NUTRITION RECOMMENDATIONS FOR OLDER ADULTS

THE PANGeA STUDY

SCIENTIFIC MONOGRAPHY

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Nutrition and physical activity are the corner stones of successful ageing. The knowledge of the causes and consequences of malnutrition, screening and diagnostic methods and of specific nutrient requirements in the older adults is the mainstream to an adequate care of the ageing population.

Assist. Prof. Dr. Nada Rotovnik Kozjek

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POVZETEK

Boljši življenjski pogoji in lažja dosegljivost dobrega kakovostnega zdravljenja kroničnih obolenj so zvišali pričakovano življenjsko dobo prebivalstva, ne le v industrijskih državah, ampak tudi na svetovni ravni. Napoved pravi, da naj bi do obdobja 2030–2035 več kot 25% evropskih prebivalcev bilo starejših od 65 let. Sedanje demografske spremembe z večjim številom posameznikov, ki so nagnjeni h krhkosti in pogostejšim akutnim ter kroničnim boleznim, bodo imele ogromen vpliv na globalne in nacionalne zdravstvene ter socialne sisteme. Za staranje je značilna velika sprememba sestave telesa (izguba mišične in kostne mase ter povečanje mase maščobnega tkiva, zlasti na trebuhu), ki vodi do slabšega delovanja mišic in kosti ter sistemskih presnovnih posledic, kot so zmanjšana občutljivost za insulin, mišična anabolna odpornost na anabolne učinke substratov prehranskih aminokislin, zmanjšana skupna poraba energije in sprememba v prehranskih potrebah. Pri starejših osebah številni in pogosto prepletajoči se dejavniki, kot so zmanjšan občutek lakote in hitra sitost, spremembe v vonju ter zaznavanju okusa, zapoznelo praznjenje želodca in druge spremembe mobilnosti prebavnega trakta, spremembe v ravni hormonov ter citokinov, vedenjske spremembe življenjskega sloga pod vplivom okolja, socialno-ekonomskih, kulturnih, psiholoških in kognitivnih dejavnikov ter zdravstvene razmere s pomanjkanjem količine in nižje kakovosti hrane ter zmanjšane telesne dejavnosti in kronične bolezni, katerih razširjenost se veča s staranjem, lahko prispevajo k spremembam sestave telesa in njihovim posledicam.

Spremembe v prehrani z izgubo mišične in kostne mase lahko privedejo do zapletov, kot so fizične omejitve ali hujša invalidnost, zmanjšana samostojnost, slabše ravnotežje, povečano tveganje padcev in zlomov, slabša imunost, daljše celjenje ran ter zlomov, daljši čas okrevanja, višja stopnja sprejemanja in ponovnega sprejemanja v bolnišnico, pogostejša institucionalizacija, povečana obolevnost ter smrtnost in ne nazadnje višji gospodarski ter socialni stroški. Poznavanje natančne razširjenosti prehranskih sprememb pri starejših je bilo v mnogih epidemioloških študijah omejeno zaradi pomanjkanja enotnih meril in merskih inštrumentov. V zadnjem desetletju je zato prišlo do večje pozornosti pri opredelitvi in določanju diagnostične metodologije ter kriterijev za opredeljevanje prehranskega statusa starejših oseb. Pri tem velja spekter pogojev, od fizioloških sprememb staranja, kar je treba upoštevati pri zelo starih osebah, do pogojev, povezanih z boleznijo, kjer je značilen večji vnetni odziv. *Sarkopenija* označuje postopno in sistemsko izgubo mišične mase ter funkcije (upad moči in zmogljivosti). Izrazi, kot so *podhranjenost, prevelika poraba in kaheksija* označujejo z boleznijo povezano, nenaravno izgubo teže in mišične mase (sarkopenija, povezana z boleznijo). Za staranje je značilno večja razširjenost kroničnih bolezni. Zato sta tveganje in razširjenost podhranjenosti visoka ne le pri akutni hospitalizaciji, ampak tudi pri dolgoročni institucionalizaciji starejših.

Prekomerna telesna teža in debelost določata, tako kot v splošni populaciji, presežek maščobnega tkiva, vrednosti pa se lahko razlikujejo pri starejših in pri mlajših. Razširjenost debelosti in trebušne debelosti, najpogosteje povezanih s presnovnimi zapleti, kot so sladkorna bolezen, visok krvni tlak in dislipidemija, se povečuje s starostjo in običajno doseže vrhunec pri starosti okoli 70 let. *Sarkopenična debelost* se nanaša na prekomerno težo in sarkopenijo pri isti osebi. Prekomerna

telesna teža se šteje za etiološki ali slabšalni dejavnik sarkopenije, s povečanim vnetnim odgovorom, ki ga povzroča odvečno maščobno tkivo. Hkrati lahko sarkopenija poveča prekomerno telesno težo z zmanjšanjem bazalnega metabolizma, z izgubo mišične mase in porabo telesne energije pri telesni dejavnosti, z izgubo moči ter neaktivnostjo. Sarkopenična debelost je povezana z večjim tveganjem za zaplete zaradi seštevajočih se učinkov obeh stanj.

Prehrana in telesna dejavnost sta pomembna elementa zdravja in spremembe življenjskega sloga lahko omilijo negativne učinke staranja. Glede na veliko breme sarkopenije, prekomerne telesne teže in slabega prehranjevanja obstaja velik interes, da bi skupaj s spremljanjem in diagnostičnimi merili določili tudi učinkovite varovalne dejavnike ter načine zdravljenja, ki so najboljši za starejšega posameznika, ne le za preprečevanje pomanjkanja energije in ključnih hranil, ampak tudi za preprečevanje kroničnih bolezni ter boljše vzdrževanje zdravja, moči, neodvisnosti in kakovosti življenja. Bolj se bo potrebno zavedati tveganj in posledic prekomerne teže, sarkopenije in podhranjenosti pri starajočem se prebivalstvu na vseh ravneh oskrbe. Upravljanje teh tveganj zahteva multidisciplinaren, celosten pristop, glede na telesne, duševne, socialne in kulturne vidike vsakega posameznika, in to ne le na zdravstveni ravni, ampak tudi na ravni skupnosti ter celotnega družbenega okolja. Telesna dejavnost za vzdrževanje, ponovno pridobitev in povečanje mišične mase mora biti del globalne oskrbe starejših, vendar se danes pogosto ne upošteva. Izobraževanje, razpoložljivost primerne hrane inlokacije, primerne za telesno aktivnost, so enako pomembni. V splošnem so za vsako starost prebivalstva potrebne posebne prehranske smernice, pripravljene na znanstvenih dokazih. Namen pričujoče monografije je pregled literature o staranju in prehrani ter razpoložljivih smernic za učinkovito prehransko oskrbo in telesno dejavnost pri starejših, vključno s podatki *študije PANGeA za utemeljitev usmeritev življenjskega sloga.* Poudarek je predvsem na samostojno živečih ali večinoma samostojnih institucionaliziranih starejših, zdravih ali s stabilnimi kroničnimi boleznimi, ne pa na osebah z akutnimi ali hudimi kroničnimi boleznimi, ki potrebujejo intenzivno klinično udravljenje in spremljanje ter posebne prehranske smernice. Znanje in veščine medicinskega in socialnega osebja, ki sodeluje pri negi starejših, ter izobraževanje bolnikov so pomemben korak v prehranskih intervencijah v skupnosti ali v specializiranih okoljih. Prednosti dobre prehranske oskrbe starejših ne vplivajo ugodno le na posameznike, ampak na vso družbo in zdravstveni sistem.

Spremljajoča publikacija je namenjena praktičnim vidikom priprave obrokov. Recepti so prilagojeni tako, da so prehranske potrebe starejših zadovoljene z izbiro lokalnih, sezonskih, tradicionalnih in cenovno ugodnih živil. Ta pristop ni le hranilno ustreznejši za starejše, ampak ga spremlja tudi skrb za okolje, obenem pa je tudi sprejemljivejši ter prijetnejši za starejše.

Malnutrition in Older Adults. Urgent Need for Action: A Plea for Improving the Nutritional Situation of Older Adults. Gerontology 2013 Population Projections 2008–2060.

SUMMARY

Better living conditions and higher availability of good quality medical treatment for chronic diseases have greatly increased the life expectancy of the population not only in industrialized countries but also at worldwide level. It is predicted that by 2030–2035 more than 25% of the European citizens will have an age 65+ years. The present demographic changes with an increased number of individuals prone to frailty and to more frequent acute illnesses and chronic diseases, often of long term duration, is going to have a tremendous impact on the global and national health and social systems. Ageing is characterized by major body composition modification (loss of muscle and bone mass and expansion of fat tissue, especially at the abdominal level) leading to muscle and bone functional impairment and systemic metabolic consequences such as reduced insulin sensitivity, muscle anabolic resistance to the net anabolic effects of dietary amino acid substrates, reduced total energy expenditure and modification in nutrient requirements. In older adults multiple and often interacting factors such as diminished hunger and increased satiety, changes in smell and taste perception, delayed gastric emptying, and other gastrointestinal tract mobility alterations, changes in hormonal and cytokine levels, behavioural lifestyle changes influenced by environmental, socio-economic, cultural, psychological and cognitive factors and health conditions with inadequate dietary quantity and quality and decreased physical activity, and chronic diseases, whose prevalence is higher with ageing, may all contribute to the body composition modifications and its consequences.

Changes in the nutritional status with loss of muscle and bone mass are associated with complications such as physical limitations to severe disability, reduced autonomy, poorer balance, increased risk of falls and fractures, immune dysfunction, delayed wound and fractures healing, longer recovery time, higher rate of hospital admission and readmission, more frequent institutionalization, increased morbidity and mortality and higher economic and social costs. The exact prevalence of nutritional changes in older adults, in many epidemiological studies has been limited by the lack of uniform criteria. In the last decade, therefore there has been an increased attention to define and set diagnostic methodology and criteria for the nutritional status of older subjects, considering a spectrum of conditions, from the physiological changes of ageing, which in any case can be severe with increasing ageing in very old subjects, to the disease related conditions characterized by a higher inflammatory response. *Sarcopenia* designates the progressive and systemic loss of muscle mass and function (decline in strength or performance). Terms such as *malnutrition, wasting and cachexia* indicate illness related, non-spontaneous, loss of weight and of muscle mass (disease associated sarcopenia). Ageing is characterized by a higher prevalence of chronic diseases. Therefore the risk and the prevalence of malnutrition increase being high not only in acute hospitalization but also with long term institutionalization of older adults.

Overweight and obesity identify, as in the general population, an excess of fat tissue, however cut-off value may be different in the older from those in the younger ages. The prevalence of obesity and of visceral obesity, most often associated with metabolic complications, such as diabetes

mellitus, hypertension or dyslipidemia, increases with age generally reaching a zenith at an age around 70 years. *Sarcopenic obesity* refers to the coexistence of overweight and sarcopenia in the same person. Overweight is considered an etiological or worsening factor for sarcopenia, through an increased inflammatory response induced by the excess adipose tissue. At the same time, sarcopenia may increase overweight by reducing the basal metabolic rate, through the loss of muscle mass, and the physical activity energy expenditure, through loss of strength and inactivity. Sarcopenic obesity is associated with a higher risk of complications because of the addictive effects of the two conditions.

Nutrition and physical activity are important components of health and lifestyle interventions may counteract the negative effects of the ageing process. Considering the high burden of sarcopenia, overweight and malnutrition, there is a great interest to define together with screening and diagnostic criteria, the best nutritional and physical activity prevention and treatment modalities best fitted for the aged individual, not only to avoid deficiencies of energy and essential nutrients, but also to prevent chronic diseases and optimize maintenance of health, strength, autonomy and quality of life. There is also a need for a more diffuse awareness of the risks and consequences of overweight, sarcopenia and malnutrition in the ageing population at all levels of care; the management requiring a multidisciplinary, holistic approach, considering the physical, psychological, social, and cultural aspects of each individual, not only at medical level but also in the community and social environment. Physical activity to maintain, recuperate and increase muscle mass should be a part of the global care of older adults, but is often not taken into account. Education, adequate food availability and places adequate for physical activity are equally important. In the general population, age specific nutritional guidelines built on scientific evidence are needed. The purpose of this publication is to give a review of the literature on ageing and nutrition and of available guidelines for effective nutritional care and physical activity in older adults with input of data from the PANGeA study to support the rationale of the reported lifestyle indications. The focus is mainly on free living or mostly autonomous institutionalized older adults, healthy or with stable chronic diseases, rather than on subjects with acute or severe chronic conditions, needing intense clinical management. Qualification of health and social care staff involved in the care of older adults and patient education is an important step in the nutritional interventions in the community or in the specialized settings. The benefits of good nutritional care in older adults are not only observed at the individual level but are also extended to the entire society and the health system as a whole.

The accompanying publication is dedicated to practical aspects of menu preparations. The recipes are organized to ensure that the nutritional requirements of older adults are met through the choice of local, seasonal, traditional and affordable foods. This approach is not only nutritionally more appropriate for older adults, but it is accompanied by a concern for the environment and at the same time, it is acceptable and enjoyable for older population.

Malnutrition in Older Adults. Urgent Need for Action: A Plea for Improving the Nutritional Situation of Older Adults. Gerontology 2013 Population Projections 2008–2060.

FOREWORD

Prof. Dr. Rado Pišot

An unbalanced and unhealthy diet as well as physical inactivity in today's society have led to a number of complications that usually reflect in weaker health condition, poorer efficiency, increased addictions and general reduction in the quality of living of individuals. All groups of people are encountering these changes and unnatural adaptations, starting with our youngest, i.e. children and youngsters as well as the active population and the elderly. The latter, whose population share has been persistently increasing, are the most vulnerable from this aspect and additionally exposed to motor inactivity due to frequent diseases. They are also having more and more difficulties in following and achieving the criteria of a healthy and balanced diet.

Before the European Community announced the year 2012 as the European Year for Active Ageing and Solidarity between Generations, a group of experts in kinesiology and health care had decided to approach the preparation and the registration of a developmental research project that would examine the situation, search for healthy ageing factors and indirectly enable the increase of the quality of living of the elderly. We applied the project within the network of numerous researchers from various Slovenian and Italian universities and other institutions, and succeeded at the tender, financed under the European Regional Development Fund and under the Cross-Border Cooperation Programme between Slovenia and Italy 2007–2013. Project activities started in October 2011, and after three years of intensive work and numerous researches with the cooperation of various researchers, kinesiologists, doctors, medical staff and students we are proud of the achieved work. The objective of the PANGeA – Physical Activity and Nutrition for Quality Ageing project was to transfer the acquired knowledge on quality lifestyle to practical use by target groups of the elderly population. The majority of activities and researches was conducted and transferred directly in the local community in cooperation with centres for daily activities for the elderly, pensioners' associations and other communities for the elderly, thus resulting in the cooperation of numerous individuals on both sides of the Slovenian-Italian border. There was quite a lot of interest for cooperation, therefore, we wish to thank all for such an extensive collection of data that now provide us with new knowledge.

At the conclusion of this project, we can summarise the implemented activities in three fundamental parts that have each individually significantly contributed to new findings. The 14-day study of permanent inactivity effects and monitoring the mechanisms of functional and cognitive decline and rehabilitation as well as re-establishment of the initial condition enabled as an insight in the processes and mechanisms of changes in individual's organism, which has been modest and incomplete until today. This unique study, also in the global aspect, where we teamed up with international experts and combined our strengths and knowledge is the first study performed at the same time on elderly and younger participants. Today, we know a lot more about what is happening with elderly individuals when they must lie in bed due to an injury or disease. We know more about how their life systems are adapting, what changes they face, what are their nutrition needs in such state and how we can organise the rehabilitation process and what kind of rehabilitation process we can expect. We dedicated our special attention to introducing new modern methods with cognitive exercise, forming and developing programmes for a more efficient/faster recovery

of motor functions and independence after hip operations, which is one of the most reoccurring problems that the elderly face.

Mass measurements enabled us an important insight in the health and the condition of functional abilities as well as dietary habits and lifestyles of the elderly in the discussed area. 905 volunteers aged from 60 to 80 years living on the border area of Slovenia and Italy cooperated in our study. We studied the aspects of their motor activity, dietary habits, functional, cognitive and motor abilities, body structure as well as socio-demographic status. Measurements, organised as mass campaigns in different environments and close to the elderly within the aspect of space, time and funds, provided an extensive database of unique results that serve for the development of appropriate recommendations and programmes, and they were also an excellent support activity to the role and meaning of quality ageing in the modern society. In the wider international aspect, this was also a unique epidemiological study implemented and integrated directly in the local environment.

The implementation of interventions to increase the quality of living of the elderly based on an extensive base of new know-how, experience and behaviour acquired in the mentioned studies. This was our main activity and duty in the last period and after the end of the project. The project has brought many positive effects, most of which have been implemented among the general public, some scientific findings will be published in the future, however, the most important findings are: the set-up of six exercise parks for the elderly on the eligible area of Slovenia and Italy, which currently offer adjusted exercise to the elderly in three Slovenian and Italian cities, thus stimulating their healthy and active lifestyle; trainers qualified for elderly exercise introduced the activities in the parks to elderly users; 8 workshops were implemented for introducing the exercise programmes among users; physical therapy protocols were optimised for the treatment of patients with hip injury/wear – proposals of physical therapy programmes and testing their efficiency in clinical study; implementation of 10 educational seminars for future exercise trainers for the elderly; preparation of study materials for supplementary education in motor activity and nutrition of the elderly; the preparation of education material and guidelines for healthy diet including practical menus and recommendations as well as physical activity manual for third age with specific recommendations and examples of exercise.

The mentioned scientific monograph will be available to the interdisciplinary team of experts in the field of providing third age quality of life, i.e. along numerous scientific and expert papers as well as scientific papers. The value of this scientific monograph is that it offers an extraordinary review of researches and theoretical standpoints made so far in the consideration of processes of functional and metabolic changes of the individual as well as that it comprehensively considers the significance of a balanced and healthy diet during old age, from instructions for monitoring dietary status, clear recommendations for proper and necessary energy intake and special advice for individual and especially specific target groups of the elderly.

The Nutrition Recommendations for the Older Adults - the PANGeA Study rounds up numerous findings and conclusions as well as concrete activities and products that offer the scientific community, experts and general public numerous levers for the quality of life in third age.

REVIEWS

Prof. Dr. Zoran Grubič

A new publication entitled »Nutrition recommendations for older adults – The PANGeA study" is a timely one. The percentage of older people in our population is rapidly increasing and health problems related to ageing are therefore getting more and more important, not only for the health system and for its medical institutions, but also for the national economy in general.

