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Abbreviations

AKE	Arbeitsgemeinschaft Klinische Ernährung
A.S.P.E.N.	American Society für Parenteral and Enteral Nutrition
AT	Austria
BMI	Body Mass Index
BW	body weight
CCEE	Countries of Central and Eastern Europe
CI	confidence interval
CV	central venous
CZ	Czech Republic
ESPEN	European Society for Clinical Nutrition and Metabolism
FTE	full-time equivalent
GDP	gross domestic product
HR	hazard rate
IQUARE	Impact d'une démarche QUAlité sur l'évolution des pratiques et le déclin fonctionnel des Résidents en Établissement d'hébergement pour personnes âgées dépendantes
LTC	long-term care
M	male
m ± sd	mean ± standard deviation
MNA	Mini Nutritional Assessment
MVA	mulitvariate analysis
ND	nutritionDay
NG	nasogastric
NGO	non-governmental organisations
NH	nursing home
PEG	percutaneous endoscopic gastrostomy
PEJ	percutaneous endoscopic jenunostomy
PV	peripheral venous
SA	sensitivity analysis
UVA	univariate analysis
WHO	World Health Organization
WL	weight loss

Factors influencing weight changes and mortality of residents in European Nursing Homes: results of the nutritionDay-initiative

"Anything worth doing is worth doing well." (www.nutritionday.org)

1. Introduction

Currently, only a small proportion of elderly, care-dependent citizens live in residential facilities in Europe. Circumstances like the low birth rate and the increasing life-expectancy, however, will not only lead to a rise in the proportion of elderly people, but also in the number of physically impaired people. As a consequence, the demand for facilities like nursing homes will rise dramatically in the near future. (1) Since nutritional care quality influences the well-being and health of the elderly, future considerations should also concentrate on a better understanding of nutrition in nursing homes. (2) This thesis, therefore, focuses on nutritional management in European nursing homes and the nutritional status of their residents in order to identify nutrition-related factors that may predict outcomes such as weight loss or mortality. The overarching goal of this study is to raise awareness of simple risk factors that, if they are detected and corrected early enough, could not only contribute to a better quality of life for people in residential facilities but might also help to avoid serious nutrition-related outcomes such as diseases associated with malnutrition.

1.1. Demographic ageing in Europe

Demographic ageing is one of the major challenges with which Europe will be faced in the next years. Ageing is the result of several factors including a decline in mortality and an increase in life expectancy. (3) The decrease in mortality is mainly caused by the lower infant mortality rate and the benefit of effective public health measures. At the same time as the mortality rate decreases, life expectancy increases due to better living standards (e.g.

better sanitation), better education and healthier lifestyles (e.g. nutrition) as well as due to the improved quality of health care (4) (3, 5, 6).

Europe accommodates 510 million people. 18.5% of them are older than 65. (Table 1). It is predicted that by 2060, 29.5% of European´s population will be age 65 or older. The median age of Europe´s population is now 42.2 years and is predicted to be 47.9 years in 2060. (5) (3, 7) In 2014, the life expectancy for the EU-28 was 77.5 years for men and 83.1 years for women. Differences among Member States are significant, ranging from almost 13 years for men to 8 years for women. (8) Greece and Italy had the highest proportion of older persons (both 24%). (9) It is especially noteworthy that the proportion of the "oldest old" (those above 80 years) increases while the number of working people steadily declines. (10) (11) The "old-age dependency ratio" is the relation of elderly people that are economically inactive (over 65 years) to economically active people (15 to 64 years). It is striking that in 2080, provided that there are the same income levels, two working people will have to care for one elderly person, while, nowadays, three to four working people can split that "job" (Table 1). Starting in 2014, the first people from the baby-boomer generation reached retirement age, leading from now on to a quicker rise in the ageing population. Migration is one factor that temporarily delays ageing and increases the work force of Europe. (3)
Table 1 presents data from Europe, particulary Austria, Germany and Hungary, the countries where most data in this thesis are derived from. Germany is the country with the oldest population. (3) In contrast to other European countries, Hungary´s population is in decline and is predicted to decrease to 8.7 mio by 2069. (12)

