter et al., 2019; Drewnowski and Shultz, 2001), but reduced food intake results in insufficient intake of some nutrients that are extremely important in

metabolic pathways, such as calcium, iron, zinc, vitamin B and vitamin E (Drewnowski and Shultz, 2001; Vranešić Bender et al., 2011).

Problems in older people that are associated with aging require interventions in the provision of energy-sufficient meals with high nutritional density, i.e. food that is rich in nutrients, thus meeting nutritional goals and not exceeding daily energy needs (Maltarić et all., 2023). The involvement of public health institutions in integrated interventions in the food intake quality, focused on health and the overall quality of life, becomes an extremely important factor.

The main goal of this paper is to present a systematic analysis of the interdisciplinary approach in the creation of public health guidelines for health/diet management for the elderly population.

Materials and methods

The numerous specificities of the nutritional status and nutrition of the elderly require a universal approach by healthcare professionals who care for them. In order to define the fundamental principles of assessing the nutritional status of the diet and artificial feeding of the elderly and the procedures related to specific clinical situations, in 2010 and 2011 it was encouraged in Croatia to develop guidelines for the nutrition of the elderly. Data reported here are foundation for development of the dietary guidelines for the elderly in Croatia by a work group.

An interdisciplinary work group contained internists, gerontologists, anthropologists, nutritionists and other experts specially trained in the treatment of geriatric patients that created evidence based national guidelines in Croatia for the nutrition of elderly people from the relevant medical literature and the clinical experiences of the members of the working group. The guidelines are published in two parts; the first part is dedicated to usual nutrition, and the second one deals with clinical nutrition of elderly people, in a narrower sense, enteral and parenteral nutrition. In addition to the basic elements of gerontology such as laws and inspections, the monitoring of gerontological public health indicators of health protection was crucial in analyzing the health needs of the elderly as well as indicating the quality of overall health care. In order to improve the monitoring of gerontological and public health indicators, the Nutritional Risk Screening 2002 (NRS 2002 web-service) was developed for determining the nutritional status of the elderly, which is recommended by the European Society for Clinical Nutrition and Metabolism (ESPEN) [Volkert et al., 2019; Vranešić Bender et al., 2011).

In addition to the rapid detection of nutritionally compromised persons, this method also enables the assessment of further worsening of the condition depending on accompanying diseases, as well as the revaluation of patients whose nutritional vulnerability could not be assessed at the time of admission. With the NRS 2002 tool, nutritional screening of patients was carried out in two steps: an initial screening in which four questions related to the body mass index (BMI) are answered: (i) Is the BMI < 20,5 kg/m2; (ii) What is the loss of body mass in the last three months; (iii) Has food intake decreased in the last two weeks; and (iv) Is there a severe acute illness present. If the answer to any of these questions was affirmative, it was continued with the second phase of the assessment, which considers accurate percentage of body mass losses and the severity of the disease. Based on all collected data, the patient was classified as exposed to nutritional risks if he/she has a

Table 2. Top 10 causes of death (2019) in United States of America (USA) and Croatia for both sexes aged 65-69; 70-74; 75-79; 80-84 and over 85 years (WHO, 2023)

	Deaths per 100 000 population									
	USA					Croatia				
	65-69	70-74	75-79	80-84	>85	65-69	70-74	75-79	80-84	>85
Ischemic heart disease	252.7	396.6	591.6	1027.3	2945.6	303.6	443.9	940.8	1992.6	5088.9
Trachea, bronchus, lung cancers	133.7	209.5	269.4	309.3	311.6	208.9	219.2	234.5	246.7	
Stroke	60.6	111.0	197.7	374.6	1040.7	154.7	286.6	633.6	1201.0	2156.2
Colon and rectum cancers	43.3	58.1	81.9	116.1		112.7	147.8	234.9	319.4	354.8
Chronic obstructive pulmonary disease	108.7	213.1	333.1	491.1	894.5	58.6	104.1	207.4	393.9	726.5
Cirrhosis of the liver	33.5					57.3	61.5			
Diabetes mellitus	44.2	63.6	80.2			46.3	101.9	188.6	430.9	602.8
Pancreas cancer	37.3	53.5	70.0			45.4	58.7			
Breast cancer	34.8					41.5	64.9	107.5		
Stomach cancer						38.1	56.3			
Kidney diseases	49.6	81.1	125.5	198.1	390.4			134.7	260.5	572.7
Alzheimer disease and other dementias		111.0	279.6	737.7	2866.7			97.8	223.7	488.4
Prostate cancer								95.9		
Hypertensive heart disease				112.4	367.6				186.8	524.5
Lymphomas, multiple myeloma		45.3								
Parkinson disease				128.3	215.3					
Falls [a]			71.7		285.4				181.8	426.0
Lower respiratory infections [b]				128.8	381.2					544.9

[a] Injuries; [b] Communicable, maternal, perinatal and nutritional conditions; other diseases are Non-communicable diseases; colors indicate the rank from the lowest (dark green) to the highest (dark red) mortality causes, white – not ranked in the top 10 for the observed column

Table 3. Food categories by serving units for elderly population (Mesarić and Pavić, 2020)

Category	1 serving unit (kcal)	carbohydrates (g)	proteins (g)	fats (g)
Bread and substitutes	70-80	15	1-5	0-1
Fruit	60	15	0	0
Vegetables	20	2-5	0	0
Milk and substitutes	100-120	10	7	4-7
Meat and substitutes	60-80	0	5-8	1-7
Fats and substitutes	45	0	0	5

total score of ≥ 3 or weekly monitoring of his/hers nutritional status is recommended (Kondrup et al., 2003). For each category from the diet (subchapter 1.1), there were recommendations for the serving size that indicated the amount of food that needs to be taken to satisfy one serving unit, and which food was an adequate replacement for the representative of the category in terms of its composition. Servings differed for each food category, as shown in Table 3.

Results and discussion

Based on the newest statistical data (Croatian Bureau of statistics) published in January 2023, the Census of population, households and dwellings, where the population is listed by counties (CBS, 2023), the data of the population aged 65 and older was extracted as step one in gaining better insights into elderly population in Croatia. Based on the Nomenclature of Territorial Units for Statistics (NUTS) of the European Union, where Croatia is included, the data were presented according to the codified Regions revised in 2021 (CBS, 2023). The share of females in the population older than 65 ranged from 56.64 % to 60.63 % in the City of Zagreb and Adriatic Croatia, respectively (Figure 1).

Distribution across the age groups defined as early, middle and older age is presented in Table 4, where among the shares it is indicated that at least one fifth of the population is aged 65 years and older. Although the WHO published in 2022 the key fact that it is expected that "till 2050 the proportion of the world's population over 60 years will nearly double from 12% to 22%", in Croatia this proportion was already reached for the population aged 65 years and older with the average of 22.17 %, where one fourth of the total female population is aged 65+ (Table 4).

