

Position Paper: Nutrition and Physical Activity for the Very Old Human under the Aspects of Proper Muscular and Respiratory Functioning

Positionspapier: Ernährung und körperliche Aktivität für den hochbetagten Menschen unter dem Aspekt einer guten Muskel- und Atemwegsfunktion

Summary

- **In very old people**, especially geriatric patients in clinics or residents in nursing homes, a good adequate diet, which considers the specifics of malabsorption in the very old, decides on the quality of life, cognitive abilities, and muscular fitness, but in principle on life and death. Many nutrients must be increased or given by supplementation. This is especially true for a necessary increased protein intake.
- **Since especially the core**, extremities and respiratory muscles are affected by sarcopenia in the very old and there is an increased risk of falls and of pneumonia in malnourished patients, the additional protein intake, if possible by natural means, also applies to the mobilization and pneumological therapy, which of course must be supplemented by respiratory and general muscle training.
- **Furthermore**, to reduce malabsorption, attention must be paid to a sufficient acid content in the diet, e.g. through vinegar, and a necessary increase in salt intake, whereby the middle-aged and the very elderly differ fundamentally in this respect.
- **In this position paper**, recommendations for the nutrition and the supplemental muscular training to avoid sarcopenia in the very old will be given in a language accessible also for non-physicians based on available scientific literature.

KEY WORDS:

Sarcopenia, Muscle Failure, Respiratory Failure, Nutrition, Elderly, Frailty

Introduction

In older age, significant changes of the body composition can be observed, which result in a decrease of bone mass and muscle mass and in an increase of fat mass and improve the particular risk due to malnutrition and/or sarcopenia in senior citizens (3, 4, 55).

The changes of body composition are an important age-related predisposition of the lost-on functionality and independence in old age (3, 4). Higher levels of vitamin D, calcium, phosphor and albumin (51) and/or omega-3 fatty acids (16) can improve the muscle power.

We all instinctively know that there is something not quite right about a protein and carbohydrate poor nutrition for newborns. In the case of babies, it seems perfectly natural to us that they need breast milk for the first few months, with lots of protein, milk sugar and enough salt (6).

Regarding the diet of people over 80, however, it does not occur to most of us that they, too, might need a completely different composition of food than young people and adults between 15 and 70. For young adults and adults up to retirement age, the motto is healthy and ecologically acceptable nutrition, and what the public and nutrition advisors consider to be so (39). Thus, as much as possible ballast materials with salad or raw food, a reduced

portion of meat products and fats, salt, and sugar only in moderation, one egg per week only and many recommendations more. Vegetarian and vegan nourishing forms became popular in urban populations and sport, pulmonary and geriatric physicians as well as nurses of assisted living homes are confronted by the younger relatives of geriatric patients and clients to offer a vegetarian or vegan nutrition to the very old. Rarely geriatric patients and clients require it themselves from caretakers.

But what is healthy for very old people in regard to the activities of daily living, to avoid frailty including sarcopenia and respiratory failure? Back to the contents of mother's milk or even "healthier," even more vegetarian with only plant-based food consisting of salad, steamed vegetables, fruit and few carbohydrates and fats, and preferably no salt at all, no meat, no sausage, and no fish?

To anticipate, the former choice is closer to the mark. But why is that?

How Digestion and Metabolism Change with Age

We can turn it around however we want, not only do we age from day to day, but our bodies age as well, and with them almost every cell in us. So not >

REVIEW

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only our outer skin becomes dry and gets wrinkles, but also our mucous membranes in the digestive tract. Our liver and especially our kidney are subject to cell death, which can no longer be compensated for by regrowing cells (8, 25, 41, 48).

A healthy intestine in young to middle aged humans with many intestinal villi absorbs nutrients and pass them on into the bloodstream. The total surface area of the intestine is the size of a soccer field. The older we get, partly due to disease, the fewer villi remain and the fewer nutrients we can absorb. All this has serious consequences for our human metabolism and unfortunately it does not always run linearly, who wouldn't know, with the calendar age. From the age of 25 on one has suddenly fully grown, the baby fat has dissolved, but one can still eat and drink what one wants and feel as strong as a tree, until in one's mid-40s one's metabolism suddenly tips over and the body changes externally and internally, the forces no longer come out of one so automatically. From the mid-60s onwards, many forces begin to weaken and the first signs of wear and tear on joints and organs become more noticeable.