The graph in Figure 1 shows the current and projected share of people aged 80 and older in some European countries. In Austria in 2006, 4.3% of the population was 80+, which will increase to 6.7% by 2030. (13, 14)

	Europe	Germany	Austria	Hungary
Total population 2016	510 056 000	82 162 000	8 700 500	9 830 500
Population 65+ (in %, 2014)	18.5	20.8	18.3	17.5
old-age dependency ratio (in %, 2015)	28.8	32.0	27.5	26.5
old-age dependency ratio (in %, 2080)	51.0	59.9	54.2	52.9

Table 1: Demographic figures of some European countries (3) (15, 16)

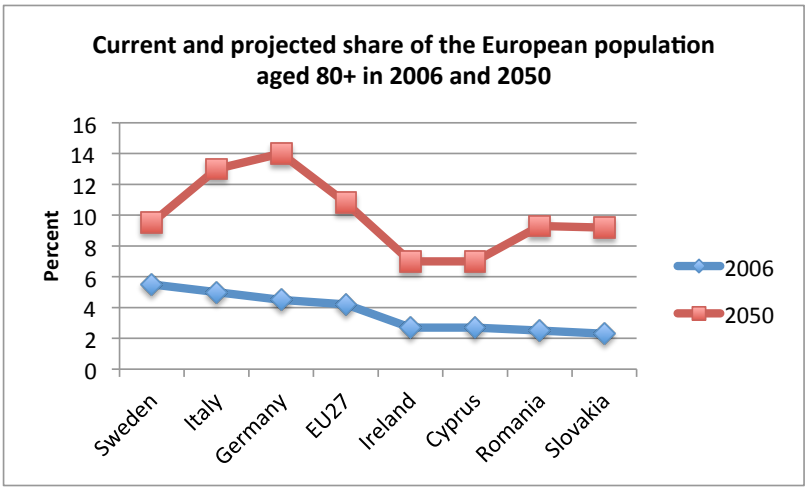


Figure 1: Current and predicted share of people 80+, EU, adapted from (17)

1.2. Challenges of an ageing population for the society

Ageing in Europe causes the society to be faced with new challenges. Non-communicable diseases, such as mental illness, stroke, cancer etc. are on the rise. (18) Therefore, the need for care will increase tremendously, which relatives and family members won´t be able to provide. There will be a high demand for institutionalised care at a high-quality level, including many more specialists for nursing and medical treatments. As a consequence, the public expenditures for long-term care will increase.

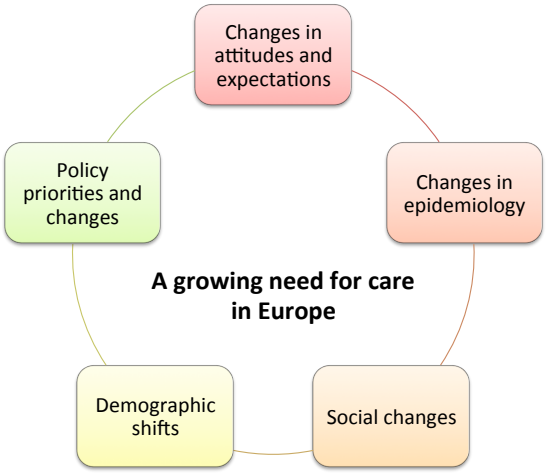


Figure 2: A growing need for care in Europe, adapted from (18)

1.2.1. Rise in non-communicable diseases

Non-communicable diseases are already the leading causes of disability and death and are steadily increasing. (18) Mental illness is more and more recognised and treated. Alzheimer's disease and dementia are becoming more prevalent in the ageing population and a growing proportion of people suffer from diabetes, heart diseases, respiratory diseases, stroke, musculoskeletal diseases and cancer. 30% of the population of 80+ are multimorbid. (19) Detailed decriptions of diseases can be found in the chapter 1.4.2.