Usually, the menus are divided into basic menus and menus for specific diseases of the elderly. The basic menus are divided into a diet without restrictions and a light diet. Diet without restrictions is intended for users with a good nutritional status who do not need special food restrictions regarding the type, method of preparation and altered intake of nutrients (Maltarić et al., 2023). In Table S1 (in Supplementary material) there is an example of a diet menu without restrictions, and in Table S2 there is an example of a light diet.

Menu examples for specific diseases of the elderly are divided into:
(I) menu for diabetes – three meals,
(II) menu for diabetes – five meals,
(III) Mediterranean diet,
(IV) menu for people with dysphagia – diet of changed consistency and
(V) mushy diet.

Table S3 shows an example of a menu for diabetes with 3 meals, Table S4 with 5 meals. Table S5 shows an example of a Mediterranean diet menu.

A diet of altered consistency is intended for users who have difficulty swallowing due to obstructions in the passage of food or liquid from the pharynx to the stomach. It is based on the appropriate consistency of food to prevent aspiration of food or liquid into the lungs and suffocation. The meal is adjusted with regards to the possibility of consuming food of a certain/adequate degree of consistency depending on the condition. The diet differs in texture and consistency, and the choice of food depends on which level is most effective for the individual user. Table 5 lists the levels/stages of food preparation with a corresponding short description, and Table S6 shows an example of a menu for people with dysphagia for the 5th level.
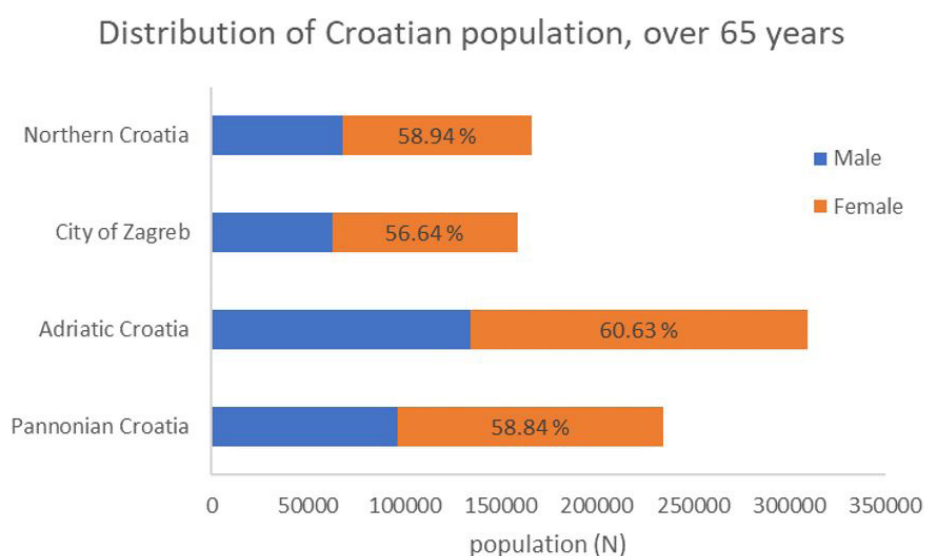

Figure 1. Distribution of Croatian population 65 years and older, according NUTS 2 regions

Table 4. Share of the population aged 65 years and older, in the total population by NUTS regions

Age	Pannonian Croatia*		Adriatic Croatia*		City of Zagreb*		Northern Croatia*		Croatia	
	M	F	M	F	M	F	M	F	M	F
65-74	12.81	14.35	13.38	14.47	10.45	12.70	11.81	13.22	12.11	13.69
75-84	5.35	8.74	6.15	8.26	5.42	7.99	4.99	7.93	5.48	8.23
85-94	1.30	3.12	1.73	3.35	1.52	2.71	1.06	2.87	1.40	3.01
>95	0.03	0.11	0.05	0.17	0.05	0.17	0.03	0.13	0.04	0.15
Total	19.50	26.32	21.31	26.25	17.43	23.56	17.89	24.16	19.03	25.07
Total number of inhabitants in the region (N)										
	1 019 535		1 298 522		767 131		786 645		3 871 833	
Average share of population 65+ (%)										
	23.01		23.85		20.70		21.11		22.17	

* Nomenclature of Territorial Units for Statistics (NUTS 2) for Croatia (CBS, 2022); M: Male; F: Female;

Table 5. Stages of preparation of food for a diet of changed consistency (Mesarić and Pavić, 2020)

Food preparation stage	Description
1st level	The food is prepared by cooking, and the desired smooth puree consistency is achieved by mixing or pureeing. It serves as a transitional way of eating from liquid to mushy food and lasts for several days. It is based on easily digestible ingredients that are easy to puree and mix.
2nd level	It is based on easily digestible foods that are easy to puree and mix. The food should be chopped to the consistency of the size of sesame seeds (finely ground meat).
3rd level	The food should be ground or chopped to a consistency the size of a grain of rice. It is based on easily digestible foods, without fatty and stringy meat, irritating spices and vegetables that causes flatulence.
4th level	The food should be chopped into pieces about the size of small bread cubes. The appropriate consistency is achieved by adding liquid foods (milk, yogurt, cream, compote juice, etc.).
5th level	Food should be soft and creamy, soupy, ground or chopped; a modified form of the usual way of eating.

The mushy diet is intended for users whose health condition requires mushy food. It is based on easily digestible foods that are easy to puree and mix. All cooked food is prepared by mixing or chopping, together (main course and side dish) or separately to make it more attractive to eat. Table S7 shows an example of a mushy diet.

In Figure 2 meal shares for daily energy intake depending on type of meal during the day (breakfast, snack, lunch, dinner, night meal) are presented. The figure was made based on the aforementioned menus which can be found in the supplements (Table S1 – S7).

Based on the same menus, a share of macronutrients in % was presented in Figure 3, while macronutrients mass is shown in Figure 4. The boxplots (Figures 3 and 4) include the summarized data "per day", for all listed menus.

Due to the importance of recognizing malnutrition, experts have developed simple, fast and effective methods of screening for malnutrition in the general population and among hospitalized patients. Early detection of malnutrition in geriatric patients is extremely important because it enables the timely inclusion of nutritional support that would prevent or reduce the loss of mental and physical functions in the elderly and reduce numerous complications associated with the disease and treatment costs (Kangasniemi et al., 2021).

As indicated in Figures 3 and 4, the data suggested that a typical diet for elderly was high in carbohydrates and relatively low in proteins, and the total amount of macronutrients consumed varies based on the calorie intake. It is important to note that these figures were averages, and individual dietary needs may vary based on factors such as age, sex, physical activity level, and overall health. Hence, it is always recommended to consult with a healthcare professional or a registered dietitian to determine individual dietary needs.