It is well known and generally accepted that prevention of health problems is much more efficient and less costly than their treatment and there is no doubt that appropriate nutrition is one of the most important issues in preventive approaches to great majority of diseases. Specific circumstances, including social and financial problems that older people are especially exposed to, make nutritional issues even more endangering and therefore deserve special attention in this population.

As defined by the authors: "*the purpose of this publication is to give a review of the literature on ageing and nutrition and of available guidelines for effective nutritional care and physical activity in older adults with suggestions from the PANGeA study to further support the rationale of the given indications*". With this regard, the PANGeA study had the goal of "*evaluating the body composition, the nutritional status, and the physical abilities of the selected population of older Slovenians and Italians, aged between 60 and 80 and their ability to walk without any aid and with continuity for 2 km*". The focus was therefore mainly on free living or mostly autonomous institutionalized older adults, healthy or with stable chronic diseases, rather than on subjects with acute or severe chronic conditions, needing intense clinical management. The ultimate goal is defined as "*to define together with screening and diagnostic criteria, the best nutritional and physical activity prevention and treatment modalities best fitted for the aged individual*".

The publication is divided into four parts. In the first one, entitled "*Theoretical background for the nutrition recommendations for older adults*", authors are providing extensive review of literature dealing with the functional and metabolic changes of ageing including changes of the immune system and various problems affecting appetite. The second part, entitled "*Assessment of the nutritional status*", provides practical guidelines and the description of diagnostic tools that should be employed at assessing nutritional status of older adults. In the third part, "*Nutrient requirements*", one can find a list of required intakes for various nutritional components as recommended by official societies. In the last part, "*Nutritional measures for specific conditions*", authors discuss specific conditions affecting nutritional habits in the ageing populations such as reduced appetite, chewing problems, constipation etc. Special attention is devoted to the nutrition for physical activity and preservation of muscle mass in this part.

The work authors invested to this publication, with the goal to compile at one place the information scattered in hundreds of papers and various studies, deserves admiration. The result

of their efforts is a publication that should be recommended to everybody dealing with older people and their nutrition.

Prof. Dr. Gianni Biolo

Improved health policies and better socioeconomic conditions have increased life expectancy in many countries. This, associated with a reduced fertility rates, has raised the proportion of individuals aged more than 60–65 years (WHO). The other side of the coin, however, shows that a longer lifespan is characterized by a high frequency of diseases, loss of independence and poorer quality of life. Numerous epidemiological studies have shown that ageing is associated with changes in nutrient intake and/or requirements and impaired protein metabolism, factors that may lead to sarcopenia, even in overweight subjects (sarcopenic obesity) and to an increased risk of malnutrition.

Multiple factors can contribute to these conditions, both physiological (from ageing) and pathological (from acute and chronic diseases), which are more common with advancing age. Functional disabilities, frailty and higher morbidity and mortality rates and soaring care expenses are the dreadful consequences. Furthermore, the prevalence malnutrition is expected to rise from the progressive ageing of the population. **All these factors definitively call for interventions favouring quality ageing while providing older adults with adequate care, from prevention to diagnosis and treatment.**

All these considerations show the relevance of up to date indications about proper nutrition for older adults, **which need to be available and familiar to healthcare staff working in the medical and social geriatric care areas to guarantee the best nutritional support.**

The aim of the present publication is to offer a review of the metabolic and body composition changes in older adults and to describe the main nutritional problems, including definition, epidemiology, consequences, diagnosis and treatment. The booklet is dedicated mostly to healthy older adults or to subjects with chronic conditions. Acute diseases treated in the hospital settings are not included.

Both, nutrition and physical activity, can improve the nutritional, functional and metabolic consequences of ageing. Recent studies have highlighted that in older adults the need for dietary protein intake is higher than in younger individuals. Changes in requirements are due, among other factors, to higher splanchnic extraction, declining anabolic responses to ingested protein and to the need of counteracting the inflammatory and catabolic conditions, induced by illnesses. The recommendations for optimal dietary protein intake in older people, which we have published in the position paper from PROT-AGE Study Group (released by European Union Geriatric Medicine Society (EUGMS) and other scientific organizations), were taken as a reference for the present publication. The indication is to include in the daily diet from 1.0 to 1.2 g of protein/kg body weight, equally spread in the three major meals; together with endurance and resistance exercises, which are highly recommended to maintain muscle mass and prevent losses. The intake

should be > 1.2 g/kg body weight/day. The epidemiological part of the PANGeA study has shown that the ageing population does not always reach these levels of intake. Other topics described in the booklet are the specific requirement for major nutrient in older adults, advices for problems such as appetite loss, chewing difficulties and dry mouth, obesity, osteoporosis, osteoarthritis and dementia. The final part, translate theory to practice through a collection of menus. The protein content of each meal has been carefully calculated and balanced with other nutrients. Palatability however has not been forgotten but actually emphasized by referring mostly to traditional well-known foods prepared with fresh ingredients in season. Easiness of the preparation and costs has also been taken into account.

I hope that this booklet will be a helpful instrument to guide older adults toward a healthier and active lifestyle. I want to thank those who have contributed to the realization of the PANGeA project, including the senior citizens who volunteered with enthusiasm for the study.

EDITORIAL

Asist. Prof. Dr. Mojca Gabrijelčič Blenkuš

Specific challenge of the PANGeA project is linking basic research evidence and epidemiological data with implementation and translation of the produced new knowledge to the policy action and practice at different levels. Namely, one of today's opened questions in public health is how to effectively link research results and policy issues (McQueen et al. 2012). Finding and using appropriate mechanisms for transferring research into policy and practice has become a major policy driver around the world (Ward et al. 2009). Nutrition recommendations for older population are the emerging issue at the policy level of today, too.

In the second part of the 20th century was more and more obvious that multisectoral strategies, measures and activities outside health sector influencing health of the population are important for better public health and wellbeing, moving governments and stakeholders towards a shared governance for health and well-being. At the same time, health sector is increasingly engaged in initiating intersectoral approaches for health and acting as health broker and advocate (WHO 2012) and the power of knowledge is one of the crucial political forces for moving health issues onto policy agenda and thus to implementation.

PANGeA first project step, that is bed rest as a basic research approach, is providing the baseline for the second step – more public health oriented mass measurements, thus providing cross-sectional survey data in the selected population of older adults. PANGeA in its third step is translating research knowledge to guidelines for health enhancing physical activity and healthy nutrition for professionals working with older population and for older citizens themselves. Last step, establishment of the free of charge motor health parks for older members of local communities, is additional unique added implementation value of the project.

Transferring research knowledge into policy and practice is "*a messy and complex process, which both policymakers and researchers can struggle with*". In the case of PANGeA, the research process itself was used to connect the evidence to its use and users by involving Association of Social Institutions of Slovenia in participatory research of the needs of healthy nutrition in older population in Slovenia.

Present monograph is a valuable translation of the PANGeA research results and present worldwide knowledge into a useful tool for experts in different fields, working with older population in different settings.

BIBLIOGRAPHY

Leppo K, Ollila E, Pena S, Wismar M, Cook S. 2013. Health in all policies. Seizing opportunities, implementing policies. Ministry of Social Affairs and Health, Finland; 3–23; 325–37.

McQueen D, Wismar M, Lin V, Jones CM, Davies M (ed). 2012. Intersectoral governance for health in all policies. World Health Organization, European Observatory on Health Systems and Policies; 1–56.

van Kammen J, de Savigny D, Sewankambo N. 2006. Using knowledge brokering to promote evidence based policy-making: the need for support structures: Bulleting of the World Health Organization 2006; 84:608-12.

Ward V, House A, Hamer S. 2009. Knowledge Brokering: The missing link in the evidence to action chain? Evid Policy; 5(3): 267–279. doi: 10.1332/174426409X463811.

World Health Organization. 1998. Health 21: an introduction to the health for all policy framework for the WHO European region. WHO European Health for All Series; No.5.

World Health Organization. 2012. Health 2020: European policy framework supporting action across government and society for health and well-being. World Health Organization Regional Office for Europe.

WHO. 2010. Adelaide statement on health in all policies – moving towards a shared governance for health and wellbeing. World Health Organization, Government of South Australia, Adelaide.

1. MAIN PRELIMINARY RESULTS FROM THE PANGeA STUDY

PANGeA study was based on two main research goals. First main research goal, PANGea bed rest study results, is discussed below. The PANGeA study second research goal was to evaluate the body composition, the nutritional status and the physical ability of older inhabitants of Slovenia and Italy, aged between 60 and 80 and their ability to walk without any aid and with continuity for 2 km. Extensive measurements were executed in 900 older healthy living adults, living in local environment, 450 in Italy and 450 in Slovenia, in 2013 and 2014. Further results on the second research goal will be published elsewhere.

1.1 The effect of physical inactivity on young and old participants (the PANGeA bed rest study)

The effect of physical inactivity, a very common condition in older population, was systematically studied from 1980 with the aim of evaluating the effect of weightlessness (microgravity) on human organism. However, physical inactivity continues to be a major public health concern and is progressively becoming the ultimate risk factor for global death. Even more, sustained periods of physical inactivity are more common in older people, and when superimposed on the natural ageing process, can cause significant declines in physiological and cognitive function and a loss of independence (Davis et al. 2001; Nybo et al. 2003). Not only in older adults, physical inactivity is implicated in the recent worldwide epidemic of obesity and indicated as a major risk factor for morbidity and mortality also in adults as well as an independent risk factor for metabolic morbidity in children and adolescents (Jakičič et al. 2001; Caballero 2007; Strong et al. 2005).

Recently, the results of PANGeA bed rest study were published in Journal of Applied Physiology (Pišot et al. 2016 - in press). To summarize, we exposed 23 healthy males (7 young, aged 18–30 years; and 16 old, aged 55–65 years) to 14-day bed rest followed by 28-day supervised recovery. Measurements performed at baseline, after bed rest and on 14th day of recovery indicated (Figure 1):

- Quadriceps muscle volume decreased after bed rest by -5.7 ± 3.9% (P = .267) and -8.4 ± 3.7% (P < .001) in young and old, respectively. Taking into account the existing difference at baseline quadriceps muscle volume decreased significantly more in old than in young (P = .031) and, moreover, in old remained lower than the baseline values also on 14th day of recovery (P = .013).
- Quadriceps maximal muscle force and power declined after bed rest significantly only in old by -13.2 ± 12.4% (P < .001) and -12.3 ± 10.4% (P < .001), respectively. It is important to underline that on 14th day of recovery quadriceps' maximal force recovered completely, while quadriceps' maximal power remained lower compared to baseline by -7.8 ± 8.9% (P = .009).

- Maximal aerobic power (VO_2peak) decreased significantly after bed rest in young and old by -7.6 ± 4.8% (P = .007) and -15.3 ± 11.0% (P < .001), respectively. By 14th day of recovery VO_2peak fully recovered in young whereas in old it remained lower compared to baseline (-9.3 ± 13.4%; P = .020).
- Gait stride length decreased after bed rest only in old (-9.9 ± 11.3%, P = .002), but fully recovered by 14th day of recovery.

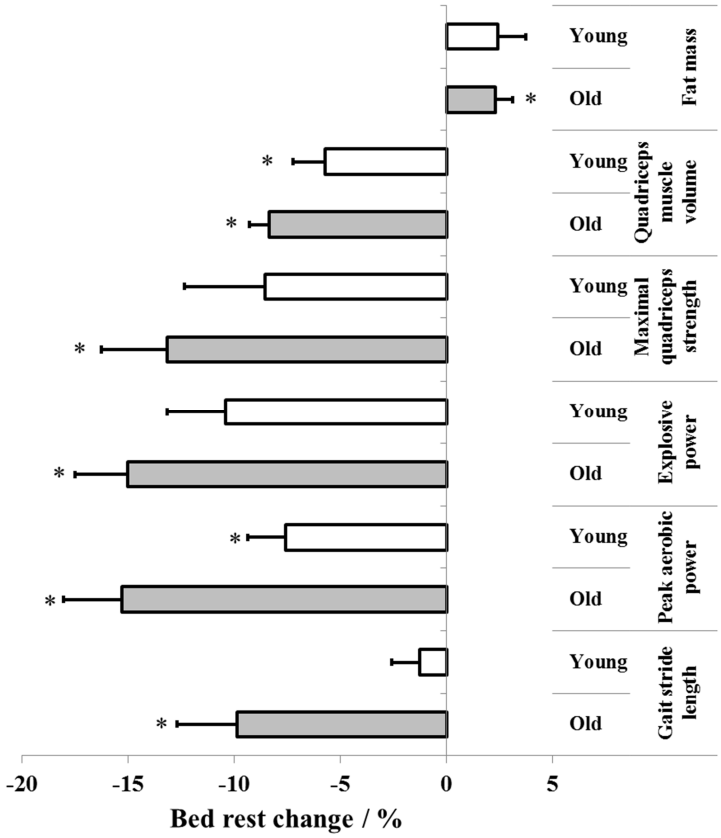


Figure 1. Mean changes (with standard error) after 14-day bed rest (physical inactivity) in groups of young and older male participants.

Furthermore, we explored also relevant parameters of the glucose and lipid metabolism:

- Body composition was altered after bed rest only in old as indicated by the fat mass increase after bed rest by 2.3 ± 3.2% (P = .022).
- Body mass, however, was not significantly altered by bed rest and recovery.
- The Matsuda index of postprandial insulin sensitivity showed a decrease after bed rest in both young and old. Surprisingly, the decrease of Matsuda index after bed rest was significantly greater in young (-46.0 ± 11.9%; P = .003) than in old (-19.8 ± 22.5%; P = .006) with an interaction effect P = .003. In old, Matsuda index fully recovered by 14th day of recovery.

- The post-prandial area under the curve of triglycerides showed after bed rest a minor and not significant variation in old (P = .121), while it significantly increased in young (47.2 ± 40.0%; P = .013) with an interaction effect P = .015.
- Plasma homocysteine concentration in the fasting state increased after bed rest in young (26.3 ± 21.4%; P = .027), whereas it did no change in old.

Bed rest in experimental condition, causes a loss of 3–5% of lean body mass in young healthy subjects. In the PANGeA study, 14 days of unloading of the skeletal-muscle system with bed rest, decreased the anabolic sensitivity to the nutritional stimuli in both young and older subjects, indicating an altered capacity to utilize amino acids for protein synthesis, at all ages. These metabolic alterations, however, were greater in the old group. These results underline the importance of an adequate protein intake and of physical activity with aging. To counteract the negative effects of anabolic resistance, protein intake should be higher in the older than in younger population, especially in very sedentary or bed ridden old subjects, in whom ageing and physical inactivity act synergistic to worsen metabolic, functional and body composition indices (see the section on nutrient requirements). The reduced muscle mass, being the skeletal muscle the greater site of glucose utilization, is associated also with an increased insulin resistance. Bed rest increased insulin resistance after just few days in young and old subjects.

The incidence of type 2 diabetes is known to increase with ageing. Several environmental and lifestyle-related factors contribute to the development of insulin resistance and, consequently, of type 2 diabetes. Particularly, a sedentary lifestyle is known to play a key role in such metabolic abnormalities. Previous studies demonstrated that insulin sensitivity is impaired after few days of experimental bed rest in young healthy subjects. As previously mentioned, in our study we observed that insulin sensitivity is impaired, in postprandial condition, after 2 weeks of bed rest, in both young and old individuals. However, the deleterious effect of unloading on insulin sensitivity is greater (double) in young as compared to older people. This result is only partially surprising, since it has been already demonstrated that the short-term negative effects of physical inactivity are more evident in trained that in untrained conditions. Furthermore nutritional or exercise interventions, aimed to ameliorate such metabolic alterations, could be more efficient in trained than in untrained subjects. Consequently, our results show that older subjects are less responsive to the detrimental effects of physical inactivity; however this group could be, potentially, also less sensible to the beneficial effects of adequate nutritional and physical activity programs. In line with PANGeA results, inactive lifestyle in older population also contributes to the development of this metabolic disorder.

To summarize, this study design compared the response to disuse (14-day bed rest) and recovery in young and old subjects, and came to the following conclusions: i) the inactivity or bed rest period (14 days) was sufficiently long to induce a response in the young as well as in the old; ii) the impact of inactivity on muscle mass and function was greater in the old; while iii) metabolic alterations were greater in the young; and iv) the recovery of baseline conditions was slower in old.

The greater detrimental effect of physical inactivity and the delayed recovery in older adults, documented by the PANGeA bed rest study, strongly emphasize the importance of an active lifestyle in old age, avoiding or minimizing periods of inactivity particularly when these are due to hospitalization and bed rest.

Caballero B. The global epidemic of obesity: An overview. Epidemiol Rev. 2007; 29:1–5.

Davis HP, Trussell LH, Klebe KJ. A ten-year longitudinal examination of repetition priming, incidental recall, free recall, and recognition in young and elderly. Brain Cogn. 2001; 46(1-2):99–104.

Jakičič JM, Clark K, Coleman E, Donnelly JE, Foreyt J, Melanson E, Volek J, Volpe SL. Appropriate intervention strategies for weight loss and prevention of weight regain for adults. Med. Sci. Sports Exerc. 2001; 33(12):2145–56.

Nybo H, Petersen HC, Gaist D, Jeune B, Andersen K, McGue M, Vau-pel JW, Christensen K. Predictors of mortality in 2,249 nonagenarians - the Danish 1905-Cohort Survey. J. Am. Geriatr. Soc. 2003; 51:1365–73.

Pišot R, Marušič U, Biolo G, Mazzucco S, Lazzer S, Grassi B, Reggiani Carlo, Toniolo L, di Prampero PE, Passaro A, Narici M, Mohhamed S, Rittweger J, Gasparini M, Gabrijelčič Blenkuš M, Šimunič B. Greater loss in muscle mass and function but smaller metabolic alterations in older compared to younger men following two weeks of bed rest and recovery. Journal of applied physiology, ISSN 8750-7587, 2016, in Press.

Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, Hergenroeder AC, Must A, Nixon PA, Pivarnik JM, Rowland T, Trost S, Trudeau F. Evidence based physical activity for school-age youth. J Pediatr. 2005; 146:732–7.

2. NUTRITIONAL STATUS

2.1 BODY COMPOSITION, FUNCTIONAL AND METABOLIC CHANGES OF AGEING

Ageing is associated with well-known body composition changes with loss of muscle mass and expansion of the fat mass. Fat distribution also changes with a prevalent deposition at visceral level. Bone mass also declines and the immunological system may become depressed. Functional changes in muscle contractility may precede gross changes. While some level of mass and function losses in different body compartments may be physiological, greater changes may lead to clinically relevant consequences including disability, metabolic changes, poorer quality of life, increased morbidity and mortality. Therefore great attention should be given to early signs and to modifiable factors including nutrition and physical activity. Body composition changes may span from loss of muscle mass or *sarcopenia,* to expanded fat mass, to the levels of overweight and obesity, to the combination of the two conditions or sarcopenic obesity, to a state of malnutrition induced by diseases and associated with sarcopenia.