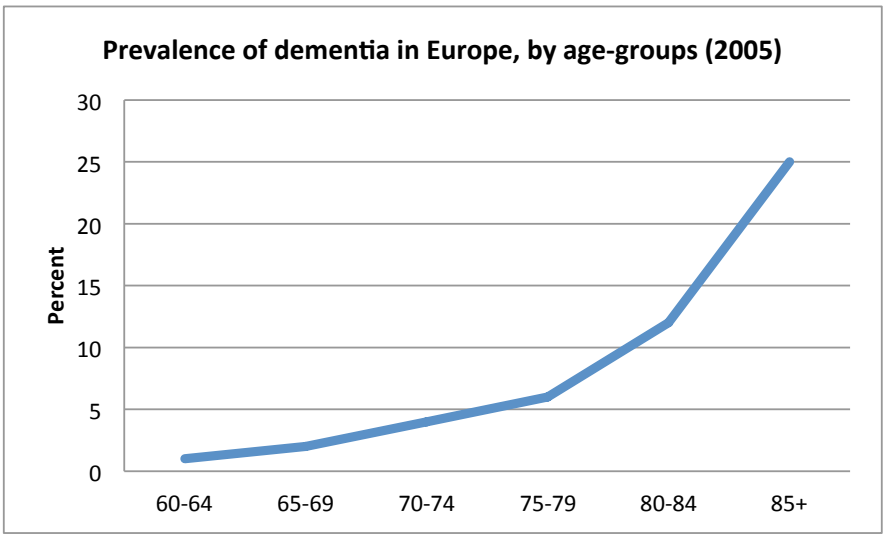


Figure 3: Prevalence of dementia in Europe adapted from (17)

There are three hypotheses derived from theories about the future of care for the elderly. The first theory assumes that the years of one´s life increase but not the years of care needed (the people stay healthier for a longer time) – "compression of morbidity-theory". The second theory says that a gain in years of one´s life also means a gain in the need for intensive care – "expansion of morbidity-theory" (pessimistic scenario). Finally, according to the 'dynamic equilibrium' hypothesis, the number of years spent in good health will remain the same during the time of life. (20)

1.2.2. Rise in long-term care expenditures

On the basis of a fourfold increase of care-dependent elderly citizens (especially the oldest-old) by 2050, the required amount of institutionalised care will increase accordingly. (20) (21) At the same time, wealthier societies are demanding more quality and more addressable care systems.

Although it is difficult to predict the future needs of places in care homes in Europe, an increase of 150% in the next 50 years is expected. (22) In 2010, 1.8% of the gross domestic product (GDP) across Europe was spent on public long-term care and it is predicted that this share will rise to 3.3-5% by 2060, depending on the different scenarios of population development. It is estimated that the public long-term care expenditure will increase by 70 percent by 2050. (21) (23) (11) (10)

The pressure on long-term care institutions rises due to these developments. (24) A different approach to health and social sector policy will be required to cope with the financial burden.

1.2.3. Sociodemographic changes

The main sociodemographic changes are the break-up of the traditional large family group and urbanisation, which complicate the situation for care. While family groups are often intact in rural areas, urban communities are different: small family units, limited living space and the younger generations often moving away from their families because of work constraints. Also, the fact that women participate in the labour market increasingly results in the availability of a smaller pool of family care. (18) Furthermore, inadequate living conditions are often responsible for a person having to leave home and move to a care

institution. For example, when a person needs to sit in a wheelchair, houses are often not adequately equipped (too many stairs, narrow doors, etc.). Houses or flats often do not suit the needs of elderly people. (25) Care institutions and their staff are more and more important, and therefore are going to be described in a separate chapter.

1.3. Residence for elderly in care institutions

There are many ways and possibilities of how elderly can live and, if necessary, be cared for. In this thesis, the focus lies on the residential facilities in nursing homes.