Based on data presented in figures 3 and 4, and the fact that as people age, their dietary needs may change, and it is important to ensure that they were meeting their nutritional requirements to maintain their health and well-being. The following are some guidelines/recommendation for compliance measures related to food composition in the elderly population:

Appropriate protein intake: To maintain muscular mass and strength, older persons may need extra proteins. For elderly persons, 1.2–1.5 grams of protein per kilogram of body weight are advised daily. To do this, include lean meats, fish, poultry, eggs, dairy products, beans, and nuts to their diet along with other sources of proteins.

Appropriate fiber intake: To maintain bowel regularity and avoid constipation, older persons may require extra fiber. Here, a daily fiber intake of 25 to 30 grams is advised. This may be done by incorporating sources of fibers into their diet, such as whole grains, fruits, vegetables, and legumes.

Appropriate vitamins and minerals intake: Due to changes in their digestive systems, decreased appetite, and interactions with medications, older persons may be at risk of nutritional deficiencies. Make sure that users receive enough calcium, vitamin D, vitamin B12, and iron, as well as other essential vitamins and minerals. This can be done by following a balanced diet that includes a range of nutrient-dense foods or, if advised to do so by a healthcare provider, by taking supplements.

Observance of specific dietary requirements: Some medical disorders, such as diabetes, high blood pressure, or renal disease, may cause certain older persons to have unique dietary requirements. Following these unique dietary requirements can aid in managing their medical issues and avoiding consequences.
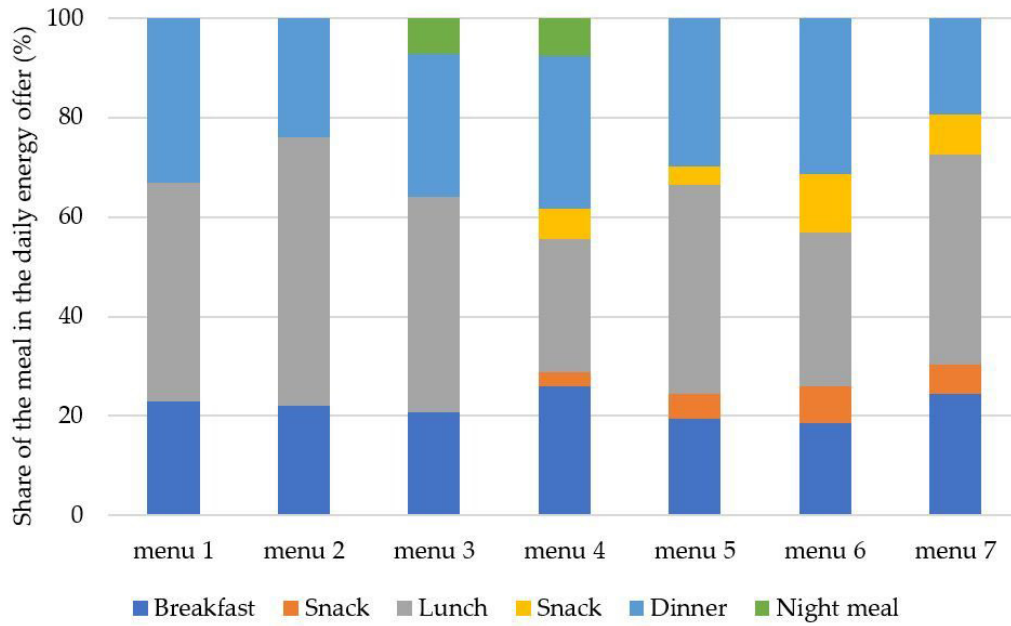
Figure 2. Share of each meal in the daily energy offer of seven menus that are presented in tables S1-S7
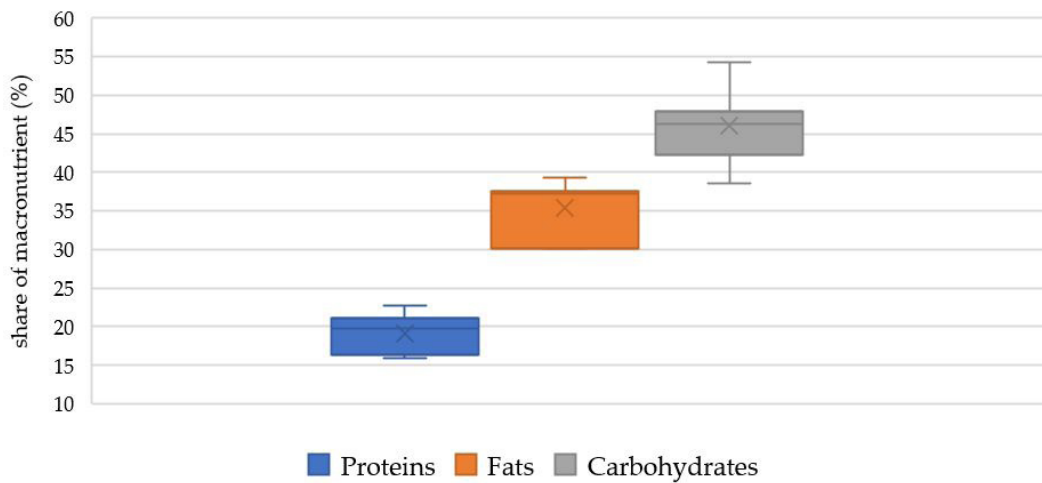

Figure 3. Share of the macronutrients from total day calorie count of seven menus that are presented in tables S1-S7
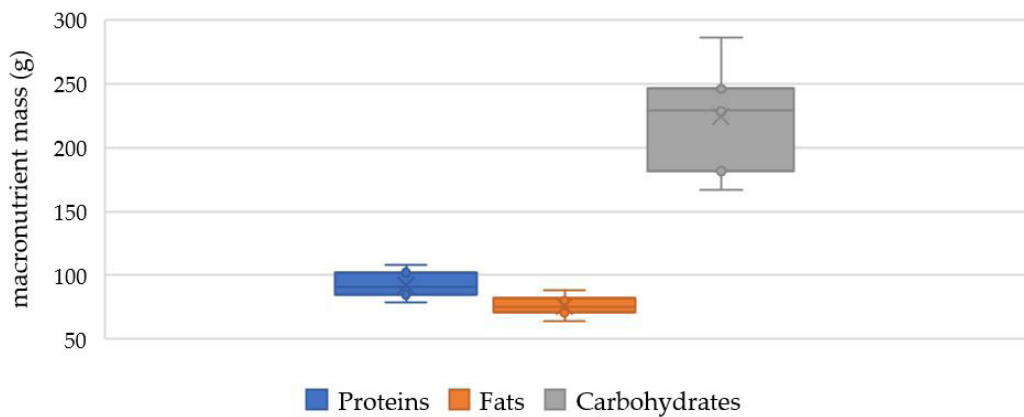

Figure 4. Mass of the macronutrients from total day calorie count of seven menus that are presented in tables S1-S7

Moreover, in planning the number and scheduling of meals, it is desirable to include the users of institutions and consider their needs and opinions. It is important to arrange the meals correctly in order to ensure sufficient energy intake throughout the day and that they are balanced with regards to the ratio of macro- and micro- nutrients (GIAG, 2006; Maltarić et al., 2020). The recommended daily food intake should preferably be divided into three main meals and two or three snacks, and the interval between meals should not exceed five hours. The interval between the evening meal and breakfast the next morning should not exceed 12 hours. That is why all the menus presented in tables S1 to S7 usually have three main meal options with an additional two to five snacks options.