Sarcopenia

Definition. Sarcopenia from Greek words *sarco "meat"*, and *poenia "little amount"* defines a condition characterized by reduced muscle mass, associated with a decline in strength or performance, with ageing. This is the definition given in the year 2010, by the EWGSOP (European Working Group on Sarcopenia in Older People), inclusive of experts from the European Geriatric Medicine Society (EUGMS), the European Society for Clinical Nutrition and Metabolism (ESPEN), the International Association of Gerontology and Geriatrics – European Region (IAGG-ER) and the International Academy of Nutrition and Ageing (IANA). The EWGSOP group classifies sarcopenia as primary or age related (associated with the physiological changes induced by ageing process) and secondary to other factors (inactivity and illnesses, nutritional problems, such as malabsorption or other gastrointestinal disorders or intake of medications, causing anorexia.) (Age Ageing. 2010; 39:412–23). The Special Interest Groups (SIG) "Cachexia-Anorexia in Chronic Wasting Diseases" and "Nutrition in Geriatrics" of the European Society of Clinical Nutrition and Metabolism (ESPEN) defined sarcopenia as any clinically relevant loss of skeletal muscle mass and function secondary to ageing, chronic diseases, cancer, low protein-energy intake and physical inactivity, with no distinction between primary and secondary sarcopenia. A separated definition has not been considered useful since in the majority of cases muscle loss is the result of multiple problems, making impossible to separate the effects of single etiological factors (Biolo, Muscaritoli 2014), especially in the ageing population, characterized by a higher prevalence of chronic and acute diseases. The diagnostic criteria for sarcopenia are not fully defined, however many tools are available (*See section on diagnosis).*

Evolution and prevalence. The *Health, Aging and Body Composition (Health ABC) study* evaluated 3,075 healthy community-dwelling men and women, aged 70–79 years, at baseline and after a

period of 3 years, to measure longitudinal changes in body composition (by dual-energy x-ray absorptiometry and computed tomography) and muscle leg strength (by isokinetic knee extensor strength). At the follow-up, all participants, both male and females, showed a mean leg muscle mass loss of 1% per year and a three times higher loss of muscle strength. Muscle function is compromised earlier and largely than mass, therefore the changes of the two components are not related in a linear way. Muscle atrophy is associated mainly with the loss of type II fibres, recruited mostly in physical activity of higher intensity. Subjects who had lost weight, during the observation period, showed a greater muscle atrophy and loss of function, while those who gained weight, even with some increase in muscle mass, did not reach any further improvement in strength. Sarcopenia starts at an age around 40 years, to continue through life, with a loss of about 40% between the age of 20 and 70 years. The prevalence of sarcopenia, because of the application of different diagnostic criteria, may show some inaccuracy. A study from the USA based on the Third National Health and Nutrition Examination Survey data, found in the population aged more than 50 years a prevalence of class I sarcopenia (skeletal muscle mass index within one to two standard deviations below sex-specific values for young adults) in 45% men and 59% women. Class II sarcopenia (skeletal muscle mass index two standard deviations below values in young adult) affected 7% of men and 10% of women, being therefore higher in women. Italian studies based on the application of EWGSOP diagnostic criteria to the baseline and follow up data of subjects aged more than 80 years, taken form the ilSIRENTE study, identified sarcopenia in 25% of community-dwelling individuals, with no differences between men and women. Participants with sarcopenia showed an over three times higher risk of falls, during a 2-year follow-up period. In the InCHIANTI study, sarcopenia always defined according to the EWGSOP criteria the prevalence of sarcopenia increased with age. It involved mainly subjects aged above 80 years (31.6% women and 17.4% men). In older subjects institutionalized in long-term care facilities, sarcopenia was more common being present in 32.8% cases, with a large gender discrepancy, being more common in males than in females, 68% vs 21%).

Causes, consequences and mechanisms. Sarcopenia and the associated body composition changes are caused by multiple factors including the so called “anorexia of ageing”, i.e. reduced food intake, seen with advancing age (*see section on appetite changes in older adults*), hormonal changes such as reduced synthesis of growth and sex hormones, resistance to leptin, insulin and thyroid hormones, and neurodegenerative processes. Other contributing factors include heritability, intake of proteins (type and quantity) and energy, vitamin D status and levels of physical activity. The ageing muscle is characterized by lower rates of protein turnover with reduced protein synthesis and increased catabolism and a decline in net protein synthesis, sustained by higher splanchnic extraction of amino acids, that impairs their availability, and by a blunted response to the anabolic stimulus of protein feeding and to the anticatabolic effects of insulin. Physical activity with muscle loading also exerts anabolic effects, both in muscles and in bones. Reduced exercise in older adults, caused by loss of strength, overweight, balance and locomotion disturbances, fear of falls, reduced opportunities, low motivation, illness condition may contributes to loss of mass and function in these tissues.

The loss of muscle mass in sarcopenic subjects causes a reduction in the basal metabolic rate and in physical activity energy requirements. These changes, if not compensated by lower energy intake, or by a heightened energy expenditure, through increased physical activity, as often is the case with ageing, may lead to an increased fat deposition. Furthermore, physical inactivity itself leads within two weeks, a short term period, to an accumulation of visceral fat, and insulin resistance, as shown in young subjects who reduced experimentally their level of physical activity to about 15% of the basal level. Sarcopenia therefore is generally associated with an increase in the percentage of body fat. This rise in fat mass is observed in both sexes and at any given BMI, being present even in normal or underweight individuals. Fat tissue is mostly expanded at the visceral or abdominal level, with an increase in waist circumference, observed more frequently in females. Furthermore, there is an age related deposition of ectopic fat at the intra-muscular, intra-hepatic and intra-pancreatic levels. Enlarged visceral adipocytes and activated macrophages, attracted in the adipose tissue by adipocyte secreted chemokines, release hormones and cytokines such as adiponectin, leptin, tumour necrosis factor and interleukin 6 (IL-6), giving rise to an inflammatory response and to insulin resistance. A higher release of free fatty acids further contributes to the insulin resistance. TNF-α has direct inhibitory effects on insulin signalling and also increment the release of free fatty acids (FFA) from adipose tissue. These changes increase the risk of developing type II diabetes, metabolic syndrome and cardiovascular complications. Recently it has been shown that, besides fat tissue, also skeletal muscle can be considered an endocrine organ, producing peptides both anabolic (insulin-like growth factor, IL -15) and catabolic (myostatin) and cytokines, called myokines' including IL-6, IL-8 and IL-15 (produced during muscle contraction). Physical activity increases the muscle synthesis of IL-6 with consequent useful metabolic consequences such an increased local glucose uptake and fat oxidation, a higher neoglucogenesis in liver and lipolysis in adipose tissue. IL-15 plays anabolic activity in skeletal muscle a role in lipid metabolism. Sarcopenia by reducing strength and function leads to poorer balance and higher risk of falls and fracture, decreases autonomy and lower quality of life, increased metabolic complications, and higher morbidity and mortality. Therefore, adequate countermeasures need to be taken.

BIBLIOGRAPHY

Biolo G, Cederholm T, Muscaritoli M. Muscle contractile and metabolic dysfunction is a common feature of sarcopenia of aging and chronic diseases: From sarcopenic obesity to cachexia. Clin Nutr. 2014 Mar 29.

Bauer J, Biolo G, Cederholm T, Cesari M, Cruz-Jentoft AJ, Morley JE, Phillips S, Sieber C, Stehle P, Teta D, Visvanathan R, Volpi E, Boirie Y. Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. J Am Med Dir Assoc. 2013; 14(8):542-559.

Boirie Y, Morio B, Caumon E, Cano NJ. Nutrition and protein energy homeostasis in elderly. Mech Ageing Dev. 2014 Jan 31.

Cruz-Jentoft A J, Baeyens JP, Bauer JM et al. Sarcopenia: European consensus on definition and diagnosis. Age and Ageing, 2010; 39(4): 412–423.

Cruz-Jentoft J, Landi F, Topinková E, J. Michel JP. Understanding sarcopenia as a geriatric syndrome. Current Opinion in Clinical Nutrition and Metabolic Care, 2010; 13(1): 1-7.

Ferrando AA et al. EAA supplementation to increase nitrogen intake improves muscle function during bed rest in the elderly Clinical Nutrition 2009; 29:18-23.

Ferrucci L, Guralnik JM, Buchner D, et al. Departures from linearity in the relationship between measures of muscular strength and physical performance of the lower extremities: the Women's Health and Aging Study. J Gerontol A Biol Sci Med Sci. 1997; 52(5):M275–85.

Fielding RA, Vellas B, Evans WJ, Bhasin S, Morley JE et al. Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International working group on sarcopenia. J Am Med Dir Assoc. 2011; 12(4):249-56.

Frontera WR, Hughes VA, Fielding RA, et al. Aging of skeletal muscle: a 12–yr longitudinal study. Journal of Applied Physiology. 2000; 88(4):1321–6.

Fry CS, Rasmussen BB. Skeletal muscle protein balance and metabolism in the elderly. Curr Aging Sci. 2011; 4(3):260-268.

Gallagher D, Ruts E, Visser M, Heshka S, Baumgartner RN, Wang J, Pierson RN, Pi-Sunyer FX, Heymsfield SB. Weight stability masks sarcopenia in elderly men and women. Am J Physiol Endocrinol Metab. 2000; 279:E366-75.

Goodpaster BH, Carlson CL, Visser M, et al. Attenuation of skeletal muscle and strength in the elderly: The Health ABC Study. Journal of Applied Physiology. 2001; 90(6):2157–65.

Health, Aging and Body Composition (Health ABC), Conley KE, Bajpeyi S, Punyanitya M, Gallagher D, Zhang Z, Covington J, Smith SR, Ravussin E. Ectopic lipid accumulation and reduced glucose tolerance in elderly adults are accompanied by altered skeletal muscle mitochondrial activity. J Clin Endocrinol Metab. 2012 Jan; 97(1):242-50.

Hida T, Harada A. Fall risk and fracture. Diagnosing sarcopenia and sarcopenic leg to prevent fall and fracture: its difficulty and pit falls. Clin Calcium. 2013 23(5):707-712.

Janssen I. Influence of sarcopenia on the development of physical disability: the Cardiovascular Health Study. J Am Geriatr Soc. 2006 Jan; 54(1):56–62.

Janssen, S. Heymsfield B, Ross R. Low relative skeletal muscle mass (sarcopenia in older persons is associated with functional impairment and physical disability. Journal of the American Geriatrics Society, 2002; 50: 889–896.

Kunihiro S, Yamaguchi A. Sarcopenic Obesity and endocrinal adaptation with age. Int J Endocrinol. 2013; 2013: 204164.

Hida T, Harada A. Fall risk and fracture. Diagnosing sarcopenia and sarcopenic leg to prevent fall and fracture: its difficulty and pit falls. Clin Calcium. 2013 23(5):707-12.

Kyle UG, Genton L, Hans D, Karsegard VL, Michel JP, Slosman DO, Pichard C. Total body mass, fat mass, fat-free mass, and skeletal muscle in older people: cross-sectional differences in 60-year-old persons. J Am Geriatr Soc. 2001 Dec; 49(12):1633-40.

Landi F, Liperoti R, Russo A et al., "Sarcopenia as a risk factor for falls in elderly individuals: results from the ilSIRENTE study," Clinical Nutrition. 2012 Oct; 31(5):652-8.

Landi F, R. Liperoti, D. Fusco et al., "Prevalence and risk factors of sarcopenia among nursing home older residents," Journals of Gerontology A, 2012; 67:48–55.

Morley JE et al Nutritional Recommendations for the Management of Sarcopenia. J Am Med Dir Assoc 2010; 11: 391–396

Morley JE, Argiles JM, Evans WJ, Bhasin S, Cella D, Deutz NE, Doehner W,Fearon KC, Ferrucci L, Hellerstein MK, Kalantar-Zadeh K, Lochs H, MacDonald N, Mulligan K, Muscaritoli M, Ponikowski P, Posthauer ME, Rossi Fanelli F, Schambelan M, Schols AM, Schuster MW, Anker SD; Society for Sarcopenia, Cachexia, and Wasting Disease. Nutritional recommendations for the management of sarcopenia. J Am Med Dir Assoc. 2010 Jul; 11(6):391-6.

Narici MV, Maffulli N. Sarcopenia: characteristics, mechanisms and functional significance. British Medical Bulletin 2010; 1–21.

Newman AB, Lee JS, Visser M, et al. Weight change and the conservation of lean mass in old age: the Health, Aging and Body Composition Study. Am J Clin Nutr. 2005 Oct; 82(4):872–8.

Pedersen BK, Febbraio MA. Muscle as an endocrine organ: focus on muscle-derived interleukin-6. Physiol Rev. 2008 Oct; 88(4):1379-406.

Roberts HC, Denison HJ, Martin HJ et al. "A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach," Age and Ageing, 2011; 40(4): 423–429.

Sakuma K, St-Onge MP, Dardevet D, Rémond D, Peyron MA, Papet I, Savary-Auzeloux I, Mosoni L. Muscle wasting and resistance of muscle anabolism: the "anabolic threshold concept" for adapted nutritional strategies during sarcopenia. Scientific World Journal. 2012; 2012:269531.

Sakuma K, Yamaguchi A. Sarcopenia and age-related endocrine function. Int J Endocrinol.2012; 127362.

Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People.

Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, Martin FC, Michel JP, Rolland Y, Schneider SM, Topinková E, Vandewoude M, Zamboni M; European Working Group on Sarcopenia in Older People.(Age Ageing. 2010; 39:412–23).

St-Onge MP, Gallagher D. Body composition changes with aging: the cause or the result of alterations in metabolic rate and macronutrient oxidation? Nutrition. 2010; 26(2):152-5.

Volpato S, Bianchi L, Cherubini A, Landi F, Maggio M, Savino E, Bandinelli S, Ceda GP, Guralnik JM, Zuliani G, Ferrucci L. Prevalence and clinical correlates of sarcopenia in community-dwelling older people: application of the EWGSOP definition and diagnostic algorithm. J Gerontol A Biol Sci Med Sci. 2014.

Welch AA. Nutritional influences on age-related skeletal muscle loss. ProcNutr Soc. 2014; 73(1):16-33.

Zamboni M, Zoico E, Scartezzini T, Mazzali G, Tosoni P, Zivelonghi A, Gallagher D, De Pergola G, Di Francesco V, Bosello O. Body composition changes in stable-weight elderly subjects: the effect of sex. Aging Clin Exp Res. 2003 Aug; 15(4):321-7.

Malnutrition and cachexia

Definition and causes. Malnutrition, formerly called "*protein energy malnutrition*", is defined as a condition of inadequate nutrition or of imbalance between the intake of energy, proteins or micronutrients and the requirements of a subject, caused most often by the presence of acute or chronic diseases. It is caused by many factors, including acute and chronic medical conditions, decreased appetite and reduced food intake, poor dentition, social and economic problems, cognitive decline and mood disorders. Malnutrition causes changes in function and body composition, with loss of muscle mass and body weight and is associated with clinically relevant prognostic consequences, with increased morbidity (higher infection rates, and postsurgical complications), longer hospital stays and recovery time, loss of autonomy, higher need for specialized care and drugs, higher health costs and mortality. There is a need for better nomenclature to define the nutritional status changes in older subjects. The terms for malnutrition have been modified many times in the past, and the debate is still open. Today we have tools to diagnose malnutrition in population with low BMI but very difficult in obese people. Latest proposals also underline the role of inflammation as the major pathophysiologic factor of disease or injury related malnutrition and its severity. Malnutrition contributes to metabolic changes and leads to cachexia. Cachexia is a severe wasting disorder, characterized by both loss of muscle and fat. It is caused by a variety of illnesses that produce pro-inflammatory cytokines. These cytokines activate proteolytic systems, mainly the ubiquitin-proteasome system, what results in the degradation of protein in muscle. Cytokines and neurohormonal changes induced by chronic inflammation also stimulate lipolysis that increases circulating triglycerides and free fatty acids. A

consensus approach was reached at meetings at the A.S.P.E.N. and ESPEN Congresses, 2010 by the National Guideline Committee which designed a three-category classification based on the absence or presence of an inflammatory response and on its intensity including: (1) starvation-related malnutrition, without inflammation, from inadequate food intake; (2) chronic disease related malnutrition, with prolonged mild to-moderate inflammation (such as in sarcopenic obesity, organ failure and cancer); and (3) acute disease or injury related malnutrition, with intense inflammatory response. The International "Cachexia consensus conference" (2008) uses the term cachexia, from the two Greek words *caco* "bad", and *hexis* "condition", to indicate a "complex metabolic syndrome associated with underlying illness and characterized by loss of muscle mass from increased protein breakdown, with or without loss of fat mass, weight loss, inflammation and anorexia". The special Interest Groups (SIG) "cachexia-anorexia in chronic wasting diseases" and "nutrition in geriatrics" part of ESPEN further defined these conditions. Pre-cachexia is defined by the presence of underlying chronic disease; unintentional weight loss ≤ 5% of usual body weight during the last 6 months; chronic or recurrent systemic inflammatory response and anorexia or anorexia-related symptoms.

Cytokines also result in anorexia, decreased gastric emptying and intestinal motility, anaemia, increased resting metabolic rate and a decrease in serum albumin. Cachexia is associated with an increase in acute phase reactants, such as C-reactive peptide and a reduced serum albumin protein. Table 1 compares cachexia with under-nutrition due to anorexia and sarcopenia. It should be recognized that in most older patients, there is an overlap in these three conditions; it is rare to see older persons with only one of these syndromes.

Table 1. Comparison of the characteristics of undernutrition due to anorexia, cachexia and sarcopenia.

	Anorexia	Cachexia	Sarcopenia
Anorexia	+	++	–
Weight loss	+	++	+/–
Fat loss	++	++	0
Muscle loss	+	+++	++
Proteolysis	–	++	+
Hypertriglyceridemia	–	++	+
Anaemia	+	++	–
Insulin resistance	–	++	+
Elevated cytokines	+/–	++	+/–
Increased C-reactive protein	–	++	–

+ present; – absent

Prevalence. According to a large review by Guigoz, based on the Mini Nutritional Assessment, the prevalence of malnutrition in free living older adults malnutrition was 2% and the risk 24% (with a wide range between 8–76%). In residents of homes for older adults the undernutrition prevalence was 9% (range 0–30%) and risk of malnutrition 45% (range 8–65%). In hospitalized patients percentages were higher, namely 23%, with 46% of the subjects at risk of malnutrition, in

institutionalized subjects numbers were 21% (range 5–71%) and 51% (range 27–70%). The BAPEN, British Association for Parenteral Enteral Nutrition, in England using a screening tool as the MUST (Malnutrition Universal Screening Tool), showed the presence of malnutrition in 32% of subjects aged over 65 years compared to 23% in younger subjects. A relatively low level of malnutrition in community-dwelling individuals, ranging from 1 to 10%, was confirmed by Seneca Study. Rates, however, increase greatly in institutionalized (5–59%) and hospitalized older patients (17–85%), with differences among countries, clinical specialties and methods of assessment.