1.3.1. Long-term care

Long-term care (LTC) "is the care for people needing daily living support over a prolonged period of time“ (24). Long-term care includes informal and formal support systems. Formal services are community services like public health, primary care, home care, rehabilitation services and palliative care as well as institutional care in nursing homes and hospices. (26) Most care is provided by informal carers who are not paid. (20)

1.3.1.1. History of long-term care

There is no doubt that the conditions of residential care homes have improved since Peter Townsend visited 173 care homes in England and published his experiences in *The Last Refuge* in 1962. (27) "Originally, the conditions in the ‘workhouses’ had to be worse than outside to deter people of going there. This view has changed to more humane values like wellbeing of the individual, individuality, dignity, respect, privacy and physical standards of the building.” (28) At the beginning of this century in Great Britain, 6% of the population aged 65 and over lived in Poor Law institutions. The 1948 National Assistance Act and old age pensions implemented a great change, and many who would earlier have had to enter the workhouse to secure a roof over their heads were then able to live with their families or on their own. (29) Later the homes developed into quite comfortable homes where people now receive constant care and careful attention, usually provided by the state or charitable institutions. The reasons for the shift from family care to care in homes are the decreasing family size, greater life expectancy and geographical dispersion of families with working and more highly educated members.

Currently, long-term care is addressed through three interconnected objectives for the services provided by the EU: universal access, high quality and long-term sustainability. Care homes are a major component of the welfare system in a country and should provide care for old, clinically unstable and vulnerable people. Specialisation is now the great challenge of long-term care institutions, e.g. for the elderly with dementia. (10) (22) Long-term care is provided at home or in an institution.

1.3.1.2. Domiciliary care or home care

Older people receive care from family members or friends within their place of living (informal) or by paid home-based care (formal). The overwhelming majority of care given to older people throughout the world is informal, much being basic social care like feeding, washing, dressing and emotional support. Informal care is usually provided without financial compensation and by non-professionals. Spouses and adult children provide most informal care; two-thirds of informal carers are women. People who are looking after their relatives or friends without compensation are defined as carers. It is assumed that in most European countries about 10% of the population are carers. (30) Paid home-based care is often utilised to support the provision of informal care activities rather than to replace it.

1.3.1.3. Institutional care

Institutional care is continuing long-term care in a residential or, more exceptionally, a hospital institution that aims to maintain health. It is often used when the family is missing, has no time for care or the burden is too high. The boundaries between various traditional settings are blurred so that a continuum of care services exists between home-based care and institutionalisation. (31) (32) Institutional care covers only a small percentage of elderly people´s demand.

Residential care is distinguished by homes for the elderly, retirement homes and nursing homes (NH). The main focus in homes for the elderly lies on “living”. The people are independent and do not use other services. In a retirement home, only little care is needed. People´s lives are self-determined and services like cleaning and food supply are regularily made use of. A nursing home is a place of residence for people who require 24 hours nursing care and have significant deficiencies and limitations with the activities of daily living.

1.3.1.4. Day care, out-patient service and other associated forms of living and care

Day care or out-patient service provides short-time care either at home or in an institution when, for example, the carer is absent. (30)

1.3.2. Elderly care in Europe

In the following, the proportions of care dependent old people, especially in Austria, Germany and Hungary wherefrom most data in this thesis come, are described. The rate of institutionalisation and affiliations as well as the staff composition are discussed.

Austria

By the end of the year 2014, 457 576 people received care allowance (Pflegegeld) in Austria. (33) There were 70 000 places in homes for living and nursing. The rest lived in private households. (34, 35) The rate of institutionalisation for those 85 and older was above 21%, the rate for the 65 and older below 5%. (36) Due to demographic and epidemiologic developments, the demand for mobile and stationary care has risen. (34)

In Austria, elderly care is assigned to Social Affairs. The constitutional responsibility of elderly care belongs to the nine Austrian provinces. (34) As a consequence, there are big regional differences regarding the distribution of nursing home spaces. The focus for the future lies on the establishment of spaces for assisted living and local residential communities. (34)

In 2008, there were 817 homes in Austria for either nursing (78%) or living (22%). (37) The density of the supply of beds in homes for people aged 75+ was 116 per 1000 inhabitants in 2002. (30) The main numbers are summarised in Table 2:

Form of care in Austria	Number of care dependent people	in %
Home (for living/for nursing)	70 000 (55 000/15 000)	17.5
Mobile services (incl. combinations with informal care of family)	100 000	25
24-h-care	20 000	5
Informal care (mainly family)	210 000	52.5
Total	400 000	100

Table 2: Nursing care in Austria (38)

The number of people working as care professionals was estimated to be around 80 000.