Muscles are particularly affected, as they no longer receive enough proteins and minerals from the food elderly people eat (3, 4, 26, 35). This affects all the muscles elderly humans need to move, to stay and not to fall, respectively core muscles and muscles of the lower extremities but also for a sufficient respiration the respiratory musculature with the intercostal muscles, the diaphragm, and the pectoralis muscles. The swallowing muscles are also affected (12, 34, 36, 38). One begins to choke more often, and lung function values already reduce significantly (24, 30).

From 80 to the mid-80s, there is another tipping point, and this affects digestion and metabolism in particular. Now the stomach, equipped with only a small part of the originally produced amount of gastric acid, can only with difficulty break down food components, the small intestine, with a fraction of the originally existing mucosal surface, can only absorb minerals, trace elements, folic acid and B vitamins to a small extent, the aged kidney loses proteins and salts like a coarse net and can no longer hold them in the blood plasma, the liver can no longer process fructose and lactose in particular, but also numerous toxins. However, the liver is still able to recover from damage, if toxins and this includes an excess of fructose are minimized by a specific nutrition for the very old (44). The loss and reduced intake of proteins combined with less exercise leads to muscle atrophy, the dreaded sarcopenia, and the risk of falls (43).

A great danger now also comes from limited respiratory work due to muscular weakness caused by muscular wasting based on too little muscle protein. This increases the risk of pneumonia due to respiratory insufficiency and insufficient clearance of mucus from the airways (1, 3, 4, 13, 31, 38).

Also, survival of elderly covid-19 patients in the first corona waves was directly related to the strength of the respiratory muscles and the corresponding previous nutrition of these patients (15, 45).

Regarding nutrition, this leads to special consequences in the very elderly because of the need to compensate for all losses and to protect the liver from further damage.

Recommendations for the Nutrition of the Very Old, also from a Pneumological Point of View

- Protein intake must be significantly increased, the daily protein requirement almost increases to 200 grams per day for a 100 kg man, compared to 70 grams for a healthy mid-

le-aged adult man of the same weight (3, 4, 8, 13, 21, 31, 41). In particular sarcopenia of core, extremities and respiratory muscles must be prevented by adequate protein intake. Of course, this is especially true for invasively and noninvasively ventilated very elderly patients and frail patients with a history of falls (3, 4, 10, 17, 37, 49). A large number of very old people in assisted living homes have a malnutrition from a too low protein intake (38, 40). This is practically impossible to achieve with a purely vegetarian (not lactovegetarian) diet. Therefore, one must draw the conclusion that purely vegetarian and especially vegan diets are negligent bodily harm in the very elderly, just as they are in a baby or young child.

- Salts and calcium as well as potassium must be supplied additionally to the food and/or the food must contain extra salts.
- B vitamins and folic acid must be supplied in part by special foods and additionally supplemented with medication by depot injections (28). Other supplements like calcium are only needed if the very old person cannot receive them from regular nutrition respectively food.
- In common diseases in very old persons like diabetes or chronic kidney failure the nutrition eventually must be adapted to the special needs with a maximum amount of both sugars in diabetes patients and additional salt in kidney failure patients. However, in most cases this can be reached with regular food as recommended.
- Highly fructose-containing and lactose-containing foods, including most types of fresh fruit (most extremely grapes), honey and, unfortunately, many fructose-containing convenience foods and industrial foods, may only be consumed to a limited extent. Foods sweetened with normal sugar or sucrose, on the other hand, are hardly harmful to the liver (18).
- Alcohol can and should even be enjoyed in moderation, but here, too, the reduced detoxification capacity of the liver must of course be considered.

The Ideal Menu for the Very Elderly

So, what should be on the menu of our patients or all the very old to maintain quality of life and avoid falls, joint pain, diarrhea and constipation, as well as weakness of the respiratory muscles and recurrent pneumonia?

Carbohydrates and „Daily“ Bread

The bread should preferably be mixed bread with small rye content, which contributes iron, and correspondingly larger wheat content. The dough should be matured and the bread one day old and not fresh to activate the so-called Food maps in the bread (Here we refer also particularly to a transmission with Nelson Mueller radiated in the German Public TV channel ZDF to the topic bread and rolls: "Nelson Mueller – the large bread report" (32)).