Data for prevalence of cachexia in older population are still missing and are probably overlapping with prevalence data of cachexia.

Consequences. Malnutrition increases morbidity and mortality, decreases autonomy and quality of life. In older women, hospitalized for a fractured femur, an inverse relation has been found between mass muscle, as an indicator of nutritional status, and mortality. Malnutrition in older patients hospitalized for rehabilitation had a negative impact on functional recovery and quality of life after discharge to the community. A number of studies have now shown that the relative risk of death is consistently highest in underweight patients than in those overweight and this holds particularly true for older subjects. On the other hand, an early diagnosis and an adequate nutritional support decrease the length of hospital stay, the incidence of complications and mortality rates.

BIBLIOGRAPHY

Abassi A, Rudman D. Undernutrition in Nursing Homes: Prevalence, Consequences, Causes and Prevention in Nursing Homes. Nutr Rev. 1994: 133-122.

Argilés JM, Anker SD, Evans WJ, Morley JE, Fearon KC, Strasser F, Muscaritoli M, Baracos VE. Consensus on cachexia definitions. J Am Med Dir Assoc. 2010; 11(4):229-30.

Burger SG, Kayser-Jones J. Malnutrition and Dehydration in Nursing Homes: Key Issues in Prevention and Treatment, National Citizens' Coalition for Nursing Home Reform, The Commonwealth Fund, July 2000.

De Groot LCPGM, van Staveren WA, Dirren H, Hautvast JGAJ. Seneca: Nutrition and the elderly in Europe, follow-up study and longitudinal analysis. Eur J Clin Nutr 1996; Suppl. 2: 50.

De Groot LCPGM, van Staveren WA, Hautvast JGAJ. Euronut Seneca: Nutrition and the elderly in Europe. Eur J Clin Nutr 1991; Suppl. 3: 45.

Jensen GL, Mirtallo J, Compher C, Dhaliwal R, Forbes A, Grijalba RF, Hardy G, Kondrup J, Labadarios D, Nyulasi I, Castillo Pineda JC, Waitzberg D; International Consensus Guideline Committee. Adult starvation and disease-related malnutrition: a proposal for etiology-based diagnosis in the clinical practice setting from the International Consensus Guideline Committee. JPEN J Parenter Enteral Nutr. 2010; 34(2):156-9.

Jensen GL, Wheeler D. A new approach to defining and diagnosing malnutrition in adult critical illness. Curr Opin Crit Care. 2012; 18(2):206-11.

Markson EW. Functional, social, and psychological disability as causes of loss of weight and independence in older community-living people. Clin Geriatr Med 2007; 13:639–652.

Marshall S, Bauer J, Isenring E. The consequences of malnutrition following discharge from rehabilitation to the community: a systematic review of current evidence in older adults. J Hum Nutr Diet. 2014 Apr; 27(2):133-41.

McWhirter JP & Pennington CR. Incidence and recognition of malnutrition in hospital. BMJ. 2004; 308, 945-985.

Morley JE. Undernutrition in older adults. Fam Pract. 2012; 29:89-93.

Muscaritoli M, Anker SD, Argilés J, Aversa Z, Bauer JM, Biolo G, Boirie Y, Bosaeus I, Cederholm T, Costelli P, Fearon KC, Laviano A, Maggio M, Rossi Fanelli F, Schneider SM, Schols A, Sieber CC. Consensus definition of sarcopenia, cachexia and pre-cachexia: joint document elaborated by Special Interest Groups (SIG) "cachexia-anorexia in chronic wasting diseases" and "nutrition in geriatrics". Clin Nutr. 2010; 29(2):154-9.

Niedert KC; American Dietetic Association. Position of the American Dietetic Association: liberalization of the diet prescription improves quality of life for older adults in long-term care. J Am Diet Assoc 2005; 105:1955-65.

Russell, C. A., and M. Elia. "Nutrition Screening Survey in the UK in 2008." British Association for Parental and Enteral Nutrition (2009).

Y. Guigoz. "The Mini Nutritional Assessment (MNA) review of the literature—what does it tell us?" The Journal of Nutrition, Health & Aging, 2006; 10(6): 466–487.

Yeh SS, Blackwood K, Schuster MW. The cytokine basis of cachexia and its treatment: are they ready for prime time? J Am Med Dir Assoc 2008; 9:219-36.

Frailty

The term defines a condition, or rather a syndrome, characterized by increased vulnerability to negative health outcomes, such as increased risk of falls, disability, dependency, morbidity, higher hospitalization rates and mortality. In spite of medical and social relevance of frailty, a generally accepted definition is lacking. Many diagnostic and severity classifications are available based on a range of assessment items from strength, disability and nutrition to the presence of associated illnesses, sensory impairment, cognition, mood and level of social support. The Fried's criteria have been used more extensively, and are based on five variables: weight loss, exhaustion, grip strength, walking speed and physical activity; however, the reference system is quite complex. The Survey of Health, Aging and Retirement in Europe (SHARE study) – a large trial on 17,304 females and 13,811 males, aged above 50 years, from 12 European countries (Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium and Israel) – employed a simplified frailty instrument (SHARE-FI), that based on data from the previous month to allow a fast screening at the level of primary care. Exhaustion is defined as too little energy to do the things one wants to do, while weight loss is assessed on appetite modification or on changes in the amount of food eaten. Weakness is based on handgrip strength (Kg) measurement with a dynamometer. Slowness is evaluated by the reported difficulties about walking 100 meters or climbing one flight of stairs, without resting, while low activity is defined by the frequency of engaging in activities requiring a low or moderate level of energy such as walking or being involved in choirs like gardening, cleaning, etc. Subjects can be classified as robust, pre-frail, and frail. The European SHARE study showed an average frailty and pre-frailty prevalence in older adults aged above 65 years of 17% and 42.3% respectively. Sarcopenia and malnutrition both increase the risk of frailty. In acute hospitalized older adult patients (65–97 years), the MNA®-SF (Mini Nutritional Assessment® short-form) was used to evaluate malnutrition or risk of malnutrition while the SHARE-FI to define frailty. Malnutrition was more common in frail subjects being 46.8% in robust, 69.0% in pre-frail, and in 93.0% of frail older adults.

BIBLIOGRAPHY

Bouillon K, Kivimaki M, Hamer M, Sabia S, Fransson EI, Singh-Manoux A, Gale CR, Batty GD. Measures of frailty in population-based studies: an overview. BMC Geriatr. 2013 Jun 21; 13:64.

Dorner TE, Luger E, Tschinderle J, Stein KV, Haider S, Kapan A, Lackinger C, Schindler KE. Association between Nutritional Status (MNA®-SF) and Frailty (SHARE-FI) in Acute Hospitalised Elderly Patients. J Nutr Health Aging. 2014; 18(3):264-9.

Espinoza S, Walston JD: Frailty in older adults: insights and interventions. Cleve Clin J Med 2005; 72(12):1105–1112.

Fried LP, Ferrucci L, Darer J, Williamson JD, Anderson G: Untangling the concepts of disability, frailty, and comorbidity: implications for improved targeting and care. J Gerontol A Biol Sci Med Sci 2004; 59(3):255–263.

Roman Romero-Ortuno A. Frailty Instrument for primary care: findings from the Survey of Health, Ageing and Retirement in Europe (SHARE). BMC Geriatrics2010; 10:57.

Obesity and sarcopenic obesity

Definition. Obesity is a condition characterized by excess deposit of body fat, which may lead to an increased risk of metabolic, mechanical, cardiovascular, neoplastic and psychological complications and premature death. Many epidemiological studies have shown an increased prevalence of overweight in the ageing population that seems to extend over the age of 70 years, both in terms of BMI and waist circumference, an indicator of fat accumulation at the abdominal level. The finding of a higher increase in waist circumference than in BMI, indicates the association of a gain in visceral fat with a loss of muscle mass. This condition seems to be more common in females, most likely from an earlier influence of the hormonal changes associated with menopause. After the age of 70 years, obesity prevalence declines. In the United States, a country where overweight is at its maximum worldwide, a major increase in obesity in the senior population, aged 65–74 years, has been shown by comparison of the periods between the years 1976–1980 and 2003–2006, with rates rising from 13.2% to 33%, in men and from 21.5% to 36.4%, in women. In the period 2007–2010, the prevalence of obesity, in females aged 65 to 74 years, showed a low further increase to 40%. These very limited change possibly from a higher attention to health or from a wider use of bariatric surgery, introduced since 1998 and progressively popular. Data on women aged above 75 years show a prevalence of obesity equal to 29%, confirming the decrease in obesity rates in the older groups of ageing cohorts. The obesity prevalence in nursing homes is also a common problem [5] involving about 15–20% of the residents. In Europe, data from various countries show non-homogeneous results, possibly reflecting differences in lifestyle, health care systems and cultural attitudes toward nutrition and physical activity. In the UK, the most recent population survey (Health Survey for England, 2012) showed that obesity prevalence increased from 12 and 14% in the 16–24 age groups, respectively in men and women, to 33% in males and females of an age between 65–64, to decline to 19–18% in the group aged more than 85 years. Visceral obesity also increased with age up to the higher decades, involving 52–64% of the males and females aged above 75 years (Health Survey for England – 2012 [NS] Publication date: December 18, 2013). In the Netherlands, 18% of males and 20% of females aged more than 60 years are obese with an increased waist circumference in 40%

of males and 56% of females. In France, the ObEpi survey (1997–2006) showed an obesity prevalence of 19.5% in the group of older adults aged 65–69 years that declined to 13.2% in the group years. An increased waist circumference was observed in 47.6% of subjects. In Spain, numbers are higher, with 35% of individuals aged above 65 years being obese, 31% males and 38.3% females, and increased waist circumference in 51% of males and 69.7% of females. In Italy, data from Istat (2009–2010) show age related increase in overweight. 60% of the subjects aged 65–74 years are either overweight or obese, decreasing to 53% between the age group 75–84 years, and to 42% aged 85 years and more. The Italian multiregional "Passi d'Argento" survey, based on phone calls and not on actual measure of weight, shows in the older group aged 64–74 years, a 44% and 16%, prevalence of overweight and obesity respectively. The frequency decline to 41 and 12% in the group 75–84 years, with a further decline to 33 and 9% in individuals aged more than 85 years. In the same age group, underweight is reported in 1, 3 and 9% of the cases, respectively. The Progetto Cuore, of the Italian National Center of Epidemiology, Cnesps-Iss, collected measured data from many public Italian Hospitals dislocated homogenously in different areas of the Country. The first survey conducted between 1998–2002, in individuals aged between 65 and 74 years, showed an obesity rate of 20% in men and 32% in women with 50 and 40% of overweight, respectively in males and females. Sarcopenic obesity (SO) refers to a condition of excess body fat and is associated with loss of muscle mass, leading to a higher risk of cardio-metabolic and functional complications. Recently, ESPEN has defined sarcopenic obesity as a "deficiency of muscle tissue mass relative to fat tissue". The condition is often associated with infiltration of fat into the muscle (ectopic fat deposition). A vicious cycle is commonly observed since overweight by itself limits the possibility of physical activity, while the muscle composition changes reduce strength and performance. There is no general agreement on the definition of SO, which in any case requires both an index of fat and skeletal muscle mass (see diagnosis).

In older adults, the diagnoses of overweight and obesity and of visceral obesity are based on the same anthropometric criteria (BMI and waist circumference) and cut off values as for adults of younger age. There are doubts about the optimal weight in the older population, whose body composition is influenced by age related changes. The obesity paradox in older adults refers to the seemingly protective effects of overweight with ageing, accordingly, studies have shown a reduced mortality risk with higher BMI.

Causes and consequences of positive energy balance and overweight. Obesity is influenced by both genetic and environmental factors. Overweight increases with age for many reasons leading to unbalance between energy intake and expenditure. Energy requirement is reduced with ageing but then it is harder to adapt by eating less than at younger age. Food may give comfort and be an answer to life problems and mood changes such as anxiety or sadness. Lack of energy or interest in cooking, especially in people living alone, may direct food choices toward energy dense, and, many times, nutrient poor food choices. On the contrary, increased free time may create opportunities for more cooking and excessive eating. On the other end, physical activity may be low because of retirement from physically demanding jobs and activities, physical disability, indoor confinement from habit, fear of falling, or sedentary hobbies and recreation, reduced opportunity or motivation to exercise (lack of adequate structures, money problems, encouraging social

context, etc.). Repeated cycles of dieting may cause increased hunger and loss of control over eating. Some drugs may also increase appetite.

Obesity, especially visceral obesity, is associated with many complications, including dyslipidaemia, hypertension, type 2 diabetes mellitus, metabolic syndrome, liver steatosis, respiratory problems, osteoarthritis, reduced exercise capacity, higher cardiovascular risk and mortality. In older subjects aged above 65–75 years, an overweight paradox, with reverse epidemiology has been observed: survival was increased in overweight individuals, even in the presence of a higher cardiovascular risk. Meta-analyses studies have shown that modest overweight was not associated with increased morbidity and mortality rates in older subjects, the relative risk increased slightly to 1.15–1.34 with BMI of 28–29 kg/m^2 and was 1.31–2.0 with a BMI > 30.35 kg/m^2. The risk becomes more relevant only at a BMI equivalent to 31–32 kg/m^2 at values higher than in young subjects. The paradox may have many explanations including the fact that with advancing age weight loss is more often associated with diseases that increase mortality. Furthermore, in late onset obesity the complications may have not the time to become manifested. Sarcopenic obesity, characterized by a higher inflammatory response, may also be related to an increased mortality risk compared to obesity conditions with normal or even increased lean body mass, induced by the bearing of a higher weight. Obesity, in any case, significantly increases the risk of being admitted to nursing homes.

BIBLIOGRAPHY

Bales CW & Buhr G. Is Obesity Bad for Older Persons? A Systematic Review of the Pros and Cons of Weight Reduction in Later Life. J Am Med Dir Assoc 2008; 9: 302–312.

Davison KK, Ford ES, Cogswell ME, et al. Percentage of body fat and body mass index are associated with mobility limitations in people aged 70 and older from NHANES III. J Am GeriatrSoc. 2002 Nov; 50(11):1802–9.

Johannsen DL, Ravussin E. Obesity in the elderly: is faulty metabolism to blame? Aging health. 2010 April 1; 6(2): 159–167.

Elisabeth MH, Mathus-Vliegen. Prevalence, Pathophysiology, Health Consequences and Treatment Options of Obesity in the Elderly: A Guideline on behalf of the Obesity Facts 2012; 5:460–483.

Fakhouri TH, Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity among older adults in the United States, 2007-2010. NCHS Data Brief. 2012; (106):1–8.

Flegal KM et al Excess Deaths Associated With Underweight, Overweight, and Obesity JAMA. 2005; 293:1861–1867.

Ogden CL, Carroll MD, Curtin LR, Mc Dowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. JAMA 2006; 295:1549–2555.

Orpana HM et al. BMI and Mortality: Results From a National Longitudinal Study of Canadian Adults Obesity. 2009; 18: 214–218.

Prado CM, Siervo M, Mire E, Heymsfield SB, Stephan BC, Broyles S, Smith SR, Wells JC, Katzmarzyk PT. A population-based approach to define body-composition phenotypes. Am J Clin Nutr. 2014 Apr 23; 99(6):1369–1377.

Roberts SB, Rosenberg I. Nutrition and aging: changes in the regulation of energy metabolism with aging. Physiol Rev. 2006; 86:651–6.

Sakuma K, Yamaguchi A. Sarcopenic Obesity and Endocrinal Adaptation with Age, International Journal of Endocrinology. Volume 2013, Article ID 204164.

Stenholm S et al. Sarcopenic obesity - definition, etiology and consequences Curr Opin Clin Nutr Metab Care. 2008; 11:693–700.

Thomas F, Pannier B, Benetos A, Ulrich M, Vischer MV. Visceral obesity is not an independent risk factor of mortality in subjects over 65 years Vasc Health Risk Manag. 2013; 9:739–745.

Witham M, Avenell A. Interventions to achieve long-term weight loss in obese older people. A systematic review and meta-analysis. Age and Ageing 2010; 39:176–184.

2.2 CHANGES OF THE IMMUNE SYSTEM IN OLDER ADULTS

Immunosenescence is considered to be a physiological part of ageing. However, recent researches indicate that immunosenescence is not accompanied by an unavoidable and progressive deterioration of the immune function, but is rather the result of a remodelling, where some functions are reduced, others remain unchanged or even increased.

The ancestral/innate immunity is relatively preserved during ageing in comparison to the more recent adaptive immunity compartment that exhibits more specific modifications of the immune system.

It is still not clarified whether there is a decline in number of neutrophil cells with age but a variety of studies showed that there is no number change. Neutrophil functions (chemotaxis, phagocytosis) seem to be declining and this is associated with an increased risk for infections. Monocyte functions are relatively preserved with healthy ageing and can respond to low grade inflammatory stimulation. Dendritic cell function is preserved with healthy ageing and the number of NK cells (natural killer cells), with well-preserved cytotoxic function, increases.

With age, the T-cell population (cellular adaptive immunity) decreases in the absolute number of total T-cells (CD3+), involving both CD4+ and CD8+ subsets. A progressive, age-dependent decline of the virgin T-cells (CD95-), which is particularly profound at the level of the CD8+ subpopulation of the oldest old subjects, is one of the main characteristics of the immune system during ageing. The progressive exhaustion of this important T-cell subpopulation dedicated primarily to the defence against new antigenic challenges (viral, neoplastic, bacterial), could be a consequence of both the thymic involution and the lifelong chronic antigenic stimulation. The immune function of older adults is therefore weakened by the exhaustion of CD95- virgin cells that are replaced by large clonal expansions of CD28- T-cells. The origin of CD28- cells has not been completely clarified yet, but it is assumed that they represent cells in the phase of replicative senescence characterized by shortening telomeres and reduced proliferative capacity, which is a striking feature of cell ageing.

The number of B-cells (humoral adaptive immunity) is reduced with ageing but also accumulation of memory B cell with less diversity and affinity of antibodies. The memory cells' response is defective with increased clonal expansion.