54% worked part-time, on average 30 hours/week. There is a trend towards higher professional qualifications. About 39 200 people worked in the field for the elderly. In 2002, 21 250 people (measured in full-time equivalents) were employed by nursing homes. 82% of the staff is female. (38) (39)

Since September 2016, there are new draft laws for the education of care professionals. Now there are three job descriptions: "care assistance (Pflegeassistenz)" and "professional care assistance (Pflegefachassistenz)" with an education of one to two years and "senior nursing specialist (gehobene Pflegefachkraft)" who are educated at a Fachhochschule. There is no unique model of a physician in a nursing homes (Heimarzt). Permant physicians in nursing homes have a longer (about 100 years old) tradition only in Vienna, where geriatric institutions that applied themselves to the “Wiener Krankenanstaltengesetz” occupied many physicians. The usual Austrian nursing home applies itself to the “Sozialversicherungsgesetz”, in which a “Heimarzt” is not provided. (40, 41)

“Pflegenotstand” in the care for elderly is a problem, i.e. more staff is needed than what is available. The required number of full-time nurses in nursing homes increased by 60% between 1995 and 2002. (39) (30)

Germany

The number of care-dependent people has increased by 15.2% from 2001-2011. In 2011, 2.5 mio. people were care-dependent in Germany (42). Of these, 69% received care at home and 31% lived in nursing homes. In 2011, there were 12 354 homes with 876 000 beds and 787 000 care-dependent people. 55% of the nursing homes were non-profit, charitable institutions (e.g. Diakonie, Caritas), 40% private institutions and 5% public utility providers or communal. On average, one institution cared for 64 care-dependent people. At home, two thirds of the people were cared for by relatives and friends while another third was cared for by ambulatory nursing service. Care-dependency is defined as receiving benefits according to the Social Insurance Code, the “Sozialgesetzbuch, SGB XI”. The demand for nursing homes and ambulatory services is generally rising while domestic care declines. (43) (44) (45, 46)

There is very high fluctuation among the staff and a high deficiency of qualified staff in Germany. In 2011, 661 000 persons worked in nursing homes (which equals about 480 000

full-time equivalents, FTE). 85% of the staff was female. In 2009, nearly every second person was a qualified, skilled worker who met the minimum standards. 7% were trainees or volunteers. Within 10 years, the staff in nursing homes increased by 35% and the number of nursing homes was raised by 28%. Part-time work especially gained in significance. (46, 47)

NHs recently can decide whether to occupy a permanent physician or not. Due to the lack of physicians, many have to do without. The regulations are specified in § 119b SGB V. (48)

Hungary

In the year 2004, one fifth of the Hungarian population was above 60 years old. (34) The population is in decline and it is predicted to reach 8.7 mio by 2069. (12) Long-term care is provided by the social and health care sector, similar to the Austrian system. The boundaries between social care and health care institutions are often blurry. As for the health or nursing care sector, in 2009, there were 27 chronic hospital beds per 10 000 inhabitants, of which 10% belonged to long-term nursing care (LTNC). In 2007, there were 999 institutions with 88 525 beds that provided social long-term and temporary care for residents. Of them, 35.7% were non-governmental organisations and 59.7% homes for elderly. The latest information (from 2013) regarding the number of residents in long and short-term residential social institutions presented 91 001 residents (49). Hungary fights with missing capacities in ambulatory and stationary care for the elderly.