The amount of dietary fiber (indigestible grain products and plant fibers in grains, peels, lettuce, and vegetables) should be reduced in the very elderly because of the limited food breakdown capacity in the stomach and reduced digestive passages in the intestines. Ideally, seniors over 80 years of age should have 12-8 grams of dietary fiber/day. The DGE (German society for nutrition) demand for middle-aged adults is however with 30 grams (39). Too fiber-rich whole grain bread is therefore rather unhealthy in old age.

The ideal carbohydrate intake for the very old comes from potatoes. The multi-chain carbohydrates of the potato can not only be digested and processed well and provide energy for

longer periods of time, but potatoes also contain protein, B vitamins and important minerals. To ensure that these valuable components of the potato are not lost during preparation, potatoes should be cooked rather coarsely and not treated too hot (as is unfortunately the case with French fries, for example). Boiled potatoes are preferable to all other forms of potato preparation that interfere more with the basic structure of the potato, such as fried potato, mashed potato, gratin and French fries. Still, even hot prepared potatoes have a positive effect on reducing short term food intake in the elderly (5).

Rice does not have the high quality for the very old humans as potatoes, but it can also be an important source of carbohydrates. Parboiled long-grain rice, long known from TV commercials, is most ideal. It has more B vitamins and is the most digestible rice due to the vacuum pressure process with which it is prepared. Unhusked wild rice should rather be avoided, not only because of the poorer digestibility, but also because of molds under its husk.

In the morning, the ideal combined supply of carbohydrates and protein is an oatmeal breakfast with cottage cheese. The latter is more digestible and nutritionally superior to fresh milk. Both the oats and the quark contain a lot of good protein, the quark additionally some calcium. If possible, you should avoid so-called melting flakes, as they are too heavily sugared. A breakfast egg, not every day but up to three times per week, can be a reliable source of protein

Meat, Fish and Vegetarian Alternatives

Of course, you can try to do without too much meat even as an aged person and supply protein through other sources such as potatoes, eggs, cottage cheese or cream cheese, kidney beans, chickpeas and humus, but it will not go completely without meat, especially high-quality beef (1). Because this is not only the meat with the highest protein content, but also provides iron, B vitamins (especially B-12) and folic acid. Poultry does not contain these nutritional components, but still represents a good protein supplier. Pork falls in between, but beef is much higher quality for seniors over 80. If it is not possible to reach a sufficient amount of protein with regular food, there is no other option than protein supplementation with specific formulas. A combination of proteins with omega 3 fatty acid has shown promising results in very old adults (33).

Any form of dish from chickpeas, most popular probably humus, is one of the best but not perfect alternative for proteins from beef (51). Dishes with kidney beans are another, but not as high on proteins as chickpeas (22). A problem with these two protein alternatives is, that dishes with them had so far a relatively low popularity in middle Europe. It is a necessary task for nutrition specialist and the media including cooking shows to make those protein sources more popular in future aging generations.

Fish can also provide protein, plus the well-known omega 3 fatty acids. Only really fatty fish species (e.g., carp) also provide a demanding amount of vitamin D, together with calcium important against osteoporosis, which one would then not have to supply artificially. However, fish cannot replace the many ingredients of beef.

Salad and Vegetables

If you do want to add some fiber, even against constipation and an as healthy as still possible gut microbiota, the best way to do this in old age is with vegetables, a salad with vinegar and canola oil in the dressing is an add on, where the freshness of salad and the vinegar are an opening key for a larger meal. The

important part of a salad with vinegar is the vinegar can also be well replaced or enriched with freshly squeezed lemon juice. Vinegar and citric acid provide an acid equivalent that can at least somewhat compensate for reduced stomach acid production in old age (50), and canola oil has the highest amount of omega-3 and omega-6 fatty acids among oils, even more than olive oil. Salad enriched diet has in one study shown in combination with fresh fruit to reduce the white and grey matter loss in patients with dementia (14).

Why are the latter so important? Well, according to current research, they are a crucial factor in the sheathing of nerve pathways and thus nerve conduction. So, we need them to counteract the decline of our mind in old age.