Additionally, when planning and creating menus in gerontology centers and nursing homes, it is necessary to take care of a diverse selection of appropriate foods in order to meet the energy and nutritional needs of the people for whom the menus are intended. The needs and wishes of the users as well as the possibility (practicality) of realizing the menu should be considered. It is important to consider the fact that many elderly people have a reduced appetite, and in addition to the three main meals, it is desirable to include two to three smaller snacks in order to spread the food intake as evenly as possible throughout the day. Each main meal should contain complex sources of carbohydrates (Figures 2, 3 and 4) – cereals or starchy vegetables (whole grain bread or pastries, unsweetened cereals (oats, millet, etc.), pasta, rice, buckwheat, barley porridge, millet, corn grits, potatoes, sweet potato, legumes). Include high-quality protein sources (as seen in Figures 3 and 4) from meat, fish, eggs, milk and dairy products or legumes every day with the main meals. Calcium needs should be met with two to three servings of calcium-rich foods such as milk, fermented milk products, milk puddings and cheeses. Ensure the intake of five servings of fruits and vegetables daily, giving preference to seasonal ones. Due to the problems with chewing and swallowing characteristic of the elderly, fruit can also be offered in the form of juice, compote or puree made from fresh fruit. As a source of liquid, prefer drinking water and teas, unsweetened or sweetened with a little honey or sugar.

Web-service NRS 2002 of the Reference Centre of the Ministry of Health for the Health Protection of the Elderly NZJZ "Dr. Andrija Štampar" enabled the monitoring of determinants that represent important public health indicators for the analysis of nutritional risks in old age (Tomašević Mrčela et al., 2017; Tomašević Mrčela et al., 2019). In addition to the calculation of the results of the NRS 2002, age groups, gender, basic anthropometric measurements, functional ability, independence, leading and accompanying diagnoses and risky behaviors were included. Graphs below contain described parameters:

entities that have been screened (Figure 5),
screening of BMI in people older than 65 years (Figure 6) and
screening results for people older than 65 years, by age and sex (Figure 7).

Screening with NRS 2002/GeroS/CEZIH (Panel) of people aged 65 years and older according to gender (n = 1013) by specified entities (7) showed the highest representation of gerontological insured persons and geriatric patients (Figure 5) in the categories of general/family medicine with 59.7% (605), acute treatment in a hospital with a share of 25.1% (254), a home for the elderly with a share of 10.8% (109) and chronic treatment in hospital with 3.5 % (35).

Screening of BMI for persons older than 65 years according to age and sex by NRS 2002/GeroS/panel CEZIH (Figure 6) for March 1, 2015, until December 14, 2022 (n = 916) indicated that the highest proportion, i.e., 49.6% of the respondents (54), had a normal body weight. Eighteen percent of respondents (165) were overweight, and 15.2% of respondents (139) were obese. 7.6% (70) were malnourished, while 8.5% of them (78) were severely malnourished.

One of the possible solutions for improvement can be found in the use of an interdisciplinary approach in the protection of the health of the elderly. Such an approach integrates numerous professional and scientific disciplines that have developed and continue to develop specialized knowledge, skills and viewpoints in the care of the elderly (Bangerter et al., 2019; GIAG, 2006; Maltarić et al., 2020). The multidisciplinary gerontological team is an irreplaceable model at all levels of providing health care and social care for the elderly. The main bearer in the protection of the health of the elderly at the level of primary health care is a team of general/family medicine specialists who are additionally educated in gerontology and geriatrics. The multidisciplinary gerontological team includes experts of different professional profiles, from doctors and nurses trained in gerontology and geriatrics, physiotherapists, social workers, gerontostomatologists, psychogeriatricians, gerontonutritionists and gerontonesiologists to gerontology nurses and others (Chen, 2021; Tomasović Mrčela et al., 2017; GIAG, 2006). The key starting points in a functional interdisciplinary approach are the common goals of all participants with a clear distribution of roles and responsibilities, as well as mutual cooperation and coordination.

To that end, for improvements in assessment and positive outcomes of health behaviors related to healthy diet for the elderly, the following were primarily important:
gerontoanthropometric characteristics of nutrition assessment,
assessment of nutritional status via MNA (Mini nutritional assessment) or NRS 2002 web-service,
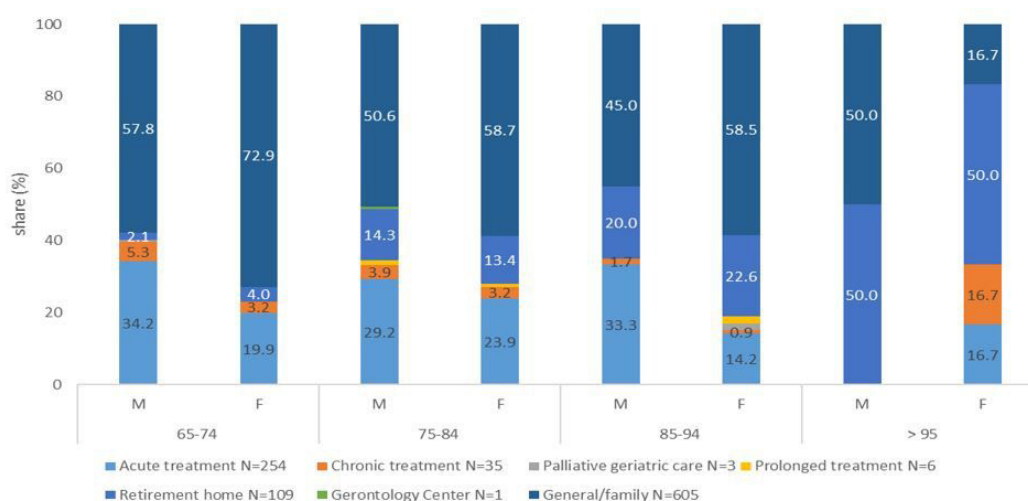