Generally, impoverished people and people with disabilities (to which the elderly belong) have the right to receive social assistance. There is a wide variety of care institutions in Hungary. Regarding the staff in long-term care institutions, no information from the Chamber of Hungarian Health Care Professionals (MESZK, president Dr. Zoltán Balogh) could be provided. For the year 2008 it could be found that 23 251 formal long-term care workers were employed in institutions. (50, 51) (24)

Table 3 gives an overview on demographic and nursing home data from three described European countries:

	Austria	**Germany**	**Hungary**
Population total	8.47 mio (2013) (52)	80.52 mio (2012) (53)	9.94 mio (2011) (54)
Population elderly	1.5 mio 65+ (2012)	21.2 mio 60+ (2009)	2 mio 60+ (2004)
Population, (elderly) predicted	2.5 mio 65+ (2040)	28.5 mio 60+ (2030)	8.7 mio total population (2069)
Care dependent people	600 000 (2004)	2.5 mio (2011)	860 000 (2003) (55)
Residents in NH	70 000 (2008)	876 000 beds (2013)	88 525 social care beds (2007)
Nursing homes	817 (2008)	12 354 (2013)	999 social care institutions (2007)
Staff in NH	21 250 FTE (2002), 16.7 LTC workers per 1000 people aged 65+ (2006)	480 000 FTE (2009)	23 251 formal LTC workers in institutions (2008) (24)

Table 3: Overview on demographic and nursing home data in Austria, Germany and Hungary; NH= nursing homes; FTE= full time equivalent; LTC= long-term care

Nursing homes structures in Germany, Austria and especially Hungary are different. The problem of missing capacities and staff occurs everywhere and turns out to be a tremendous challenge for society in the future. Furthermore, ageing of course affects the individual. These issues will be described in the following chapters.

1.4. Implications of increased longevity in individuals

The increase in life expectancy, which is one of the factors that leads to population ageing, also affects the ageing individual. The individual person is of particular interest in this thesis for exploring risk factors for (individual) weight loss and mortality of residents in nursing homes.

Figure 4: Ageing, adapted from („Ageing“ on www.manbir-online.com)

The next section deals with changes in the body composition, metabolism and physiological functions in the elderly, always with regard to nutrition. Finally, common diseases and causes of death for old people are summarised.

1.4.1. Body composition, metabolism and physiological functions

Body composition changes with ageing. The main change is the reduction in fat-free mass, especially muscles. Organs and bone density decrease. These reductions are associated with a higher risk of falls and fractures that can lead to immobility. Furthermore, body water is reduced in elderly people and amounts to 45-50% of the body instead of 60% at younger age. Reduced fat-free mass is often replaced by fat-mass, which is then distributed from the extremities to the abdominal region. Abdominal fat favours arteriosclerosis, elevated blood lipids, high blood pressure and insulin resistance. Loss of muscle mass is also associated with reduced energy needs, less appetite and food intake. The maintainance of muscle mass through training and nutrition is a major priority in ageing. Regarding energy demands, people with diseases like cancer, heart insufficiency, chronic obstructive pulmonary disease (COPD), acute infections of the respiratory tracts or hyperactivity due to dementia are an exception.

As far as metabolism is concerned, elderly people often suffer from an impaired glucose tolerance mainly due to reduced insulin production, but also because of reduced physical activity and nutritional intake. While the metabolism of protein is not influenced by ageing, fats are less metabolised and lead to an accumulation of total body fat. Fat accumulation is also stimulated by hormonal changes and inactivity. High fat consumption is a main risk factor for cardiovascular diseases, insulin resistance and diabetes mellitus. Changes in body metabolism with age are individually different.