The next major characteristic of the immune system during ageing is the up-regulation of the inflammatory responses, which appear to be detrimental for longevity. Ageing is accompanied by chronic low-grade inflammation state clearly showed by 2-4-fold increase in serum levels of inflammatory mediators. A wide range of factors has been claimed to contribute to this state; however, the most important role seems to be played by the chronic antigenic stress, which affects immune system throughout life with progressive activation of macrophages and related cells. This pro-inflammatory status, interacting with the genetic background, potentially triggers the onset of age-related inflammatory diseases as atherosclerosis. Thus, the analysis of polymorphisms of the genes, that are key nodes of the natural immunity response, might clarify the patho-physiology of age-related inflammatory diseases as atherosclerosis.

BIBLIOGRAPHY

Montoya-Ortiz G. Immunosenescence, aging, and systemic lupus erythematosus Autoimmune Dis. doi: 10.1155/2013/267078. Epub 2013 Oct 24.

Sansoni P1, Vescovini R, Fagnoni F, Biasini C, Zanni F, Zanlari L, Telera A, Lucchini G, Passeri G, Monti D, Franceschi C, Passeri M. The immune system in extreme longevity. Exp Gerontol. 2008 Feb; 43(2):61–65.

Vasto S1, Candore G, Balistreri CR, Caruso M, Colonna-Romano G, Grimaldi MP, Listi F, Nuzzo D, Lio D, Caruso C. Inflammatory networks in ageing, age-related diseases and longevity. Mech Ageing Dev. 2007 Jan; 128(1):83–91.

2.3 APPETITE CHANGES IN OLDER ADULTS

In older adults, multiple factors may cause appetite changes that may lead to lower food intake, inadequate nutrition, body composition changes and weight loss. The major mechanisms involved are: changes in smell, and taste, poor dentition, chewing and swallowing problems, reduced hunger and satiety, compared to younger controls, lower dietary variety, mobility alterations of the gastrointestinal tracts, use of multiple prescription drugs with an impact on appetite, or interfering with an adequate nutrient utilization, social, economic and cultural factors and depression or cognitive function changes. Epidemiological studies have shown a progressive reduction in energy intake in the older individuals most likely in the range of 25%. Older men, compared to younger subjects, show an altered compensation of food intake during periods of overeating or under-eating. During a three-week overfeeding and underfeeding period causing weight gain or weight loss, followed by feeding ad libitum, young men adjusted their energy intake and returned to their baseline weight after overfeeding or gained lost weight after underfeeding. During that period, overfed older men lost only 29% of the weight gained, while underfed older participants recuperated only 64% of the weight lost. Therefore, both malnutrition and overweight may be more difficult to manage in older subjects. Ageing is associated also with short term less complete energy intake compensation, compared to young, after a preload, such as a portion of yogurt. Older men reduced less the intake of food at the subsequent meal. This response can be advantageous in subjects at risk of malnutrition or malnourished requiring extra food or oral supplementations. These given between meals will not affect or affect little the total daily food

intake. The anorexia also contribute to development of cachexia and according to Morley review from 2012 (Table 1) there is overlap in these three conditions: anorexia, malnutrition and cachexia in older persons.

BIBLIOGRAPHY

Morley JE. Undernutrition in older adults. Fam Pract. 2012; 29:89-93.

Roberts SB. Energy regulation and aging: Recent findings and their implications. Nutr Rev. 2000; 58:91-97.

Roberts SB, Rosenberg I. Nutrition and aging: Changes in the regulation of energy metabolism with aging. Physiol Rev. 2006; 86:651-667.

Changes in appetite regulating hormones

Reduced hunger and increased satiety in older adults are the associated changes in appetite regulating hormones, active both at the central and the peripheral levels, including ghrelin, cholecystokinin (CCK), peptide YY (PYY), glucagon-like peptide-1 (GLP-1) and insulin, synthetized at various levels of the gastrointestinal tract after nutrient stimuli. The levels of CCK, a satiety hormone that slows gastric emptying, are higher than in younger subjects, while those of ghrelin, favouring hunger, are lower. Gastric emptying with prolonged satiety is also induced by PYY and GLP-1. The plasma concentration of leptin, the hormone secreted by adipocytes, are increased causing a lower hunger sensation through inhibition of the neurons producing neuropeptide Y, acting as a food intake promoter in the central nervous system. Increased levels of insulin have similar actions, further contributing to early satiety in aged individuals. The presence of inflammation also contributes to appetite changes in older adults.

Changes in taste, smell and visual acuity

Ageing may lower the perception of taste and aroma in foods, thus reducing food consumption and variety and interfering with the diet quality and optimal nutrient intake. Threshold levels for detection and identification of sweet, bitter, salty and acid sensation may be higher than in younger subjects, while intensity and specificity of taste, texture or olfactory sensations can be reduced. Multiple factors may be involved, including loss of peripheral olfactory receptors and of central olfactory neurons, respiratory tract infections, and taste bud structural abnormalities, chewing problems, periodontal diseases, xerostomia, zinc deficiency and the effect of some drugs. Smell is also affected by neurological disorders, including Alzheimer's disease, Parkinson's disease, and dementia. Social and culture related aspect may however have an influential impact. Visual acuity offers relevant cues for food identification and appreciation. Loss of sight may therefore contribute to inadequate food intake. The sensory-specific satiety is the decreased appreciation and interest in a single food type with specific characteristics, already eaten, compared to other foods not yet consumed. Sensory specific satiety is an important mechanism in favouring the intake of a higher variety of foods, when available, and thus a higher meal size. With ageing, this type of satiety is reduced, therefore larger amounts of a single variety of food may be eaten, but

appetite for any other food is depressed. The limited food variety may increase the risk of nutrient deficiencies. Cognitive, olfactory and gustatory stimulation by food induces the cephalic phase of digestion, causing an early increase in the salivary, gastric, pancreatic, and intestinal secretions involved in the digestive processes. Palatable foods cause higher levels of secretions, therefore in ageing palatability of foods should be given particular attention.

Chewing problems

Poor dental and gum conditions, missing teeth, ill fitted dentures, inadequate oral hygiene, xerostomia, and mouth diseases may interfere with taste and smell, the formation of an adequate bolus, easy to swallow, and the intake of a variety of foods. The need for products with reduced consistency may lead to the exclusion or limitations of various food categories, such as difficult to manage fruits and vegetables, legumes, whole grain cereals or meats.

Xerostomia or dry mouth with reduced salivary flow interferes with smell and taste, by reducing the solubility of taste related and aromatic compounds and increase the risk of dental caries and mouth infections, thus causing discomfort and pain that may interfere with adequate food intake. Major causes of xerostomia are drugs, some diseases, and inadequate fluid intake.

Changes in gastrointestinal mobility

A delayed gastric emptying is considered the major factor responsible for the extended postprandial satiety observed in older subjects. Besides the changes in the appetite regulating hormones, already described in the above paragraphs, another major mechanism involved is the reduced adaptation of the gastric fundus to the volume of the alimentary bolus entering the stomach, causing a faster filling of the antrum. The reduced fundus compliance is associated with a lower synthesis of nitric oxide.

Social isolation, economical problems, physical limitations, logistic problems, inadequate assistance.

Food quantity, quality, variety, and appetite may be compromised from reduced resources, loneliness and mood depression. The lack of help and support, due to socio-economic reasons, or to shame from being dependent and pride in asking for help may also be involved. Living alone has been shown to increase the risks and the prevalence of malnutrition. Changes to new environments may be particularly difficult. They may disrupt habits, food preferences, meal schedules, habitual and consolidated social contacts, or broader, but relevant, aspects, such as values, confidence and intimacy, thus interfering with long term established eating behaviour.

Psychological and mental problems.

Depression is frequent among older subjects, being more common in women. Reduced social support and social contact together with lower quality of life due to economic problems and

physical limitations, are common risk factors for a depressed mood, which may be responsible for significant weight loss and malnutrition. Depressed subjects may lose motivation to purchase and prepare food or find no pleasure from eating, thus reducing food intake. Often the condition may go undiagnosed because signs may be difficult to separate from other age or disease related conditions such as easier fatigability, sleepiness, social isolation, etc. (15). Furthermore, the presence of malnutrition, lack of strength, physical limitations, pain and poorer quality of life can contribute to the development of depression. Alcohol abuse present in some older subjects can also interfere with adequate nutrition. The energy content of alcohol may displace the intake of nutrient dense foods; furthermore, recent researches have shown that alcohol can interfere with central hypothalamic areas involved in the regulation of feeding. Alcoholism can become a self-medication against depressive moods but it may also contribute to depression, thus causing a vicious cycle that is difficult to manage. Dementia can have great impact on the nutritional status, being associated with disruptive behaviour during feeding, lack of interest in food, changes in energy requirements and dysphagia.

3. ASSESSMENT OF THE NUTRITIONAL STATUS

The screening and the diagnosis of nutritional status in older adults requires a good knowledge of physiological changes associated with ageing as well as the impact of pathological condition on the nutritional status.

3.1 SARCOPENIA

The European Geriatric Medical Society (EUGMS) Consensus Committee of defining sarcopenia have introduced a very simple evaluation tool with few basic tests, included in an algorithm of actions (Table 2). The first test to be administered, is the gait speed in meter/second. If the result is < 0.8 m/sec., a direct measurement of muscle mass is indicated, while if the result is above the cut off value a handgrip strength measurement is made. If this is low, muscle mass measurement should be performed.

The committee specifies also who should get evaluated for sarcopenia. Somebody who: 1. Notes a decline in function, strength, "health" status; 2. Self-reports mobility-related difficulty; 3. Has a history of recurrent falls 4. Presented a recent unintentional weight loss (> 5%); 5. Is in the post-hospitalization phase; 6. Has a chronic condition, such as type 2 diabetes mellitus + chronic heart failure, chronic obstructive pulmonary disease, chronic kidney disease, rheumatoid arthritis or cancer.

BIBLIOGRAPHY

Biolo G, Cedereholm T, Mascaritoli M. Muscle contractile and metabolic dysfunction is a common feature of sarcopenia of ageing and chronic diseases: From sarcopenic obesity to cachexia. Clin Nutr 2014; 33:737–748.

Cruz-Jentoft AJ, F. Landi, E. Topinková, and J. P. Michel. Understanding sarcopenia as a geriatric syndrome, Current Opinion in Clinical Nutrition and Metabolic Care, 2010; 13(1):1–7.

Cruz-Jentoft AJ, J. P. Baeyens, J. M. Bauer et al. Sarcopenia: European consensus on definition and diagnosis. Age and Ageing, 2010; 39(4):412–423.

Roberts HC, H. J. Denison, H. J. Martin et al. A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. Age and Ageing, 2011; 40(4):423–429.

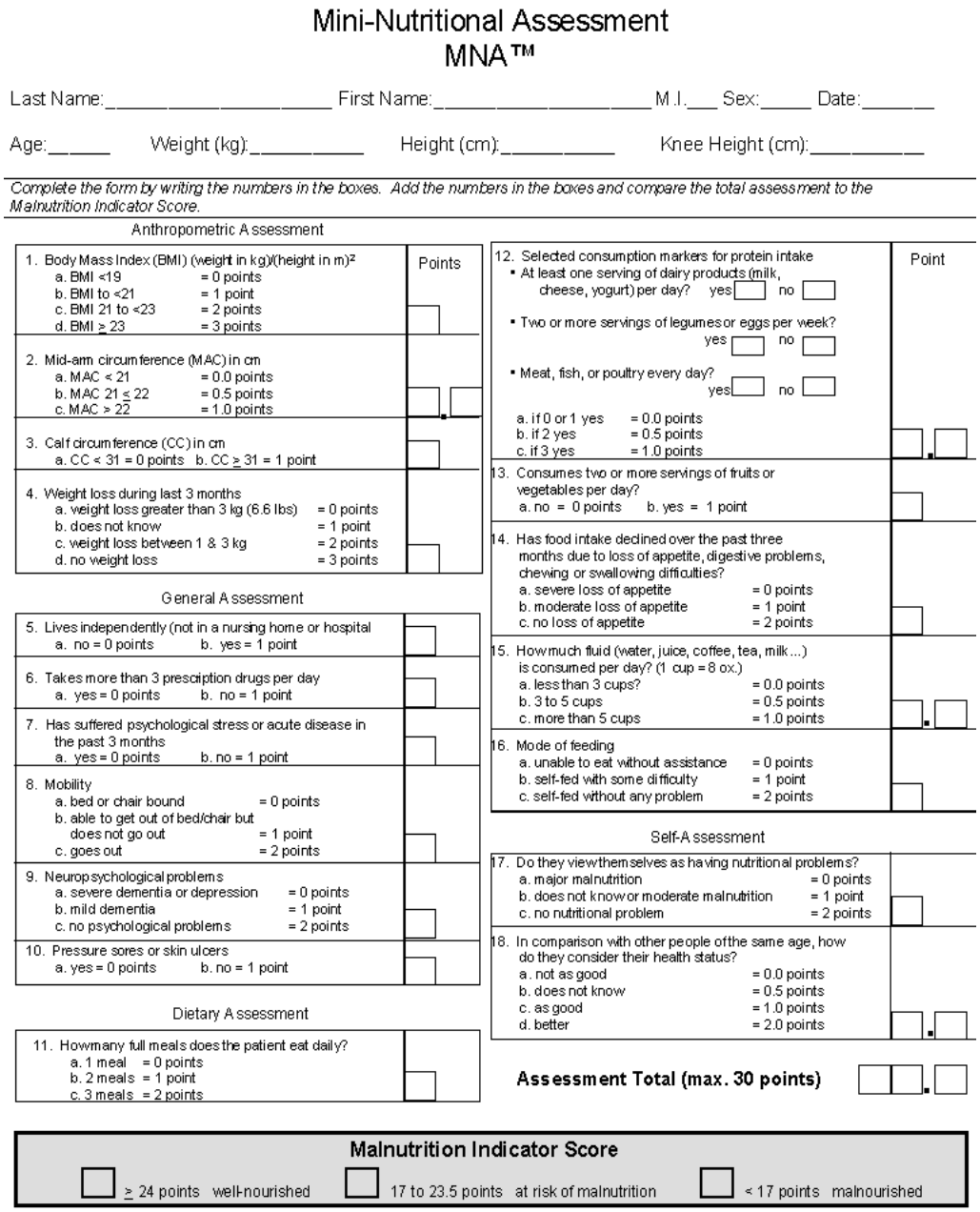
Table 2. Criteria for the clinical diagnosis of sarcopenia (Cruz-Jentoft et al. 2010)

Muscle mass	***Calculations***	***Cut-off values***
Anthropometry *Corrected arm muscle area (CAMA):*	*CAMA = mid-upper arm Circumference, MUAC - ??x (triceps skinfold thickness, TSF/10)2)/(4x ?) – i i = 10 for men; 6.5 for women.*	*men 21.4 cm^2* *women 21.6 cm^2*
Bioimpedance analysis (BIA) *Fat-free mass index (FFMI)* *Skeletal muscle index (SMI) = skeletal muscle mass, SMM, kg/height, m^2), Janssen's equation*	*SMM (kg) = [(height^2/BIA, Resistance x 0.401) + (gender x 3.825) + (age x -0.071)] + 5.102. Height in cm; Resistance in ohms; for gender, men= 1, women = 0; age in years*	*men 16 kg/m^2* *women 15 kg/m^2* *men; < 8.87 kg/m^2* *women; < 6.42 kg/m^2* < 2 standard deviations below a young adult reference value
Dual energy X-ray absorptiometry (DXA) *Appendicular skeletal muscle index ASMI*	*ASMI = FFM kg/height^2*	*men < 7.26 kg/m^2* *women < 5.45 kg/m^2*
Computed tomography scan, CTS *Lumbar skeletal muscle index*	*At L3 level, only if CTS is performed for other reasons*	*men, <55 cm2/m2* *women <39 cm2/m2*
Hand Grip strength (GS, kg)		*Men: BMI 24, GS 29; BMI 24.1-28, GS 30; BMI > 28. GS 32. Women: BMI 23, GS 17; BMI 23.1-26, GS 17.3; BMI 26.1-29: GS 18; BMI > 29: GS 21.*
Physical performance *Gait speed (4-m walk test)* *Timed Up and Go (TUG)* *Short Physical Performance Battery (SPPB) (standing balance, gait speed, and chair sit-to-stand)*	*TUG. Time for person to rise from a chair, walk 3 m. turn around, walk back to chair, and sit down*	*Speed < 0.8 m/s* *> 10 s*
Strength and performance questionnaires *SARC-F screen for sarcopenia*	***Components and questions.*** ***Strength***. *How much difficulty do you have in lifting and carrying 4.5 kg?* ***Assistance in walking*** *How much difficulty do you have walking across a room?* ***Rise from a chair.*** *How much difficulty do you have transferring from a chair or bed?* ***Climb stairs*** *How much difficulty do you have climbing a flight of 10 stairs?* ***Falls*** *How many times have you fallen in the past year?*	*None = 0, Some = 1 A lot or unable = 2* *None = 0, Some = 1 A lot, use aid or unable = 2* *None = 0, Some = 1, A lot or unable without help = 2* *None = 0, Some = 1, A lot or unable = 2* *None = 0; 1-3 = 1; 4 or more = 2* *Score = or > 4 is predictive of sarcopenia and poor outcome*

3.2. MALNUTRITION

The most commonly used screening test is the MNA (Mini Nutritional Assessment), developed specifically to assess the risk of developing malnutrition or the presence of malnutrition in older subjects. The MNA includes two parts (see Picture 1). The first is a screening test based only on questions, which can be answered by the subject personally or by family members or caregivers, the second part, which if administered with the first, is called the long form, includes anthropometric data (BMI and calf circumference, measured with a tape at the largest diameter of the leg) and laboratory indices.

Picture 1. Mini Nutritional Assessment (MNA)



Mini-Nutritional Assessment
MNA™

Last Name:_____ First Name:_____ M.I.___ Sex:_____ Date:_____

Age:_____ Weight (kg):_____ Height (cm):_____ Knee Height (cm):_____

Complete the form by writing the numbers in the boxes. Add the numbers in the boxes and compare the total assessment to the Malnutrition Indicator Score.