Figure 5. Types of health and social care units that screened elderly individuals through the online service NRS 2002/GeroS/panel CEZIH in persons aged 65 years and older, by age and gender (2015. – 2022., N = 1013)
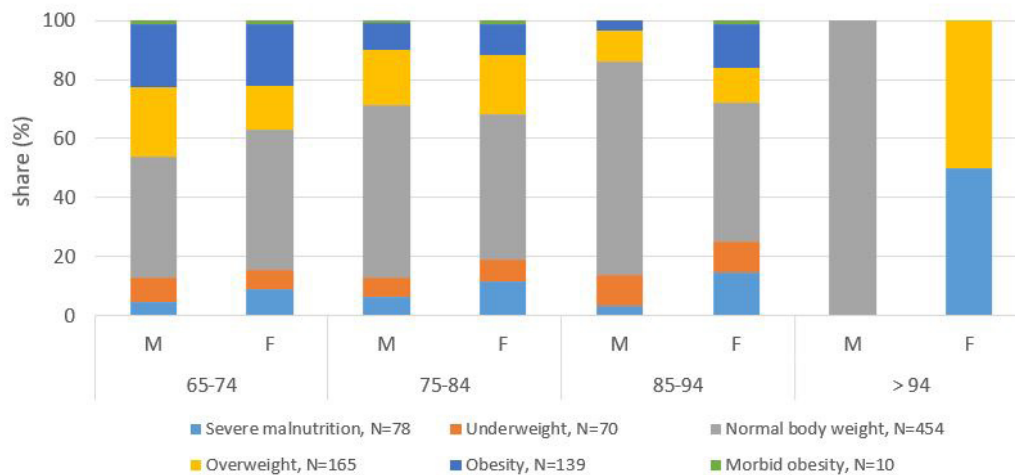
Figure 6. Shares of nutritional status categories (according to BMI) found in persons aged 65 years and older, followed by the online service NRS 2002/GeroS/panel CEZIH (2015–2022, N = 916)
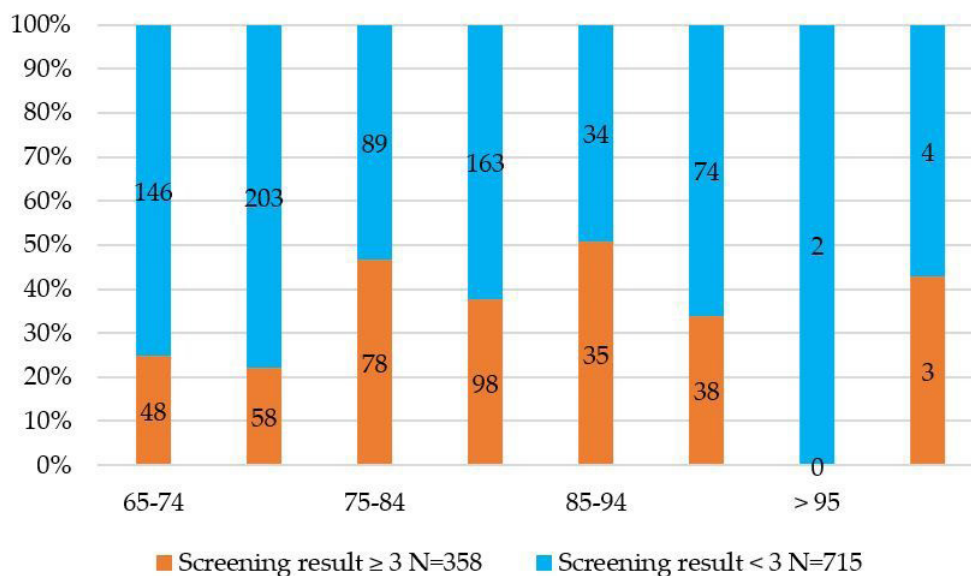

Figure 7. Screening results for people aged 65 years and older by age and sex followed by the online service NRS 2002/GeroS/panel CEZIH (2015–2022, N = 1073)

assessment of the energy needs of the elderly in relation to age, physical activity, and morbidity,

ratio of macronutrients (energy from proteins, fats, carbohydrates) as shown in Figures 3 and 4,

intake of micronutrients (for example calcium, vitamin D, B12 and folic acid), and

adherence to the eight dietary rules for the elderly.

An indispensable factor for the health of the elderly is planning and preparation of menus in gerontological centers and nursing homes to meet their energy and nutritional needs, which are often nutritionally compromised (Saka et al., 2019; Blencowe et al, 2012). The guidelines of nutritional and gerontological norms can help in assessing the energy and nutritional values of the menu and achieving compliance with the recommendations. Menus should be adapted to elderly people and energetically and nutritionally adapted to prevent malnutrition or obesity. The energy intake should be coordinated with individual physical activity and the minimum needs for the intake of particular macro- and micro- nutrients (Saka et al., 2019). A person who is an expert in the field of nutrition (e.g. nutritionist/dietitian), should play a key role in creating the menu and assessing the energy and nutritional values in accordance with the recommendations. Through this research, a limitation was also determined mainly as lack of data pertaining to the national research

and/or studies dealing with the nutrition of this extremely vulnerable part of population. Proportionally to the increase in age (CBS, 2023), the frequency of illnesses and serious conditions that can have extremely bad outcomes also increases, and diet therapy can certainly be of exceptional help in the prevention of diseases that dominate at this age (Bloom et al., 2015). An individual approach to each person is extremely important, as is the uniformity of norms that are the beginning of nutritional care. This is the main contribution of current work to the extremely important area of geriatric nutrition/care and public health, especially those located in the elderly care centers.

Conclusions

Inadequate nutritional status is a significant problem in the elderly population. Malnutrition leads to progressive deterioration of the health condition, reduction of physical and cognitive functional condition, increased utilization of the health care system, institutionalization and increased mortality.

Health benefits are associated with reductions in risk factors associated with many chronic diseases, and functional benefits include improved endurance, strength, flexibility and balance in old age. Equally, in old

age it is very important to prevent the loss of muscle mass and to maintain and improve muscle strength and balance in order to reduce the risk of falls, fractures and other injuries. These adaptations contribute to the ability to maintain an independent lifestyle and ensure a high quality of life in later years. In this case, the elderly will continue to participate in everyday life activities without restrictions, such as shopping, working in the garden or playing with grandchildren. The Healthy Active Aging Strategy, in accordance with WHO guidelines, directs the National Action Plans to the potential vulnerability of the elderly population in relation to nutritional status, especially the occurrence of malnutrition and the safety of the food they consume. Monitoring the components of positive health behavior, which includes healthy diet for the elderly, enables the analysis and evaluation of gerontological determinants that are key to the process of active healthy aging, which mainly contributes to preserving functional ability, preventing disease and improving health and quality of life in old age.

The healthy and balanced diet of the elderly as the main factor in preserving health in this interdisciplinary approach implies the intake of whole grains, legumes, white meat and fish, dairy products with a reduced proportion of milk fat, olive oil, nuts and seeds, seasonal fruits and vegetables and a limited intake of red meat, meat products and industrially processed food with a high content of trans fat, saturated fatty acids, simple sugars and salt. Lastly, future studies should be conducted in larger numbers at Croatian territory with the aim to improve life quality of elderly, while providing another point of reference for important nutritional data, relevant to the entire Europe.