Many physiological changes associated with ageing are related to the gastrointestinal tract with impact on the nutritional status. Tooth loss leads to impaired chewing functions and thereby to reduced (healthy) food intake. Less healthy, vitamin-reduced, cooked food replaces fresh fruits and vegetables or wholegrain products. Furthermore, a bad chewing function reduces digestibility and usability of nutrients. Xerostomia is caused by low liquid

intake, radiotherapy and high drug intake, leading to a change in food selection and nutritional deficits. As far as other parts of the GI-tract are concerned, the stomach is especially impaired by ageing processes. As the gastric mucosa is supplied with less blood, its cells decrease and gastritis occurs more often. This again influences the bioavailability of some vitamins and minerals (Ca, Fe, B_{12}). Bacterial overgrowth is a further risk of low gastric acid production. Appetite and food intake is reduced as the stomach emptying is slower because of less gastric movements. High activity of cholecystocinin leads to early satiety. Some problems with the small intestine that occur with age affect lactose tolerance and worsen calcium resorption. While lactose intolerance leads to diarrhoea, a major problem for elderly people is obstipation. The rectum gets less sensitive; its muscles are weaker and the intake of fluids is often low. The size of the liver and kidneys shrink with age, which can lead to worsening metabolic and detoxification functions. As the functionality of urine concentration is impaired, regular and adequate liquid intake becomes more important.

Age-related changes in the endocrine system including higher activity of the hormone for satiety can have negative effects on the nutritional status. Due to the reduced capacity of the immune system, infectious diseases are more frequent. People are more easily confused and disoriented due to fewer neurotransmitters as well as shifts in vitamins and electrolytes households. Due to reduced sensory cells, the senses of taste and smell get worse with age. Drug intake also influences sensory cells negatively. The sensation of thirst is reduced. Drugs, like diuretics and laxatives, additionally lead to negative fluid balances, risking dehydration or exsiccosis. Furthermore, low energy needs, low body activity and eating pains foster a lack of appetite. All these changes together cause anorexia of ageing. Anorexia is an age-related, very frequent change in eating behaviour that diminishes the desire to eat and implies worse nutritional status. (56) (57) Anorexia of ageing not only occurs because of physiological reasons, but also as a consequence of certain illnesses or due to environmental changes or psychological reasons. (58)

1.4.2. Diseases affecting older people

In 1998, the WHO published the following “major chronic conditions affecting older people worldwide”:

- Cardiovascular diseases (such as coronary heart disease)

- Hypertension
- Stroke
- Diabetes
- Cancer
- Chronic obstructive pulmonary disease
- Musculoskeletal conditions (such as arthritis and osteoporosis)
- Mental health conditions (mostly dementia and depression)
- Blindness and visual impairment

(59)

The main diseases of the elderly are described in the following. Nutritional associations are outlined.

Cardiovascular Diseases

Cardiovascular diseases, including ischaemic heart diseases or cerebrovascular diseases are the main cause of death in the elderly. (60) Modifiable factors such as nutrition as well as normative age related changes in cardiovascular function predispose the elderly to cardiovascular diseases. Thus, the heart rate gets slower with age and the size of the heart increases (but not the chambers), so that the heart fills more slowly. Abnormal rhythms and murmurs are more common among elderly people. Furthermore, blood vessels change as well as baroreceptor sensitivity. Therefore, the elderly suffer more often from orthostatic hypotension, causing dizziness. On the other hand, hypertension due to the thickening of the artheries also increases with age. (61) Long-term hypertension contributes to coronary artery disease, stroke, heart failure, etc. Importantly, many risk factors for cardiovascular diseases (e.g. obesity) can still be controlled and are very often nutrition related.

Obesity

As defined by the WHO, "overweight and obesity are abnormal or excessive fat accumulations that may impair health". (62) For adults, being overweight means having a BMI ≥ 25 kg/m^2, while obesity means a BMI ≥ 30 kg/m^2. For the elderly, these barriers are slightly different and will be described in chapter 1.5.4.1. “Sarcobesity” is a term that describes the association of sarcopenia and obesity. (63) Obesity is also a form of malnutrition, namely overnutrition.

Obesity is related to several clinical conditions, like diabetes mellitus, heart diseases, hypertension and also chronic conditions like osteoarthritis and dementia. It also plays a

role in a systematic inflammatory state, and its association with certain types of cancers is obvious. The accompanying immobility in the obese leads to a further risk of losing calcium reserves in bones (the basis of osteoporosis), vascular complications, pressure ulcers and respiratory conditions. Obesity is known to increase with ageing in Europe up to the age of 65 and decreases thereafter (Figure 7).