Anthropometric Assessment

1. Body Mass Index (BMI) (weight in kg)/(height in m)²
   a. BMI <19 = 0 points
   b. BMI to <21 = 1 point
   c. BMI 21 to <23 = 2 points
   d. BMI ≥ 23 = 3 points

   Points

2. Mid-arm circumference (MAC) in cm
   a. MAC < 21 = 0.0 points
   b. MAC 21 ≤ 22 = 0.5 points
   c. MAC > 22 = 1.0 points

3. Calf circumference (CC) in cm
   a. CC < 31 = 0 points b. CC ≥ 31 = 1 point

4. Weight loss during last 3 months
   a. weight loss greater than 3 kg (6.6 lbs) = 0 points
   b. does not know = 1 point
   c. weight loss between 1 & 3 kg = 2 points
   d. no weight loss = 3 points

General Assessment

5. Lives independently (not in a nursing home or hospital)
   a. no = 0 points b. yes = 1 point

6. Takes more than 3 prescription drugs per day
   a. yes = 0 points b. no = 1 point

7. Has suffered psychological stress or acute disease in the past 3 months
   a. yes = 0 points b. no = 1 point

8. Mobility
   a. bed or chair bound = 0 points
   b. able to get out of bed/chair but does not go out = 1 point
   c. goes out = 2 points

9. Neuropsychological problems
   a. severe dementia or depression = 0 points
   b. mild dementia = 1 point
   c. no psychological problems = 2 points

10. Pressure sores or skin ulcers
    a. yes = 0 points b. no = 1 point

Dietary Assessment

11. How many full meals does the patient eat daily?
    a. 1 meal = 0 points
    b. 2 meals = 1 point
    c. 3 meals = 2 points

12. Selected consumption markers for protein intake
    - At least one serving of dairy products (milk, cheese, yogurt) per day? yes ☐ no ☐
    - Two or more servings of legumes or eggs per week? yes ☐ no ☐
    - Meat, fish, or poultry every day? yes ☐ no ☐

    a. if 0 or 1 yes = 0.0 points
    b. if 2 yes = 0.5 points
    c. if 3 yes = 1.0 points

    Point

13. Consumes two or more servings of fruits or vegetables per day?
    a. no = 0 points b. yes = 1 point

14. Has food intake declined over the past three months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
    a. severe loss of appetite = 0 points
    b. moderate loss of appetite = 1 point
    c. no loss of appetite = 2 points

15. How much fluid (water, juice, coffee, tea, milk ...) is consumed per day? (1 cup = 8 oz.)
    a. less than 3 cups? = 0.0 points
    b. 3 to 5 cups = 0.5 points
    c. more than 5 cups = 1.0 points

16. Mode of feeding
    a. unable to eat without assistance = 0 points
    b. self-fed with some difficulty = 1 point
    c. self-fed without any problem = 2 points

Self-Assessment

17. Do they view themselves as having nutritional problems?
    a. major malnutrition = 0 points
    b. does not know or moderate malnutrition = 1 point
    c. no nutritional problem = 2 points

18. In comparison with other people of the same age, how do they consider their health status?
    a. not as good = 0.0 points
    b. does not know = 0.5 points
    c. as good = 1.0 points
    d. better = 2.0 points

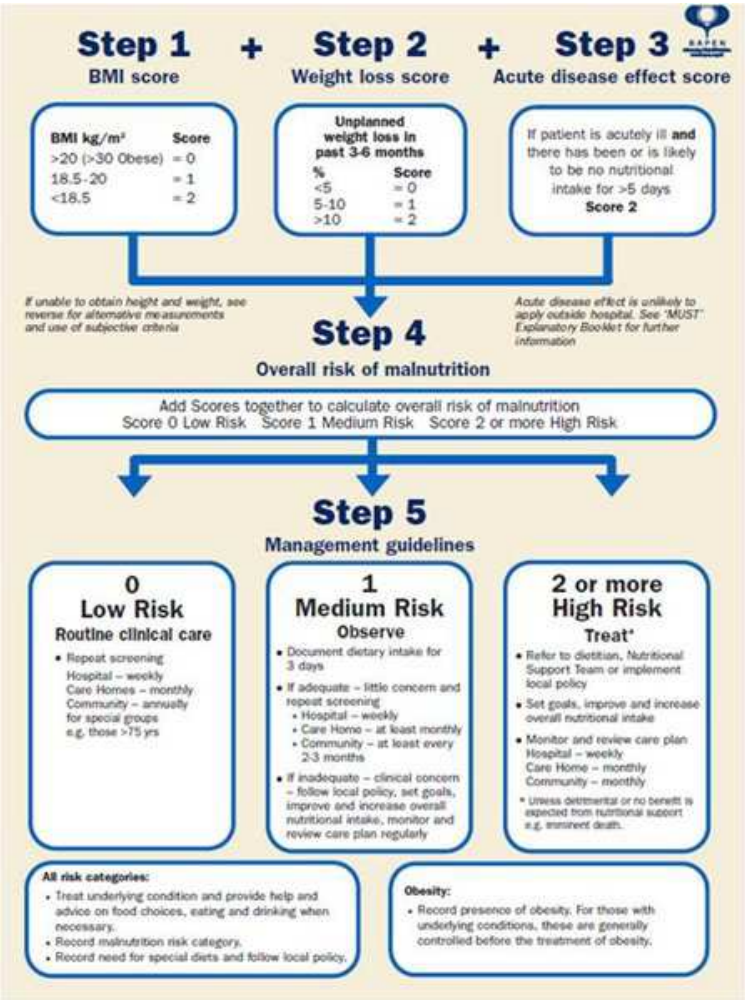
Assessment Total (max. 30 points) ☐☐.☐

Malnutrition Indicator Score

☐ ≥ 24 points well-nourished ☐ 17 to 23.5 points at risk of malnutrition ☐ < 17 points malnourished

The MUST is a five-step screening tool used to identify malnourished subjects or those at risk of malnutrition, which includes management guidelines to develop a care plan. Besides being used in the hospitals, it can be applied in the community and other care settings. It is very simple and all care staff members (Picture 2) can use it.

Picture 2. Malnutrition Universal Screening Tool (MUST)



The Nutritional Risk Screening NRS 2002, recommended by ESPEN, is a tool used mainly in hospital settings and is therefore not reported here.

BIBLIOGRAPHY

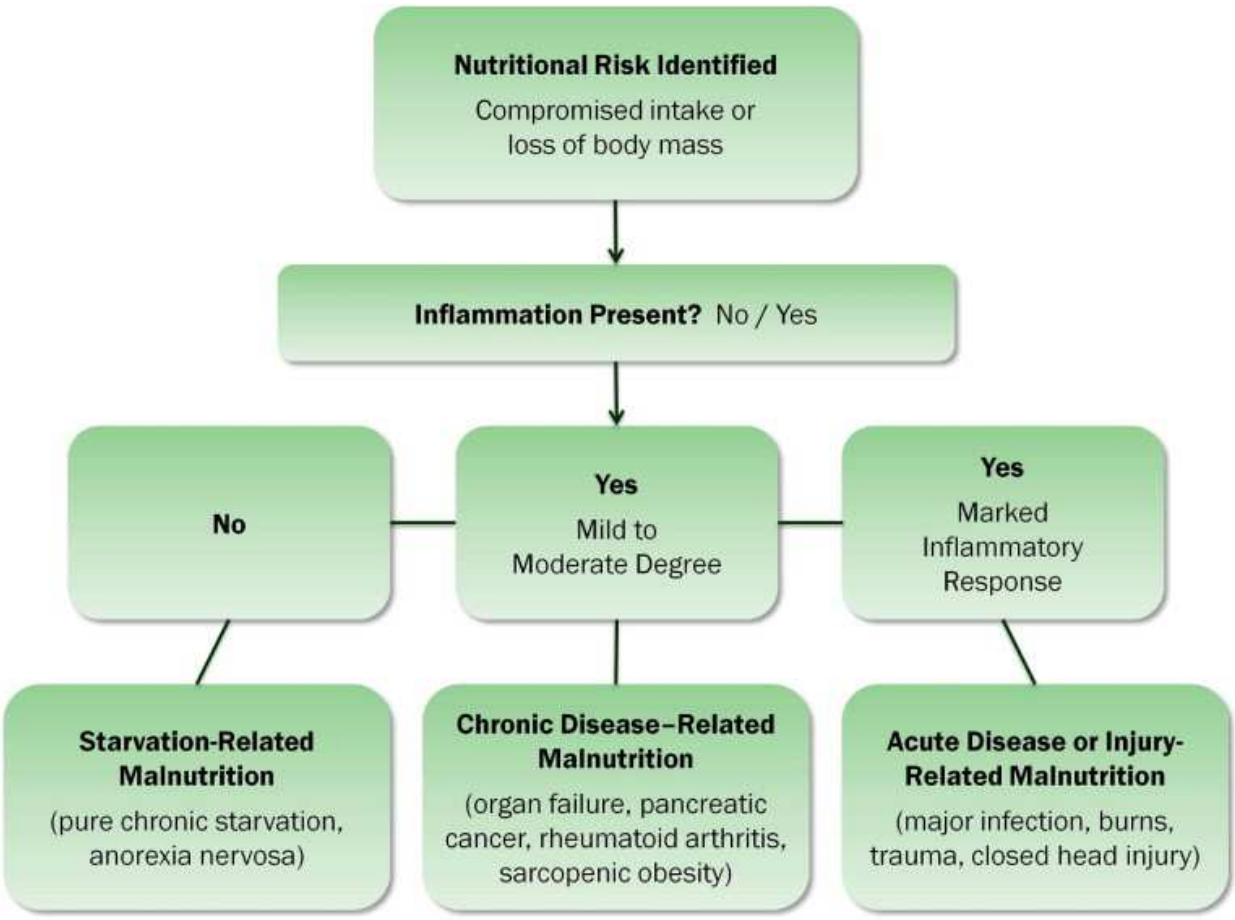
de Groot M, Beck AM, Schroll M, van Staveren WA. Evaluating the DETERMINE your nutritional health checklist and the mini nutritional assessment as tools to identify nutritional problems in elderly Europeans. European Journal of Clinical Nutrition, 1998; 52(12):877–883.

Guigoz Y. The Mini Nutritional Assessment (MNA) review of the literature—what does it tell us? The Journal of Nutrition, Health & Aging, 2006; 10:466–487.

Kondrup J, Allison SP, Elia M et al. ESPEN Guidelines for nutritional screening 2002. Clinical Nutrition 2003; 22(4): 415-421.

Diagnosis. The diagnosis of malnutrition, its severity and complications follows the same basic principles than that applied in any medical condition, with an increased focus on the metabolic and nutritional indices. It can be conducted by medical doctors, and partially by dietitians and nurses. The diagnostic procedures vary according to the malnutrition definition used. In the Consensus Statement of the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition, 2012, which defines malnutrition on the bases of the presence or absence of inflammation and its severity propose the following flow-chart (Picture 3).

Picture 3. Diagnostic algorithm for nutritional risk. Consensus Statement of the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition, 2012.



The group has identified six characteristics recommended for diagnosis including: 1. insufficient energy intake; 2. weight loss; loss of muscle mass; loss of subcutaneous fat); localized or generalized fluid accumulation that may sometimes mask weight loss; and diminished functional status as measured by hand grip strength. The presence of two or more are recommended for diagnosis. The diagnosis includes multiple tools; however, the number of indices has been simplified, compared to the past.

Table 3. Diagnostic tools for malnutrition

DIAGNOSTIC TOOLS			
Tools	**Suggested by ASPEN, 2012**		**Used in most clinical practice**
History and clinical diagnosis	Past and present medical history, to address the possibility of malnutrition/inflammation		- Changes in body weight during the previous 3-6 months; -Any modification in appetite, dietary intake, food preferences; -Changes in gastrointestinal functions; - Any changes in strength and physical functions; - Past and present acute and/or chronic diseases; - Pharmacological treatment (type of drugs, duration of the treatment, timing of intake, side effects and signs of interference with nutritional status (taste/smell changes, dry mouth, nausea, diarrhoea or stipsis).
Physical examination	Assessment of body composition changes or signs of micronutrient deficiencies		-Observation/objective evaluation of muscle and fat mass; -Observation/objective evaluation of the hydration status, including presence of edema (which may be associated with reduced albumin levels); -Search for signs of vitamin deficiencies such as dermatitis, glossitis, cheilosis, neuromuscular irritability, etc.
Inflammation signs	Fever or hypothermia, tachycardia, hyperglycaemia		
Anthropometric data.	Height and weight measurement. Weight measurement should be performed on admission to any clinical setting and throughout the length of stay		Height and weight measurement, BMI Body composition with BIA (Bioelectrical Impedance Analysis) or DEXA.
Laboratory data	C-reactive protein (CRP), white blood cell count, blood glucose levels. Albumin, pre-albumin should not be used as malnutrition indices and interpreted with cautions as inflammation indices.		Routine and specific measurements including: blood cell count, levels of glucose, cholesterol, triglycerides, liver enzymes, creatinine, visceral proteins (albumin, pre-albumin, transferrin), acute phase proteins (CRP), electrolytes (sodium, potassium, magnesium, phosphates, calcium) and vitamins.
Food/Nutrient Intake	Evidence from the patient's past medical records, diet history or 24-hour recall, from patient or care giver, observation of actual food intake during meals or evaluation of post-meal plate waste)		Diet history obtained from patients or caregivers; daily observation of food intake.
Functional assessment.	Hand-grip strength		-Muscle strength evaluation. Dynamometry (measurement of the hand grip strength with the evaluation of the highest strength, reached during 3 consecutive attempts (at the dominant hand side), or measurement of walking distance, or respiratory function (FEV1); -Immunological function. Blood lymphocyte count, total number and percent of T lymphocytes.
Nitrogen balance and resting energy expenditure	To support the presence of systemic inflammatory status		Occasionally
Cognitive function	Not suggested		MMSE (Mini Mental State Examination) in older patients
Follow–up and periodical re-evaluation			-Follow-up is required to assess the efficacy of dietary treatment. Food intake should be assessed daily.

Cachexia – diagnostic criteria

Weight loss of at least 5% in 12 months or less in the presence of underlying illness. Edema-free weight should be used; if weight loss unknown, a BMI < 20.0 kg/m **plus three** of the following criteria should be used:

- Decreased muscle strength (lowest tertile);
- Fatigue, defined as physical and/or mental weariness resulting from exertion; an inability to continue exercise at the same intensity with a resultant deterioration in performance;
- Anorexia defined as a total caloric intake < 20 kcal/kg body weight/day or 70% of usual food intake or presence of poor appetite;
- Low fat-free mass index defined form a mid-upper arm muscle circumference < 10^{th} percentile for age and gender; appendicle skeletal muscle index by DEXA (kg/m^2)< 5.45 in females and < 7.25 in males;
- Abnormal biochemistry: (a) increased inflammatory markers: CRP (> 5.0 mg/l), IL-6 > 4.0 pg/ml); (b) Anaemia (haemoglobin < 12 g/dl); and (c) Low serum albumin (< 3.2 g/dl), (Evans et al. 2008).

The following needs to be excluded: starvation, malabsorption, primary depression, hyperthyroidism and age-related loss of muscle mass.

Pre-cachexia is defined on: the presence of underlying chronic disease; unintentional weight loss ≤ 5% of usual body weight during the past 6 months; chronic or recurrent systemic inflammatory response and anorexia or anorexia-related symptoms. The role of inflammation is considered central.

BIBLIOGRAPHY

Evans WJ, Morley JE, Argilés J, et al. Cachexia: a new definition. Clin Nutr. 2008 Dec; 27(6):793-9.

3.3. OBESITY AND SARCOPENIC OBESITY

Obesity. For the time being, the assessment of obesity in older adults uses the same methods and cut-off values as in younger subjects, even though they may not be optimal with advancing age.

Body mass index, BMI. Measurements of weight, in kg, and of height, in meters, allow to calculate the BMI (kg/m^2) and to define the level of overweight. Some special precautions should be taken in older subjects. Height may have been modified by spinal curvature changes or vertebral collapse. In this case, the use of a measured height in the calculation of BMI may lead to an overestimation of overweight, especially with a high gap between the adult life height and that

present in ageing. A better estimation can be obtained by using the measurement of the knee height (BABEN).

Waist circumference, abdominal circumference, waist/hip ratio. The measurement allows defining the visceral localization of fat tissue, which is more often increased in older subjects, especially females. The *waist circumference* is measured at midway between the upper borders of the iliac crest and the lower margin of the last ribs, possibly with the subject in a standing position and at the end of expiration. The position of the umbilicus should not be used as reference, also because the laxness of the abdominal tissue may change its position. The *abdominal circumference* is taken at the level of the superior margin of the iliac crest in the same standing position as for the waist circumference. In older adults, attention should be given to the changes in the spine height. The curved posture moves the location of the ribs, and the abdominal circumference, which is measured distally from the rib cage, may be a better choice. Cut-off value for abdominal circumference is < 89 cm in women and < 102 cm in men. They are a part of the criteria of the ATP III for the diagnosis of the metabolic syndrome. These values are often referred to in literature as waist circumference. To avoid research and clinical biases, there is an urgent need for a more precise nomenclature. Different cut-offs are suggested for Asian ethnic groups. Recently some groups are suggesting increasing cut-off values for body circumferences in older subjects.

Sarcopenic obesity. The diagnosis is based on the measurement of indices of fat and lean tissues. Most often, sarcopenia is defined by the total appendicular skeletal muscle (ASM) measured by DEXA, normalized for height, to obtain the ASM Index (ASMI; kg/m^2). Sarcopenia is defined by values < 2 SD below the mean for healthy young subjects, < 7.26 kg/m^2 for males and 5.45 kg/m^2 for females. In alternative, Muscle Mass (MM) can be calculated using bioimpedance data and the Janssen's predictive equation (FMI; kg/m^2). The diagnosis of overweight relies on different indices such as BMI or percent of fat mass (%) or waist circumference. Reference values consider quintiles for fat and muscle. Sarcopenic obesity is present if measured values fall in the upper two quintiles for fat and lower two quintiles for muscle. Whole-body dual-energy X-ray absorptiometry data, obtained from the 1999–2004 NHANES, have been used to obtain sex- and body mass index (BMI)–specific decile groups for appendicular skeletal muscle index (ASMI; kg/m^2) and fat mass index (FMI; kg/m^2). Four specific body-composition phenotypes can be identified, namely low adiposity with high muscle mass, high adiposity with high muscle mass, low adiposity with low muscle mass and high adiposity with low muscle mass.

BIBLIOGRAPHY

Prado CM, Siervo M, Mire E, Heymsfield SB, Stephan BC, Broyles S, Smith SR,Wells JC, Katzmarzyk PT. A population-based approach to define body-composition phenotypes. Am J Clin Nutr. 2014 Apr 23; 99(6):1369-1377.

4. NUTRIENT REQUIREMENTS IN OLDER ADULTS

Older subjects are a very non-homogeneous group that includes a number of age decades, from just above 60-65 to over 100 years. Furthermore, it should be considered that some physiological changes begin earlier in life, around the age of 50. Both long term and recent lifestyles show large variability in the older population and so does the type, number, duration, severity and response and compliance to treatment of acute and chronic diseases. The levels of physical activity and the type and duration of pathological conditions seem to have a greater impact on the nutritional status than the physiological changes of ageing. Guidelines on macronutrient and micronutrient requirements, considering age and sex, are available both for healthy aged subjects and for disease conditions. For healthy subjects, the SINU (Italian Society for Human Nutrition) have published the recently revised edition of the LARN (Recommended Daily Nutrient Allowances), 2012. LARN are reported in tables.