By the way, again on the acid equivalent, seniors are often prescribed stomach acid blockers for heartburn over a long period of time. While this is convenient, it brings with it some very unpleasant side effects. On the one hand, without stomach acid, food can be broken down poorly and thus many important nutrients are lost. On the other hand, stomach acid also protects us from excessive growth of dangerous bacteria in the gastrointestinal tract, e.g., clostridia bacteria and, of course, microbes that are found on food. In addition, when stomach acid is greatly reduced, this easily leads to nausea during a more sumptuous meal. So, it is better to sleep with a slightly upright upper body, drink a glass of milk if you have heartburn and avoid large amounts of alcohol or very fatty foods before going to bed than to take the so-called proton pump inhibitors continuously. If, despite everything, it is not possible to go without stomach acid blockers for a while, a salad with vinegar or lemon dressing should be part of the menu once a day.

Let's move on to the king food ingredient for old people: Vegetables. Vegetables should be eaten as much as goes in without overloading the intestines with too much fiber. Next to beef, it is the most important and even more enriched food component with vital minerals. No matter what vegetables: green beans, red beans, broccoli, spinach, chard, peas, asparagus, kohlrabi, cauliflower, fennel, cabbage, tomatoes, beets, etc. And here's the kicker: Funnily enough, frozen vegetables are sometimes healthier than fresh vegetables that have been sitting around for a few days. This is because the important folic acid, also present in vegetables, loves cold and then keeps better in frozen vegetables than in fresh vegetables harvested a few days ago.

Frozen vegetables, surprisingly, contain more vitamins and folic acid than fresh vegetables, because shock freezing usually preserves more folic acid and vitamins in vegetables two to three hours after harvest than even market vegetables sold the day or two after harvest.

Some beans also still contain proteins, and some vegetables also contain bitter compounds with antioxidants that have anti-inflammatory effects (important in old age against urinary tract infections) and some are expectorants.

The antioxidants are found highly enriched naturally also in onions, shallots, garlic, chives, parsley, and further herbs. The diet of older people should also contain some of these, even though raw onions in larger quantities can cause intestinal irritation in some older people. Here it depends on the suitable quantity, to which one should approach. The same applies, by the way, to the vegetables per se that one tolerates best. Our body tells us quite well, even in old age, what tastes good to us and at the same time does not put too much strain on us.

Cheese for Dinner

A good cheese with mixed or brown bread and a glass (0.125-0.2 l) of red wine with it for dinner. Yes, this is indeed what >

Box 1

A sample meal plan for an over 80-year-old by ecotrophologist Bettina Knoerr PhD.

Breakfast: coffee or tea, a bowl of unsweetened oatmeal with cottage cheese and, if necessary, a pear cut into it. Alternatively, a good mixed bread with butter and jam or some salami. One-three times a week a breakfast egg.

Lunch: Beef roulade with jacket potato and mixed salad. Served with mineral water with a higher salt content.
Lunch Dessert or with afternoon coffee/tea: A fruit salad or a piece of sponge cake twice a week.

Dinner: A cheese plate nicely arranged with high-quality cheese, brown or mixed bread with butter and a small portion of chives. Alternatively, a large baked potato or jacket potatoes with cream cheese or cottage cheese and a salad. Served with a glass of wine or half a beer or wheat beer. Alternatively, a glass of rose hip tea.

the ideal dinner would look like for a very old person well over 80 years old (18). The cheese is an important source of calcium against osteoporosis and contains more calcium than milk, the bread (see above) provides vitamin B12, and the wine provides just the right amount of alcohol (about 12 grams a day according to WHO recommendations) and antioxidants against arteriosclerosis. It is important, as many scientific studies have now shown, to consume alcohol with food and not separately from meals alone. This clearly reduces the harmful effects of alcohol on our liver and our nerve cells in the brain.

In Germany, of course, beer lovers should not be left out. Wheat beer (Hefeweizen) in particular is a good source of vitamin B1. Of course, alcohol should be enjoyed in moderation and as written above, always together with a meal, but abstinence from alcohol in old age makes no sense from a nutritional point of view, and the one half-pint in the early evening can also be a vital fluid and vitamin donor for old people.

From the Queen we know that the cup of tea should not be missed. In fact, healthy is, for example, a cup of rosehip tea with dinner, as in good old times in our youth in the youth hostel, because rosehip tea helps to flush out uric acid. Otherwise, tea like coffee is not unhealthy, as a liquid donor and as a stimulating drink, especially nutritionally healthier than a glass of water, but the cup of Earl Grey or Ceylon tea is not especially healthy or healthier than coffee.

Healthy = Fruit? No!