References

Bales C.W. (2002) Alternative diet therapy for elderly patients. Unique concerns for a high-risk population. Clinics Geriatric Medicine, 18(4) 841-51.

Bangerter L.R., Fadel M., Riffin C., Splaine M. (2019) The older Americans act and family caregiving: perspectives from federal and state levels. The Public Policy Aging Report, 29(2) 62e6.

Bellisle F. (2014) Meals and snacking, diet quality and energy balance. Physiology and
Behavior, 134 38-43.

Blencowe H., Cousens S., Oestergaard M.Z., Chou D., Moller A.B., Narwal R., Adler A.,
Garcia C.V., Rohde S., Say L., Lawn J.E. (2012) National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: a systematic analysis and implications. Lancet, 379 2162-2172.

Bloom D.E., Chatterji S., Pharm P.K., Lloyd-Scherlock P., McKee M., Rechel B., Rosenberg L., Smith J.P. (2015) Macroeconomic implications of population ageing and selected policy responses. Lancet, 384 649-657.

Brownie S. (2006) Why are elderly individuals at risk of nutritional deficiency? International Journal Nursing Practice, 12 110-118.

CBS, Croatian Bureau of Statistics. "Nacionalna Klasifikacija Statističkih Regija 2021. (HR_NUTS 2021)". Narodne Novine (in Croatian) (125/2019). 2019. Available online: https://narodne-novine.nn.hr/clanci/sluzbeni/full/2019_12_125_2507.html (accessed on 12 December 2022).

CBS, Croatian Bureau of Statistics (2023-01-2). "Census of population, households and dwellings in 2021. – population by counties. Available online: https://podaci.dzs.hr/hr/podaci/stanovnistvo/popis-stanovnistva/. (accessed on 20 January 2023).

CDC, Schedule of NCHS Statistical Products and Reports 2023 Available online: https://www.cdc.gov/nchs/fastats/deaths.htm. (accessed on 22 March 2023).

Chen G. (2021) Building, integrating, and sharing our aging society: improving older adults' health together. China CDC Weekly, 3(40) 835e6.

Cox PR. (1958) The aging of populations and its economic and social implications. Journal of the Royal Statistical Society: Series A (General), 121(2) 253.

Croatian Society for Gerontology and Geriatrics (2021) Nutritional gerontological norms - an example of Croatian successful practice (Croatian: Prehrambenogerontološke norme - primjer hrvatske uspješne prakse). Available online: https://www.youtube.com/watch?v=pQuW2V5JVtc (accessed on 22 November 2023).

Drewnowski A., Shultz J.M. (2001) Impact of aging on eating behaviors, food choices, nutrition, and health status. Journal of Nutrition Health and Aging, 5(2) 75–79.

Eurostat. Population structure and ageing – Statistics Explained. Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php/Population_structure_and_ageing (accessed on 10 June 2022)

Fuchs F.D., Whelton P.K. (2020) High blood pressure and cardiovascular disease.
Hypertension, 75(2) 285e92.

GIAG, Geriatric Interdisciplinary Advisory Group. Interdisciplinary Care for Older Adults with Complex Needs: American Geriatrics Society Position Statement. JAGS. 2006, 54, 849-852.

Kangasniemi M., Papinaho O., Moilanen T., Leino-Kilpi H., Siipi H., Suominen S., Suhonen R. (2021) Neglecting the care of older people in residential care settings: A national document analysis of complaints reported to the Finnish supervisory authority. Health Soc Care
Community, 30 1313-1324.

Keller H.H. (2019) Malnutrition in institutionalized elderly: how and why? Journal of the American Medical Directors. Association, 41(11) 1212-1218.

Kolarić B., Tomek-Roksandić S., Vranešić Bender D., Pavić E. (2020) Prehrambeno-gerontološke norme / jelovnici u domovima za starije osobe i gerontološki centrima. Ministry of health of Republic of Croatia.

Kondrup J., Allison S.P., Elia M., Vellas B., Plauth M. (2003) Educational and Clinical Practice Committee, European Society of Parenteral and Enteral Nutrition (ESPEN). ESPEN guidelines for nutrition screening 2002. Clinical Nutrition, 22(4) 415-21.

Lee S.B., Oh J.H., Park J.H., Choi S.P., Wee J.H. (2018) Differences in youngest-old, middle-old, and oldest-old patients who visit the emergency department. Clinical and Experimental Emergency Medicine, 5(4) 249-255.

Maltarić M., Ruščić P., Kolak M., Vranešić Bender D., Kolarić B., Ćorić T., Sousa Hoejskov P., Bošnir J., Gajdoš Kljusurić J. (2023) Adherence to the Mediterranean Diet Related to the Health Related and Well-Being Outcomes of European Mature Adults and Elderly, with an Additional Reference to Croatia. International Journal of Environmental Research and Public Health, 20(6) 4893.

Maltarić M., Vranešić Bender D., Kolarić B., Vorkapić Furač J., Tomek-Roksandić S., Bošnir J. (2020) Eight Dietary Recommendations for the Elderly, Abstracts of the 3rd International Congress on Food Safety and Quality "Food, Health and Climate Changes", Archives of Industrial Hygiene and Toxicology, 71(Suppl.1), Šostar, Z., Šikić, S., Krivohlavek, A. (ed.), Zagreb: Institute for Medical Research and Occupational Health, pp. 38-38.

Mesarić N., Pavić E. (2020) Dodatak smjericama: Jelovnici u domovima za starije osobe I gerontološkim centrima. In: Prehrambeno-gerontološke

norme / jelovni-ci u domovima za starije osobe i gerontološki centrima (ed. Kolarić, B., Vranešić Bender, D., Pavić, E.). Ministry of health of Republic of Croatia (pp. 260-267 and 422-436).

Miličević T., Kolčić I., Đogaš T., Živković P.M., Radman M., Radić J. (2021) Nutritional Status and Indicators of 2-Year Mortality and Re-Hospitalizations: Experience from the Internal Clinic Departments in Tertiary Hospital in Croatia, Nutrients, 13(1) 68.

Saka S., Oosthuizen F., Nlooto M. (2019) National Policies and Older People's Healthcare in Sub-Saharan Africa: A Scoping Review. Annals of Global Health, 85(1) 91.

Sánchez-Sánchez M.L., García-Vigara A., Hidalgo-Mora J.J., García-Pérez M.Á., Tarín J., Cano A. (2020) Mediterranean diet and health: A systematic review of epidemiological studies and intervention trials. Maturitas, 136 25-37.

State Council, The State Council of China (2019) Healthy China action plan (2019e2030). http://www.gov.cn/xinwen/2019-07/15/content_5409694.htm. (accessed on 20 January 2023).