Energy requirements

Total energy requirements are reduced in older subjects. The progressive loss of muscle mass accounts for a decline of the basal metabolic rate of about 30%, between ages of 20 and 70 years. The energy expenditure from physical activity is also reduced because of a more sedentary lifestyle, or a decline in the duration or the intensity of exercises. A decreased fat oxidation may also contribute to lower energy needs.

BIBLIOGRAPHY

Starling RD, Poehlman ET. Assessment of energy requirements in elderly populations. Eur J Clin Nutr. 2000 Jun; 54(3):104-11.

Table 4. Energy requirements in older adults, male and female; general values. Source: Società Italiana di Nutrizione Umana (SINU), www.sinu.it, SINU, LARN 2012.

	Males	Females
Energy kcal/day	65 years 32 kcal/kg BW > 65 y - 30 kcal/kg BW	65 years 32 kcal/kg BW > 65 y - 30 kcal/kg BW

Table 5. Height and weight for male and female population, aged above 60 years. The height and weight reported in the table are equivalent to a BMI of 22.5 kg/m^2. BMR has been obtained by the Sheffield equation. Source: Società Italiana di Nutrizione Umana (SINU), www.sinu.it, SINU, LARN 2012.

MALES Height, m.	MALES Weight, kg	BMR (Basal metabolic rate) Kcal/day	Physical activity level			
			1.45 Low	1.60 Moderate	1.75 High	2.10 Intense
1.50	49.5	1165	1695	1870	2045	2450
1.60	56.3	1245	1810	1995	2185	2620
1.70	63.6	1330	1930	2130	2330	2800
1.80	71.3	1425	2065	2275	2490	2985
1.90	79.4	1520	2200	2430	2655	3185

FEMALES Height, m	FEMALES Weight, kg	BMR (Basal metabolic rate) Kcal/day	Total energy expenditure = BMR x Physical activity level			
			1.45 Low	1.60 Moderate	1.75 High	2.10 Intense
1.50	49.5	1110	1605	1770	1940	2325
1.60	56.3	1170	1695	1870	2050	2455
1.70	63.6	1235	1790	1980	2165	2595
1.80	71.3	1305	1895	2090	2285	2740
1.90	79.4	1380	2000	2210	2415	2900

In ill older patients, energy requirements are estimated from predictive equations for the definition of the resting metabolic rate plus correction factors for the physical activity and stress level. The recommended protein intake for older adults with acute or chronic diseases is 1.2–1.5 g/kg BW/day, therefore higher than in healthy subjects. Severely ill or malnourished patients may need even higher levels up 2.0 g/kg BW/day. According to ESPEN guidelines, energy and protein intake need to be adjusted for body weight referring to the ideal body weight.

Carbohydrates

The acceptable range is 45–60% of total energy, mainly as complex sugars, with a preference for low glycaemic index products. This is also supported with results from PANGeA bed rest study. Intake of simple sugars should be within 15% of total energy or less. Fibre recommendation is also reported.

In physically active older adults, nutritional guidelines for increased intake of carbohydrates for athletes are recommended. Additional carbohydrate intake should be increased according to metabolic demands of exercise. With moderate physical activity is this in range 1–2 g/kg body mass per day. Additional carbohydrate intake should be consumed soon after physical activity (1 g/kg).

Table 6. Recommended carbohydrate intake in older adults. Source: Società Italiana di Nutrizione Umana (SINU), www.sinu.it, SINU, LARN 2012.

Total carbohydrates as % total energy	**Simple sugars**	**Dietary fibers**
45–60%	< 15%	12.6–16.6 /1000 kcal or at least 25 g/day even with an energy intake < 2000 kcal/day.
Preference for lower glycaemic index products	It includes sugars from fruits, milk and added sugar in commercial or home made products Limit fructose or high fructose or glucose corn syrups	Preference of foods naturally rich in fibres such as wholegrains, pulses, fruits and vegetables.

Fats

Recommendations in older subjects are equivalent to those for adults. Attention must be paid to the presence of dyslipidaemia that may require some adjustments. High blood cholesterol requires a lower intake of saturated fats from animal sources (butter, cream, cheeses and fatty meats) and from hydrogenated vegetable fats such a margarine or palm oil. While high triglycerides levels may require attention to the intake of simple sugars, or of total carbohydrates, Omega-3 fatty acids with anti-inflammatory properties are found in them.

Table 7. Recommended fat intake in older adults. Source: Società Italiana di Nutrizione Umana (SINU), www.sinu.it, SINU, LARN 2012.

Total fats as % total energy	Saturated fatty acids	Polyunsaturated PUFA, n.6	Polyunsaturated PUFA-n3	Monounsaturated	Trans fatty acids
20–35%	< 10% (5–10%)	4–8%	0.5–2%	Remaining percentage	As low as possible
	Total Long chain - PUFA: 250 mg/day				

Protein requirements

The adequate intake of proteins is influenced by many factors. Quantity and quality of proteins are of course fundamental. Quality is defined by the biological value of proteins present in different foods, that is, the amount of essential amino acids and the proportions among them, that best favour protein net synthesis in the human body. Amino acids are considered essential, or indispensable, if they are not synthesized by the human body, because of the lack of the necessary enzymes and must therefore be acquired from exogenous dietary sources. Non-essential amino acids, now called dispensable, can be synthesized by the body, in adequate amounts in normal conditions; however dietary supply may improve anabolism. The requirements of essential amino acids are not increased in older subjects compared to the younger population. Protein quality is higher for animal products that are most efficient body protein synthesis compared to those of vegetarian origins. The combination of proteins from cereals with those from pulses improves the amino acid profile of the meal. Proteins from vegetable proteins, derived from cereals are less anabolic, even though the combination of cereals with pulses improves the biological value of the protein mixture. Quantity should be enough to stimulate protein synthesis in the post-prandial in order to reach a daily net protein balance. The digestibility and the absorption rates of amino acids are also important since they can modify the magnitude, the timing and the length of time of amino acid availability for protein synthesis in muscle and other tissues, after meals. An example are milk proteins, with whey, rapidly absorbed and available called “fast protein” in comparison with casein, defined as slow protein. After resistance training, both types of proteins however showed similar anabolic effects. Supplementation with branched chain amino acids, and especially leucine, can also be a way to improve protein synthesis. However, there is no indication for the general use of these compounds in older subjects to counteract sarcopenia. Other factors that influence the net protein synthesis are the following: the associated intake of energy that must be adequate, age, physiological status, physical activity, levels and the timing of protein intake in relation to the exercise period. In the latest nutritional guidelines, the recommended daily protein intake for healthy older subjects has not been considered any different from that in younger adults. Recommended quotas are 0.8 g/kg/body weight according the U.S.A. Recommended Dietary Allowance (RDA) and the EFSA, European guidelines and 0.9 g/kg BW, according the Italian guidelines. These quotas are based on nitrogen balance studies that are the equilibrium between nitrogen intake, through the diet, and losses from the body through the excreta, assessed after a period of dietary equilibration of 5 days, at fixed protein intake. The PROT---AGE working group, formed of experts from different countries, after an extensive review of the literature and from their own researches, has concluded that those amounts are inadequate in older patients, even though nitrogen balance may be reached. The timing of dietary equilibration may be too short for accounting changes in tissues with slow protein turnovers. Furthermore, even though correction factors are included into the calculations, to adjust for the excretion of nitrogen through minor ways and of non -protein nitrogen, some errors can be introduced. Also, nitrogen intake and losses are not easy to define, over the 24-hour period. Finally, the capacity of the body to adapt to lower protein intake, may maintain nitrogen balance in a neutral state, but at the expenses of a reduced total body protein amounts. In aged subjects, sarcopenia is associated with an anabolic resistance

to the stimulatory effects of amino acids on net protein synthesis. Gastrointestinal problems may limit protein absorption and the availability of amino acids in skeletal muscle, which is further reduced by a higher splanchnic extraction. The anabolic resistance, as shown by many studies, can be counteracted by a higher protein intake and/or by physical activity. Furthermore, an adequate of protein intake may be needed in older adults because of the higher risk for osteoporosis and depressed immune response. Possible negative effects of protein on bone health have been attributed to the increased urinary calcium excretion with high protein diets. However, dietary proteins have a positive effect on calcium absorption and on the levels of insulin-like growth factor 1, IGF-1, with anabolic effects on bone tissue. As For these reasons PROT-AGE working group recommend for healthy older people:

- Average protein daily intake 1.0–1.2 g/kg body mass/day (i.e. recommended protein intake for 80-year-old man is 80–96 g of protein per day);
- Recommended protein intake per meal is 25–30 g, including 2.5–2.8g of amino acid leucine (i.e. milk, oatmeal, peanuts, fish, poultry, wheat germs, almonds, egg-whites);
- Recommended protein daily intake should be proportionally divided to three main daily meals to provide sufficient and permanent supply of amino acids to the cells for the protein synthesis;
- For the physically active older adults recommended daily intake of protein is a bit higher, 1.2–1.5 g/kg of body mass per day;
- Immediately after physical activity, additional intake of 20–25 g protein is recommended;
- Older adults should consume main meal, including 20–25 g of protein, three to four hours prior to endurance training; immediately after the training a light meal with additional intake of 20–25 g protein is recommended; when breakfast is the main meal in before the morning training, the time interval could be shortened – light breakfast is recommended minimum one hour in before the training;
- Protein intake after the physical activity is considered as a part of the daily-recommended protein intake and represents the difference in needs between the physically inactive and physically active older adults. The extent of the additional intake of protein need depends on the amount and intensity of the physical activity; each individual should adapt the protein intake to the daily physical activity level. Very ambitious older sportsmen might need individual nutritional counselling followed by the appropriate individual nutrition strategy;
- Older adults should never do power and strength exercise in fasting condition during the day.

From a practical point of view, in order to reach the recommended amounts of proteins and ensure their quality it requires a good knowledge of the sources of protein, on the amount present in different kind of foods and on possible food combination in daily menus to balance animal and vegetable proteins.

BIBLIOGRAPHY

Bauer J, Biolo G, Cederholm T, Cesari M, Cruz-Jentoft AJ, Morley JE, Phillips S, Sieber C, Stehle P, Teta D, Visvanathan R, Volpi E, Boirie Y. Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. J Am Med Dir Assoc. 2013 Aug; 14(8):542-59.

Hays NP, Kim H, Wells AM, Kajkenova O, Evans WJ. Effects of whey and fortified collagen hydrolysate protein supplements on nitrogen balance and body composition in older women. J Am Diet Assoc. 2009 Jun; 109(6):1082-7.

Vitamin and mineral requirements

Older subjects often utilize multivitamin and mineral supplements for fear of deficiency or because of the health claims of some products. Among these, there are the potential effects on cognitive function and health, the efficacy however remains elusive. The Physicians' Health Study II on 5,947 males aged 65 years or more, a randomized, double-blind, placebo-controlled trial about the effects of regular multivitamin supplementation on cognition, verbal memory, and category fluency, conducted from 1997 to 2011, showed no differences in comparison with the placebo group. Generally, in the otherwise healthy older population there is no need for dietary supplements, if the dietary intake of nutrients follows the indications on requirements and if the diet is characterized by balance and variety.

Table 8. Recommended vitamin intake in older adults. Source: Società Italiana di Nutrizione Umana (SINU), www.sinu.it, SINU, LARN 2012.

	Vit. C mg	Thiamine mg	Riboflavine mg	Niacin mg NE	Vit. B6 mg	Folate ug	Vit. B12 ug	Vit. A Ug RE	Vit. D ug	Vit. E mg a-TE	Vit. K
Males 60–74 y	105	1.2	1.6	18	1.7	400	2.4	700	15	13	170
>75 y	105	1.2	1.6	18	1.7	400	2.4	700	20	13	170
Females 60–74 y	85	1.1	1.3	18	1.5	400	2.4	600	15	12	170
> 75 y	85	1.1	1.3	18	1.5	400	2.4	600	20	12	170

Folate. Folate deficiency causes megaloblastic anaemia. Low levels of the vitamin are associated with increased blood levels of homocysteine and increased risks of cardiovascular diseases and dementia. In healthy people with high homocysteine levels, folate supplementation for three years improved cognitive function. However, the benefits are not clearly demonstrated and supplementation of the vitamin is not generally recommended. It must be considered that folate supplementation in the presence of vitamin B12 deficiency can cause irreversible neurological damage.

Vitamin B12. Absorption of food-bound B12 requires an acidic gastric environment to allow its release from the intrinsic factor. This may be impaired with ageing from reduced gastric acid secretion or drug effects.

***Vitamin D**: See section on osteoporosis*

BIBLIOGRAPHY

Grodstein F, O'Brien J, Kang JH, Dushkes R, Cook NR, Okereke O, Manson JE,Glynn RJ, Buring JE, Gaziano M, Sesso HD. Long-term multivitamin supplementation and cognitive function in men: a randomized trial. Ann Intern Med. 2013 Dec 17; 159(12):806-14.

Table 9. Recommended mineral intake in older adults. Source: Società Italiana di Nutrizione Umana (SINU), www.sinu.it, SINU, LARN 2012.

	Calcium mg	Phosphate mg	Magnesium Mg	Sodium g	Potassium g	Iron mg	Zinc mg	Fluoride
Males 60–74 y	1000	700	240	1.1	3.9	10	11	4
>75 y	1200	700	240	1.1	3.9	10	11	4
Females 60–74 y	1200	700	240	1.1	3.9	10	8	3
> 75 y	1200	700	240	1.1	3.9	10	8	3

***Calcium**. See section on osteoporosis.*

***Iron*.** From a nutritional point of view, iron deficiency may be caused from a long term low dietary intake of the mineral. The bioavailability of iron from vegetable sources is low; an associated intake of foods rich in vitamin C, however, can improve the mineral absorption.

Fluid intake

Dehydration is a common problem in older subjects and they also have a reduced sense of thirst, which may interfere with an adequate fluid supply. Consequences may be relevant including concentration and attention deficits, up to mental confusion. Reduced salivary flow and stipsis may be aggravated by inadequate fluids consumption. Some older adults may consciously limit drinking for fear of urinary incontinence, other may drink little because water or other fluids are not available (for example when drinks are present or offered only at meal times) or there may be a dislike for many drinks, including regular water. Use of diuretics or laxatives may compound the problem. The daily intake of fluids should be at least eight 200 ml glasses (1600 ml). It is very important to remember that high levels of physical activity and a higher environmental temperature require bigger amount of fluid intake. Another rule can be to achieve an intake of 30 ml/kg of body weight/day. Fluids can be derived also from non-alcoholic beverages such as fruit juices and smoothies, soft drinks, coffee and tea, regular or decaffeinated, herbal teas, meat or vegetable broths, freshly made, or from bouillons, soups, popsicles and fresh fruits and vegetables. Soft drinks however may contain too much sugar. Fruit juices may also cause an excessive simple sugar intake and are deprived of most fibres. Therefore, fresh fruits or smoothies prepared with blended fruits are a better choices.

Alcoholic beverages

Some alcohol intake, mainly as wine, may be beneficial with ageing having positive effects on psychological wellbeing, quality of life and possibly on cardiovascular mortality. The intake of alcoholic beverages should be in the order of one unit a day to a maximum of 3 units/day in men and 2 in women. One unit is equivalent to one glass of wine (about 120 ml) and one glass of normal beer (about 250 ml).

BIBLIOGRAPHY

Bradbury J et al Nutrition Counselling Increases Fruit and Vegetable Intake in the Edentulous J Dent Res 2006; 85:463–468.

Chávez EM, Borrell LN, Taylor GW, Ship JA. A longitudinal analysis of salivary flow in control subjects and older adults with type 2 diabetes. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2001; 91(2):166–73.

Furuta M, Komiya-Nonaka M, Akifusa S, Shimazaki Y, Adachi M, Kinoshita T, Kikutani T, Yamashita Y. Interrelationship of oral health status, swallowing function, nutritional status, and cognitive ability with activities of daily living in Japanese elderly people receiving home care services due to physical disabilities. Community Dent Oral Epidemiol. 2013 Apr; 41(2):173–81.

Keller H, Chambers L, Niezgoda H, Duizer L. Issues associated with the use of modified texture foods. J Nutr Health Aging. 2012 Mar; 16(3):195–200.

Marcenes W et al The relationship between dental status, food selection, nutrient intake, nutritional status, and body mass index in older people 2003; 19:809–816.

5. NUTRITIONAL MEASURES FOR SPECIFIC CONDITIONS

5.1. OBESITY

The obesity paradox and the controversial benefits of weight loss and the risk of worsening sarcopenia by food restriction suggest a prudent management of obesity with ageing. Weight loss should be recommended mostly to subjects affected by type 2 diabetes, metabolic syndrome and cardiovascular disease, associated with higher morbidity and mortality risk. It is suggested to reduce the daily energy intake by 500 to 1000 calories/day, considering the total energy requirement, to obtain a weight loss of 0.5–1 kg per week and a final total loss of 10% of the initial weight. This amount of calorie restriction is not lower than that recommended in younger subjects; therefore, energy intake should be tailored to individuals, considering their body composition data, functional capacity and severity of metabolic or vascular derangements. Dietary treatment should be associated with a physical activity program, with aerobic, endurance and resistance exercises, with the aim to spare lean body mass loss that may already be reduced with ageing.

BIBLIOGRAPHY

Prevalence, Pathophysiology, Health Consequences and Treatment Options of Obesity in the Elderly: A Guideline-Elisabeth M.H. Mathus-Vliegen a on behalf of the Obesity Management Task Force (OMTF) of the European Association for the Study of Obesity (EASO); Obes Facts 2012; 5:460–483.

5.2. OSTEOPOROSIS AND OSTEOARTHRITIS

Osteoporosis. Osteoporosis is a condition associated with reduced bone mass and altered bone tissue structure, leading to loss of bone strength and increased risk of fractures, even in the absence of trauma. Most often osteoporotic changes involve the spine, the proximal femur (hip) and the distal forearm (wrist). Unfortunately, the presence of osteoporosis is silent until clinical manifestation; therefore, a proper evaluation is mandatory. The diagnosis relies on determining the Bone Mineral Density, BMD, measured by DEXA, at the level of the hip or the spine ≤ 2.5 standard deviations below the mean in a young healthy reference population. The risk and prevalence of osteoporosis increases with age. Fractures cause pain, disability, lower quality of life, dependency, need for nursing home admission and are associated with higher mortality rates (10–20% higher mortality within one year from the hip fracture). Nutritional factors with a role in the management of osteoporosis include calcium intake and vitamin D status (both relevant in bone metabolism), dietary protein (proteins form the bone matrix, represent 22% of bone tissue and modulate osteoblast and bone formation by increasing the synthesis of insulin-like growth factor-1 (IGF-1), body weight and physical activity (because of the anabolic effects of gravity and weight bearing exercises in bone mass).