Whether it is due to times of shortage during the war or formerly in eastern European countries under communist governments, whether we associate tropical fruits with vacations in warm climates - the superstition that fruit is a particularly healthy food cannot be eradicated in all age groups but especially among older people. Doesn't the saying "An apple a day keeps the doctor away" already say that fruit is healthy? Well, on the one hand, the emphasis could be on "an" apple a day, not on 3 or 4, on the other hand, apples, preferably from a meadow orchard, contain healthy pectin, but to generalize this to all types of fruit is unfortunately fundamentally wrong. Most of the fruits that can be bought in our supermarkets contain high amounts of fructose, often they are sweet-highly cultivated, worst of all seedless grapes, the transport and their shelf life in the supermarket shelf they owe more than all other fresh foods to the spraying of

pesticides and the chemicals for the surface treatment.

The decisive reason why people over 80 should enjoy fruit only in moderation, and if then actually one peeled apple or pear a day respectively fresh fruit over commercially available fruit juices, which contain even more fructose than fresh fruit, is the fact that the fructose stresses the already no longer fully functional liver and leads to an acceleration of the development of a fatty liver, also the liver is still able to recover as written above (18, 20, 33). So, fingers away from mandarins and relatives and enjoy instead rather a bar of dark chocolate with good cocoa and lower sugar content.

Nevertheless, for refreshment and far better tolerated than fresh fruit, or the tarnished children's apple slices, is a good fruit salad, which in turn helps to stabilize the acid-base balance and whose sugar (sucrose) can be converted by the liver quite well into energy.

Salt is Vital

Less salt against high blood pressure is often the motto. What is perfectly right for the 55-year-old stressed businessman is wrong for the 90-year-old grandma. Her kidney loses so much salt, which is urgently needed for all functions of the cells, that salt should be additionally supplied by well-seasoned meals or by a well-salted mineral water.

Based on the above written we give a recommendation for a one-day sample of nutrition for an over 80-year-old (Box 1).

The Need for Supporting Muscular Training

The best nutrition is worthless without adequate muscle training and the need for frequent muscle training is linear to the elderly person's age (3, 4, 27). Because only this prevents sarcopenia. A short daily training session for both extremities and respiratory muscles is crucial.

The result of many scientific studies in elderly have shifted the importance of endurance training to mainly weight and resistance training (3, 4, 36). Also, here counts: As older a person as higher the proportion of resistance training in overall mobilization and muscle training (26, 47).

Resistance muscle training in regard to core and extremity muscles is not only important concerning the reduction in sarcopenia but also in regard to keep the core stability for balance in order not to fall (7).

There might be evidence that in male elderly substitution with testosterone can reduce sarcopenia in combination with weight and resistance training (45). In a study with 61 male veterans at a veteran's administration clinic in Little Rock, Arkansas, male seniors with a mean age of almost 80yrs (78, 2yrs) profited from additional testosterone supply in lower and higher intensity resistance training. However, the authors of this study saw the main effect in high intensity resistance training compared to lower intensity resistance training even with supplemental testosterone.

Also, regarding respiratory function regular respiratory muscle training in addition to a protein rich nutrition is crucial in the very old to avoid pneumonia (9). To make such a training feasible and affordable in addition to physiotherapy the daily short time use of little training devices for the respiratory muscles might be of great help. ■

Conflict of Interest

The authors have no conflict of interest.

Summary Box

In very old people > 80 years, especially geriatric patients in clinics or residents in nursing homes a specific diet, which differs from nutrition recommendations for middle aged persons or elderly persons up to 80yrs of age is necessary

Many nutrients must be increased or given by supplementation. This is especially true for a necessary increased protein intake to avoid sarcopenia and falls.

It is important to control electrolytes especially natrium chloride (salt) and add salt to meals in order to respond to the reduced kidney function in the very old. The middle-aged and the very old differ fundamentally in this respect. In middle aged increased natrium chloride in food should be avoided according to nutrition recommendations against high BP. To reduce malabsorption, attention must be paid to a sufficient acid content in the diet, e.g. through vinegar.

Regular physical exercise is essential to enhance the nutritional effects in order to avoid sarcopenia. Resistance muscular training is preferred over endurance training.

Daily respiratory muscle training with simple training devices like the Flutter or Tri-Ball Trainer should accompany muscle training to reduce the risk of pneumonia.

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