State Council, The State Council of China (2017) Notice of the general office of the state Council on printing and distributing the medium and longterm plan for the prevention and treatment of chronic diseases in China (2017-2025). http://www.gov.cn/zhengce/content/2017-02/14/content_5167886.htm. (accessed on 20 January 2023).

Tomasović Mrčela N., Tomek-Roksandić S., Kolarić B., Mravak S., Lukić M., Lovrić K., Sajko D. (2017) Specifičnosti zdravstvenih mjeraPostupnika tima doktora opće/obiteljske medicine u domovima za starije osobe. U: Tiljak H, Depolo T, ur. XXIV. Kongres obiteljske medicine, Pretilost, Treća dob, April 20. – 22., Dubrovnik, Hrvatska, Dubrovnik, Hrvatska udružba obiteljske medicine 2017, 59-71.

Tomasović Mrčela N., Kolarić B., Ćorić T., Maltarić M., Sajko D., Arnaut K. (2019) Praćenje pojavnosti stanja pothranjenosti u starijih osoba po dobnim skupinama putem web-servisa NRS 2002 // Konferencija "Živjeti starost – izazov za pojedinca, obitelj i društvo", Zagreb, 2019. pp. 35-35.

UN, United Nations. (2023) World population ageing 2020 highlights. 2020. https://www. un.org/development/desa/pd/news/world-population-ageing-2020-highlights. (accessed on 20 January 2023).

Volkert D., Beck A.M., Cederholm T., Cruz-Jentoft A., Goisser S., Hooper L., Kiesswetter E., Maggio M., Raynaud-Simon A., Sieber C.C., Sobotka L., van Asselt D., Wirth R., Bischoff S.C. (2019) ESPEN guideline on clinical nutrition and hydration in geriatrics. Clinical Nutrition, 38(1) 10–47.

Vranešić Bender D., Krznarić Ž., Reiner Ž., Tomek Roksandić S., Duraković Z., Kaić-Rak A. et al. (2011) Hrvatske smjernice za prehranu osoba starije dobi, I. dio. Liječnički vjesnik, 133 263-271.

WHO (2023) Global health estimates: Leading causes of death. Available online: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death (accessed on 15 February 2023).

WHO (2023a) The top 10 causes of death. Available on: https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death (accessed on 15 February 2023).

Yan M.R., Welch R., Rush E.C., Xiang X., Wang X. (2019) A Sustainable Wholesome Foodstuff, Health Effects and Potential Dietotherapy Applications of Yacon. Nutrients, 11(11) 2632.

Yao X., Zheng Z., Wang Z., Yuan Q., Yin H., Zhang W. (2023) Nationally funded health management projects for older adults in China and the United States: Comparative analysis based on data from two principal institutions, International Journal of Nursing Science, 10(1) 8-15.

Zuilani G., Guerra G., Ranzini M., Rossi L., Munari M.R., Zurlo A., Blè A., Volpato S., Atti A.R., Fellin R. (2006) High interleukin-6 plasma levels are associated with functional impairment in older patients with Vascular dementia. International Journal of Geriatric Psychiatry, 22 305-311.

Supplements

Table S1. An example of a diet menu without restrictions (Kolarić et al., 2020)

Dish name	Energy value		Proteins [g]	Fats [g]	Carbohydrates [g]
	[kcal]	[kJ]			
Corn grits with milk	393.00	1656.05	12.48	12.26	58.23
Apple	70.84	295.68	0.46	0.00	18.33
Total breakfast	**463.84**	**1951.73**	**12.94**	**12.26**	**76.55**
Beef soup with ram	99.67	416.71	3.20	5.79	8.39
Turkey risotto with zucchini	459.62	1916.50	28.40	11.99	51.99
Beet salad	123.60	515.62	3.22	5.02	16.36
Semi-white bread	207.20	879.20	5.84	2.08	41.36
Total lunch	**890.09**	**3728.03**	**40.66**	**24.89**	**118.08**
Chicken stew with vegetables and dumplings	342.24	1430.27	30.38	13.94	24.53
Semi-white bread	207.20	879.20	5.84	2.08	41.36
Acidophilic milk	120.00	508.00	6.80	6.40	9.00
Total dinner	**669.44**	**2817.47**	**43.02**	**22.42**	**74.89**
Total day	*2124.77*	*8918.91*	*84.89*	*88.65*	*246.05*

Table S2. An example of a light diet menu (Kolarić et al., 2020)

Dish name	Energy value		Proteins [g]	Fats [g]	Carbohydrates [g]
	[kcal]	[kJ]			
Pomegranate tea	44.89	190.46	0.11	0.04	12.14
Butter	150.20	628.40	0.20	16.60	0.00
Turkey breast delicacy	51.00	216.60	9.00	0.90	1.80
Semi-white bread	207.20	879.20	5.84	2.08	41.36
Total breakfast	**453.29**	**1914.66**	**15.15**	**19.62**	**55.30**
Beef soup with noodles	100.17	418.82	3.25	5.80	8.46
Steak	424.24	1771.48	29.17	30.16	8.89
Pasta	325.00	1356.20	9.60	6.60	56.80
Green salad with carrots and celery	53.42	219.21	0.92	4.63	2.03
Semi-white bread	207.20	879.20	5.84	2.08	41.36
Total lunch	**1110.03**	**4644.91**	**48.78**	**49.27**	**117.63**
Grain cheese	166.00	700.00	25.40	4.40	6.20
Semi-white bread	207.20	879.20	5.84	2.08	41.36
Acidophilic milk	120.00	508.00	6.80	6.40	9.00
Total dinner	**493.20**	**2087.20**	**38.04**	**12.88**	**56.56**
Total day	*2056.53*	*8646.76*	*101.98*	*81.77*	*229.49*

Table S3. Example of a menu for diabetes - with 3 meals (Kolarić et al., 2020)

Dish name	Energy value		Proteins [g]	Fats [g]	Carbohydrates [g]
	[kcal]	[kJ]			
Oatmeal with yogurt and forest fruits	350.54	1603.44	18.67	14.50	53.85
Total breakfast	**350.54**	**1603.44**	**18.67**	**14.50**	**53.85**
Beef soup with ram	99.67	416.71	3.20	5.79	8.39
Beef steak in sauce	312.04	1302.90	24.50	21.90	4.67
Zucchini risotto	205.36	853.64	4.76	5.08	35.25
Red cabbage salad	69.27	286.77	2.00	5.12	4.26
Tangerine	42.84	178.92	1.13	0.00	10.08
Total lunch	**729.19**	**3038.92**	**35.59**	**37.90**	**62.64**
Millet with vegetables and turkey	351.51	1477.98	28.36	7.43	34.71
Beet salad	75.29	312.17	1.44	5.00	6.11
Apple	61.20	255.51	0.00	0.00	15.30
Total dinner	**488.00**	**2045.66**	**29.80**	**12.43**	**56.12**
Acidophilic milk	120.00	508.00	6.80	6.40	9.00
Total night meal	**120.00**	**508.00**	**6.80**	**6.40**	**9.00**
Total day	*1717.72*	*7196.03*	*90.87*	*71.22*	*181.61*