***Calcium intake*.** Calcium intake should have been adequate since early age to allow young subjects to reach the maximum potential for peak bone mass (around the age of 30 years) and kept adequate throughout adulthood for maintenance of bone tissue. Menopause in females and ageing in both sexes contribute to bone mass losses. With ageing, the intestinal absorption of calcium may be reduced while urinary losses may be higher. Guidelines on nutrient intake for the healthy population generally suggest an increased intake of calcium in the older population: 1000 mg/day for subjects aged 60–74 years and 1200 mg/day for people aged above 75 years (LARN, 2013, see table). However, guidelines specific for osteoporosis report higher intake of calcium at an earlier age, especially in women. *The* 2010 *National Osteoporosis Foundation (NOF), Clinician's Guide to Prevention and Treatment of Osteoporosis. Washington, DC:* and the *National Academy of Sciences (NAS)* recommend an intake of at least 1200 mg of calcium per day in women aged more than 50 years. Dosage of calcium should not be > 1500 mg/day because a higher intake does not add any further benefits. The Canadian guidelines 2010 give similar indications: the total daily intake of elemental calcium (through diet and supplements) for individuals over the age of 50 should be 1200 mg [grade B evidence]. In many populations, most dietary calcium comes from milk and dairies. The intake of these products may be absent or reduced for many reasons, such as vegan diets, lactose intolerance, high cholesterol or obesity, requiring saturated fats and/or calorie restriction, or distaste for milk or dairy products. In these cases, attention should be paid to include other calcium sources, such as some types of vegetables; i.e. broccoli or cauliflower, legumes and soy products (tofu, soy milk, etc.), fish (eaten whole with their bones, as in the case of small fish, or preserved whole in oil), dry nuts, especially almonds, and foods fortified with calcium (cereals, orange juice, etc.). Calcium rich mineral waters or tap water, can also contribute to the total daily calcium intake from food. Some vegetable components may reduce calcium absorption; therefore, intake levels should be kept at a good level. Many people, however, choose low mineral waters with a low calcium content. Even if a greater attention to the choice of foods may lead to an increased calcium intake, supplements may be necessary.

Vitamin D. The best-established benefit of vitamin D is on bone health. Low levels of vitamin D, with the associated secondary hyperparathyroidism, may contribute to the development of osteoporosis. However, this vitamin may also have important role in muscle function and immune status. Reduced levels have been associated not only with increased risk of osteoporosis but also of cancer and vascular diseases. Pre-vitamin D is synthesized in the skin on exposure to UV light of the sun, for about 10–15 minutes/day. Exposure of usually undressed body parts (face, hands, and arms) allows an adequate synthesis. Fewer foods are natural sources of the vitamin, mainly egg yolks, seawater fish, liver and fish liver oils. In some countries, some foods are fortified with vitamin D (milk, margarine, bran flakes); however, this practice is not present everywhere. The pre-vitamin is then activated through hydroxylation steps in the liver and kidney. Older patients are at higher risk for vitamin D deficiency. Skin synthesis of the vitamin is lower because of shorter sun exposure or a reduced synthesis efficacy. Furthermore, the hydroxylation to 1.25 di-hydroxy-calciferol in the kidney may be reduced. The reference recommendation suggests an intake is 15 µg and 20 µg respectively in subjects aged 60–74 and above 75 years, in both sexes. NOF and the Canadian guidelines recommend a higher intake of 800–1000 international units (IU) of vitamin D,

or 20–25 µg/day, in individuals aged ≥ 50 years, in order to keep serum levels of 25 (OH)D at 30 ng/ml (75 nmol/L) or higher. To achieve optimal vitamin D status, daily supplementation with more than 1000 IU (25 µg) may be required. The Canadian guidelines indicate that daily doses up to 2000 IU (50 µg) are safe and do not necessitate monitoring [grade C].

Protein intake. Proteins have anabolic effects on bone; on the other hand, their intake has been associated with increased urinary calcium excretion, with possible negative side effects on calcium balance. Furthermore, proteins can modify acid-base balance by lowering the blood pH, with a direct chemical dissolution of bone and a catabolic effect on net bone turnover from an increased bone reabsorption. There is however adequate evidence in older subjects of the protective effect of higher protein diet on bone mass, if associated with an adequate calcium intake, in the range of the quantities suggested by the guidelines, to counteract the negative effects of dietary proteins on calcium urinary excretion and on bone turnover. On the other hand, a high protein intake with a low consumption of calcium was found to be associated with an increased hip fracture risk. The protein intake should be > 0.85 g/kg BW/day or around range of 24% of total energy. The sources of protein from animals or vegetables do not seem to be relevant.

Physical activity. Weight-bearing exercises such as walking, running, dancing and Tai-Chi (widely used by the older population in the Orient) and muscle-strengthening exercises (with weight or elastic bands) may increase bone density and muscle mass, thus improving muscle strength and body balance with better control of the risk of falls and fractures. Canadian guidelines recommend three types of physical activities according to different severity of osteoporosis and its complications: (1) Exercises involving resistance training, appropriate for the individual's age and functional capacity, and/or weight-bearing aerobic exercises for subjects with osteoporosis or at risk for osteoporosis [grade B evidence]; (2) Exercises to enhance core stability and to compensate for weakness or postural abnormalities for individuals who have had vertebral fractures [grade B]; and (3) Exercises that focus on the balance, such as tai chi, or on balance and gait training, for those at risk of falls.

***Other foods*.** Magnesium, zinc, vitamin K, B group vitamins may have an impact on bone health. A diet with an adequate amount of fruit and vegetables and protein rich foods may allow a balanced intake of nutrients. Excessive alcohol intake may interfere with osteoblast activity, reduce the intake of calcium rich foods and favour falls. Therefore, intake should be limited to no more than two alcohol units/day (*see alcohol intake*).

BIBLIOGRAPHY

Papaioannou A, Morin S, Cheung AM, Atkinson S, Brown JP, Feldman S, Hanley DA, Hodsman A, Jamal SA, Kaiser SM, Kvern B, Siminoski K, Leslie WD. Clinical practice guidelines for the diagnosis and management of osteoporosis in Canada, 2010.

Bischoff-Ferrari HA et al. Prevention of Non vertebral Fractures With Oral Vitamin D and Dose Dependency Arch Intern Med. 2009; 169:551–561.

Francis RM. What do we currently know about nutrition and bone health in relation to United Kingdom public health policy with particular reference to calcium and vitamin D? British Journal of Nutrition 2008; 99:155–159.

Papaioannou A, Morin S, Cheung AM, Atkinson S, Brown JP, Feldman S, Hanley DA, Hodsman A, Jamal SA, Kaiser SM, Kvern B, Siminoski K, Leslie WD; Scientific Advisory Council of Osteoporosis Canada. 2010 Clinical practice guidelines for the diagnosis and management of osteoporosis in Canada: summary. CMAJ. 2010 Nov 23; 182(17):1864–73.

The National Osteoporosis Foundation. Clinician's Guide to Prevention and Treatment of Osteoporosis. Washington, DC: National Osteoporosis Foundation; 2010 (NOS).

5.3. OSTEOARTHRITIS (OA)

Osteoarthritis is a condition characterized by degenerative processes of joint cartilages, involving mainly hand and feet, spine, hip and knees, whose prevalence increases with ageing. OA causes pain, joint swelling and stiffness, with reduced body stability, flexibility and movements. Symptoms worsen after periods of rest. The causes of OA are multiple. Primary OA refers to the degenerative forms associated with ageing, secondary osteoarthritis is the result of factors such as repeated trauma, surgery, infectious and metabolic diseases. Obesity is also a common factor causing mechanical strain and damage, particularly at the knees and hip joints; however, metabolic factors may also be involved. OA, together with sarcopenia, with loss of muscle strength and function, and the mobility problems in overweight individuals, contributes heavily to reduced physical activity, disability and poorer quality of life with ageing. The association of OA and obesity increased by 44% the chance of being physically inactive. Treatment of OA includes physical activity with the goal of strengthening muscles and improving joint mobility. Programs should combine stretching, low-impact aerobics, such as swimming and stationary cycling, strength exercises, with ankle cuff weights and bands, and balance improvement. In obese older women, physical activity programs and nutritional strategies to gradually lose 5–10% of the initial weight, in a period of 6 months, proved to be effective. The association of exercise with a dietary program, compared with exercise treatment only, caused higher weight loss, improved indices of inflammation, such as IL-6 levels, reduced pain, increased walking speed, function and quality of life. Individuals with weight loss ≥ 10% or more, showed better control of pain and systemic inflammation and lowering of compressive force at the knee, than those who lost 5% to 9.9% or less than 5%, of the baseline weight. Some nutrients and foods with anti-inflammatory and antioxidant effects may have value in the management of OA. Among these, there are foods rich in omega-3 fatty acids such as oily fish or walnuts or evening primrose oil, rich of gamma-linolenic acid (GLA). Some compounds that may aid in the maintenance and reconstruction of cartilage are glucosamine sulphate, acting as a source of mucopolysaccharide (glycosaminoglycan) or chondroitin sulphate. The Glucosamine/Chondroitin Arthritis Intervention Trial (GAIT) however showed inconclusive evidences for any benefits from these compounds.

Some non-pharmacological strategies may be useful to improve daily life functions. Patients with hand deformities from OA may have problems with food preparation or with eating. In these cases, modified utensils such as adhesive dishes, that remain attached to the table, without the need of being held, special devices for opening cans and bottles or cutting foods, without efforts, or modified spoons, forks and cutlery, with angled or thicker handles, may be of great help for ensuring adequate nutrition while maintaining autonomy and self-confidence.

BIBLIOGRAPHY

Anton S, Manini TM, Milsom VA, Dubyak P, Cesari M, Cheng J, Daniels MJ, Marsiske M, Pahor M, Leeuwenburgh C, Perri MG. Effects of a weight loss plus exercise program on physical function in overweight, older women: a randomized controlled trial. Clin Interv Aging. 2011; 6:141–149.

Messier SP, Mihalko SL, Legault C, Miller GD, Nicklas BJ, DeVita P, BeaversDP, Hunter DJ, Lyles MF, Eckstein F, Williamson JD, Carr JJ, Guermazi A, Loeser RF. Effects of intensive diet and exercise on knee joint loads, inflammation and clinical outcomes among overweight and obese adults with knee osteoarthritis: the IDEA randomized clinical trial. JAMA. 2013 Sep 25; 310(12):1263–73.

Sawitzke AD, Shi H, Finco MF, Dunlop DD, Harris CL, Singer NG, Bradley JD, Silver D, Jackson CG, Lane NE, Oddis CV, Wolfe F, Lisse J, Furst DE, Bingham CO, Reda DJ, Moskowitz RW, Williams HJ, Clegg DO. Clinical efficacy and safety of glucosamine, chondroitin sulphate, their combination, celecoxib or placebo taken to treat osteoarthritis of the knee: 2-year results from GAIT. Ann Rheum Dis. 2010 Aug; 69(8):1459–64.

5.4. DEMENTIA

Prevention. There is a great interest in the prevention of dementia, since a higher prevalence of this condition is expected from the longer life expectancy and ageing of the population. Lifestyle interventions are promising even though interference from confounding factors or heterogeneous methodology in up to now studies, make conclusions far from definitive. Therefore, specific nutritional guidelines are not yet available. Some indications can however be taken into account since nutritional factors with possible protective effects have other health benefits as well. These relates mainly to antioxidant compounds present in a variety of vegetable products, vitamin B and D and omega-3 fatty acids, from fatty fish and nuts. A number of studies have found positive effects on cognitive function of the Mediterranean diet, a dietary model that includes multiple protective factors, introduced through a variety of foods, or of specific, typically Mediterranean, foods such as olive oil or nuts.

BIBLIOGRAPHY

Martínez-Lapiscina EH, Clavero P, Toledo E, Estruch R, Salas-Salvadó J, SanJulián B, Sanchez-Tainta A, Ros E, Valls-Pedret C, Martinez-Gonzalez MÁ. Mediterranean diet improves cognition: the PREDIMED-NAVARRA randomised trial. J Neurol Neurosurg Psychiatry. 2013; 84:1318–25.

Otaegui-Arrazola A, Amiano P, Elbusto A, Urdaneta E, Martínez-Lage P. Diet, cognition, and Alzheimer's disease: food for thought. Eur J Nutr. 2014 Feb; 53(1):1–23.

Saaksjarvi1 K, Knekt1 P, Lundqvist A, Mannisto S, Heliovaara M, Rissanen H Jarvinen R. A cohort study on diet and the risk of Parkinson's disease: the role of food groups and diet quality. Brit J of Nutr. 2013; 109:329–337.

Treatment. Dementia is characterized by cognitive decline associated with mood and behaviour changes including anxiety, depression, restlessness, agitation and wandering that may disrupt mealtimes. These factors, together with forgetfulness and disinterest in food, anorexia induced by drugs, increased energy requirement from hyperactivity, or dysphagia, which may develop in later stages, interfere with an adequate nutrient intake, leading to malnutrition.

Behavioural interventions. Nutritional interventions in older subjects with dementia have different goals according to the stages of the disease and the level of behavioural and physical functioning. The first levels of nutritional interventions are aimed at improving mealtime behaviour. Few studies have evaluated their effects in institutionalized older adults. An interesting modality is the organization of Breakfast Clubs that is group meetings where individuals share all processes of the meal from food preparation to cleaning after eating, while being engaged in conversations lead by an expert facilitator with the aim of encouraging memory, listening, decision-making, and communication. Other interventions are built either on food availability and variety (for example meals served at tables, with free access to food and taking into account food preferences, in place of meals based on standard portions and food types) or on the eating environment (for example provision of very good room lighting and bright and contrasting colours for dishware and table mats and other dining accessories or music played at meals). Most of these strategies improved difficult behaviours. The presence of a person encouraging feeding and communication between subjects was also relevant.

Supplementation with omega-3 fatty acids and lipoic acid. These compounds have high anti-inflammatory activity and could have a role in the treatment of Alzheimer's disease. EPA and DHA are omega-3 fatty present in fatty fishes and in fish oil. Populations with a more frequent consumption of fish showed an association with a lower risk for Alzheimer's disease. Lipoic acid is a compound present in meat and organ meat and in smaller quantities in vegetable foods, it is used mainly to protect fish oils from oxidation, however it has independent antioxidant and anti-inflammatory properties. A group of subjects with Alzheimer's disease were treated with supplements of omega-3 (675 mg DHA and 975 mg EPA) with or without lipoic acid, for 12 months. No changes in oxidation of lipids was observed; however, the supplementation, in comparison of the placebo reduced the decline in the MMSE, *Mini-Mental State Examination,* and in the IADL *Instrumental Activities of Daily Living.*

BIBLIOGRAPHY

Effectiveness of Mealtime Interventions on Behavior Symptoms of People with Dementia Living in Care Homes: A Systematic Review. 2014. JAMDA.

Shinto L, Quinn J, Montine T, Dodge HH, Woodward W, Baldauf-Wagner S, Waichunas D, Bumgarner L, Bourdette D, Silbert L, Kaye J. A randomized placebo-controlled pilot trial of omega-3 fatty acids and alpha lipoic acid in Alzheimer's disease. J Alzheimer's Dis. 2014; 38(1):111–20.

Whear R, Abbott R, Thompson-Coon J, Bethel A, Rogers M, Hemsley A, Stahl-Timmins W, Stein K. Effectiveness of mealtime interventions on behavior symptoms of people with dementia living in care homes: a systematic review. J Am Med Dir Assoc. 2014 Mar; 15(3):185–93.

5.5. FOOD/DRUG INTERACTIONS AND DRUG/FOOD INTERACTION

Older subjects often take multiple drugs. The interactions between food and drugs may need to be taken into accounts. Food can interfere with the drug absorption, metabolism or excretion and function. On the other hand, drugs may change taste, irritate the stomach, give gastrointestinal problems or interfere with minerals or vitamin absorption, use or excretion. Always read if the drug should be taken in the fasting state or with food. With warfarin (Coumadin) treatment, an excess of foods rich in vitamin K, such as green leafy vegetables, spinach, broccoli, cauliflower, Brussel sprouts may interfere with the drug coagulation action. Some diuretics may increase the urinary losses of minerals (potassium, magnesium, and calcium) or they may increase potassium levels. Grapefruit and grapefruit juice may increase drug absorption with risk of toxicity; therefore, they should not be taken with medicine but at least two hours before or after.

5.6. NUTRITIONAL SUPPLEMENTS IN OLDER ADULTS

Nutrition for worst conditions and the presence of malnutrition or complications, such as dysphagia, may require nutrition support through supplements or total enteral nutrition. Dietary oral supplements improved body weight in patients with dementia. Enteral nutrition was shown to be effective to improve malnutrition in some studies, but not in others. Few studies have shown positive effects on the mortality rates. The effectiveness of nutritional support is highly influenced by the severity of the disease and the type and severity of the associated comorbidities, and the general conditions of the older subjects (16).

BIBLIOGRAPHY

Lin LC, Huang YJ, Watson R, Wu SC, Lee YC. Using a Montessori Method to increase eating ability for institutionalized residents with dementia: a crossover design. J Clin Nurs. 2011 Nov; 20(21-22):3092–101.

Martínez-Lapiscina EH, Clavero P, Toledo E, Estruch R, Salas-Salvadó J, SanJulián B, Sanchez-Tainta A, Ros E, Valls-Pedret C, Martinez-Gonzalez MÁ. Mediterranean diet improves cognition: the PREDIMED-NAVARRA randomised trial. J Neurol Neurosurg Psychiatry. 2013 Dec; 84(12):1318–25.

Whear R, Abbott R, Thompson-Coon J, Bethel A, Rogers M, Hemsley A, Stahl-Timmins W, Stein K. Effectiveness of mealtime interventions on behavior symptoms of people with dementia living in care homes: a systematic review. J Am Med Dir Assoc. 2014 Mar; 15(3):185–93.

6. CONCLUSION

The PANGeA nutritional recommendations represent the theoretical background for the nutrition recommendations for older adults to prevent frailty. The focus is mainly on free living or mostly autonomous institutionalized older adults, healthy or with stable chronic diseases, rather than on subjects with acute or severe chronic conditions, needing intense clinical management.

The guidelines are supported by data of the literature review on ageing and nutrition, the review of available guidelines for effective nutritional care and physical activity in older adults and results from PANGeA study. Moreover, since the development of anabolic resistance in older population indicates an increase in protein requirements, the PANGeA results show that ageing and physical inactivity synergistically enhance protein requirements. Protein intake in bedridden old person (man) should therefore be greater than in bedridden young person (man) as well as in normally active old subjects.

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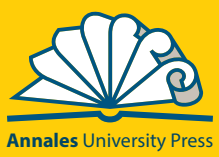

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