Table S4. Example of a menu for diabetes – with 5 meals (Kolarić et al., 2020)

Dish name	Energy value		Proteins [g]	Fats [g]	Carbohydrates [g]
	[kcal]	[kJ]			
Milk	110.40	465.60	7.92	4.32	11.04
Turkey breast delicacy	51.00	216.60	9.00	0.90	1.80
Butter	75.10	314.20	0.10	8.30	0.00
Graham bread	168.00	707.70	5.73	2.28	29.27
Tangerine	42.84	178.92	1.13	0.00	10.08
Total breakfast	**447.34**	**1883.02**	**23.88**	**15.80**	**52.19**
Plums	51.30	214.65	0.81	0.00	12.96
Total snack	**51.30**	**214.65**	**0.81**	**0.00**	**12.96**
Vegetable soup	8.86	37.06	0.62	0.04	1.62
Grilled turkey breast	190.00	795.00	24.60	6.40	0.00
Mixed vegetables	262.38	1093.24	9.30	9.75	37.62
Total lunch	**461.24**	**1925.30**	**34.52**	**16.19**	**39.24**
Apple puree and ground almonds	107.40	448.82	1.38	4.29	15.85
Total snack	**107.40**	**448.82**	**1.38**	**4.29**	**15.85**
Hamburger	316.65	1320.97	18.08	26.77	0.84
Buckwheat salad	215.37	898.44	4.94	5.53	35.96
Total dinner	**532.03**	**2219.41**	**23.02**	**32.30**	**36.80**
Kefir yoghurt	130.00	544.00	7.20	7.00	9.60
Total night meal	**130.00**	**544.00**	**7.20**	**7.00**	**9.60**
Total day	*1729.32*	*7235.20*	*90.81*	*75.58*	*166.64*

Table S5. An example of a Mediterranean diet menu (Kolarić et al., 2020)

Dish name	Energy value		Proteins [g]	Fats [g]	Carbohydrates [g]
	[kcal]	[kJ]			
Tea with lemon and honey	20.41	85.38	0.13	0.04	6.02
Margo OMEGOL	78.15	327.45	0.00	8.85	0.00
Turkey ham delicacy	34.00	144.40	6.00	0.60	1.20
Grain pastry	237.60	1003.20	8.80	4.72	39.92
Total breakfast	**370.16**	**1560.43**	**14.93**	**14.21**	**47.14**
Banana	94.80	397.20	1.32	0.36	23.04
Total snack	**94.80**	**397.20**	**1.32**	**0.36**	**23.04**
Beef soup with noodles	100.17	418.82	3.25	5.80	8.46
Roast chicken	236.25	988.13	35.81	10.31	0.00
Mashed potato	211.90	885.00	5.52	2.98	43.48
Satarash	82.40	342.04	1.22	5.26	8.08
Graham bread	168.00	707.70	5.73	2.28	29.27
Total lunch	**798.72**	**3341.68**	**51.53**	**26.64**	**89.29**
Apple	70.84	295.68	0.46	0.00	18.33
Total snack	**70.84**	**295.68**	**0.46**	**0.00**	**18.33**
Grain cheese	166.00	700.00	25.40	4.40	6.20
Tomato salad	73,84	308.44	1.82	5.02	5.75
Olive oil	40.95	168.35	0.00	4.55	0.00
Graham bread	168.00	707.70	5.73	2.28	29.27
Acidophilic milk	120.00	508.00	6.80	6.40	9.00
Total dinner	**568.79**	**2392.49**	**39.75**	**22.65**	**50.22**
Total day	*1903.31*	*7987.47*	*107.99*	*63.85*	*228.01*

Table S6. An example of a menu for people with dysphagia for the 5th level (Kolarić et al., 2020)

Dish name	Energy value		Proteins [g]	Fats [g]	Carbohydrates [g]
	[kcal]	[kJ]			
Millet porridge with banana and orange	392.41	1648.48	15.11	8.80	64.43
Total breakfast	**392.41**	**1648.48**	**15.11**	**8.80**	**64.43**
Greek yogurt with wild berries and honey	156.00	652.10	3.67	9.62	17.40
Total snack	**156.00**	**652.10**	**3.67**	**9.62**	**17.40**
Sausage stew with chicken	434.63	1813.58	26.58	13.52	54.78
Semi-white bread	103.60	439.60	2.92	1.04	20.68
Pear compote with chopped walnuts	112.93	474.29	1.53	4.44	17.46
Total lunch	**651.16**	**2727.47**	**31.03**	**18.99**	**92.92**
Soft biscuit with fruit	249.57	1047.94	5.03	10.92	32.58
Total snack	**249.57**	**1047.94**	**5.03**	**10.96**	**32.58**
Omelette with cheese (from oven)	576.00	242,20	29.46	20.08	67.39
Yogurt with probiotics	85.50	357.00	4.95	2.25	11.55
Total dinner	**661.50**	**2777.20**	**34.41**	**22.33**	**78.94**
Total day	*2110.64*	*8853.28*	*89.25*	*70.66*	*286.27*

Table S7. An example of a menu for a mushy diet (Kolarić et al., 2020)

Dish name	Energy value		Proteins [g]	Fats [g]	Carbohydrates [g]
	[kcal]	[kJ]			
Tea with lemon and honey	40.66	170.10	0.27	0.08	12.00
Oatmeal with milk and banana	429.64	1801.42	15.08	11.18	66.55
Total breakfast	**470.29**	**1971.52**	**15.35**	**11.25**	**78.55**
Greek yoghurt	115.00	481.00	3.30	9.50	4.30
Total snack	**115.00**	**481.00**	**3.30**	**9.50**	**4.30**
Beef soup with ram	94.00	393.06	3.16	5.27	8.16
Mixed beef	368.92	1537.72	22.08	27.27	9.22
Polenta	209.40	891.00	4,50	0.48	46.92
Tomato sauce	142.77	593.28	1.64	10.80	11.51
Total lunch	**815.08**	**3415.06**	**31.31**	**43.82**	**75.811**
Apple puree with biscuits	153.82	644.03	1.64	1.82	33.45
Total snack	**153.82**	**644.03**	**1.64**	**1.82**	**33.45**
Mixed chicken stew	375.21	1563.72	27.39	13.50	38.96
Total dinner	**375.21**	**1563.72**	**27.39**	**13.50**	**38.96**
Total day	*1929.40*	*8075.33*	*79.05*	*79.89*	*231.07*