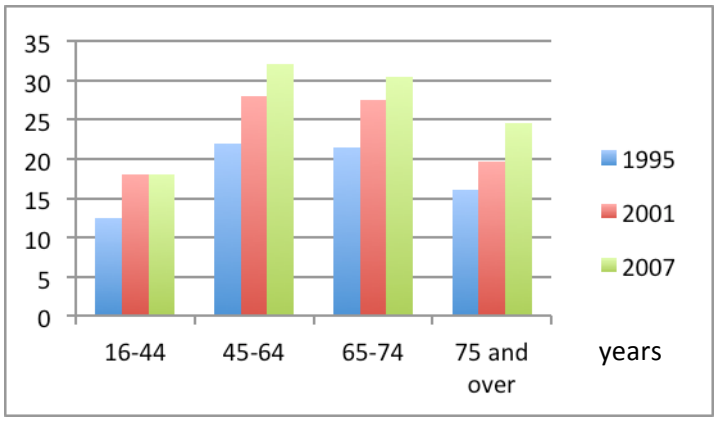


Figure 5: Percentage of people who are obese by age, England 1995, 2001 and 2007, adapted from (63)

In general, obesity leads to a growing burden of disability and the associated social care and health costs. (64) Nevertheless, the effects of obesity in the old age group are controversially discussed. Kaiser et al. showed that obesity in elderly nursing home residents was protective against functional decline and mortality compared to residents with a low BMI. The prevalence of obesity in that study population was 23.5%. (65) For the time of admission period in a NH, when people often lose weight, it is of advantage to have a higher BMI. (66) Still, a lot of studies present obesity as an exacerbation of the age-related decline in functional ability. (67) More investigations are required to understand the risk factor of obesity in old age. Obese people in nursing homes are a particular population as they have survived the complications of their own obesity. Thus, obesity is a challenging topic, especially for caregivers and staff.

Diabetes

"Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces." (68) About 40% of people above 80 years suffer from diabetes and approximately 34% of nursing homes residents. Decreased physical activity, obesity and inflammatory states increase the insulin resistance in peripheral tissue and insulin release is reduced. Diabetes is associated

with higher complications and resource utilisation. (69) (70) In the long-term, the risk for diabetes is reduced by encouraging health-promoting behaviour, like the intake of a balanced diet, regular physical activity, normal body weight, moderate consumption of alcohol and not smoking. (71)

Cancer

Cancer describes a large group of diseases that can affect any region of the body. It is also called malignant tumours or neoplasms. With cancer, abnormal cells are created rapidly that grow beyond their boundaries and can then invade other parts of the body or organs (metastasizing), potentially causing death. (72)

Cancer is the second highest cause of death worldwide for the elderly. Men have twice as high a risk of dying due to cancer than women. (60) 67% of all cancer deaths occur in the elderly 65+. (73) (74)

Nutrition is associated with cancer. The WHO estimates that a lower intake of fruits and vegetables worldwide is responsible for 14% of the mortality from stomach and colon cancers. The World Cancer Research Fund (WCRF) states that non-starchy vegetables and fruit probably protect against cancer of the oral cavity, larynx, pharynx, oesophagus and stomach. Consumption of milk is likely to protect against cancer of the colon and rectum while a high intake of calcium influences the risk for prostate cancer negatively. It is also possible that a high intake of saturated fatty acids can lead to a higher risk for coronary heart disease and breast cancer and that long-chained polyunsaturated fats reduce the risk of colon cancer. According to the WCRF, high consumption of red and processed meat is a risk factor with regard to the development of colorectal and other forms of cancer. Furthermore, the development of stomach cancer seems to be related to high consumption of salt. As far as vitamin-D is concerned, a quantitative dose-response relationship showed that higher concentrations of 25(OH)D in the blood were accompanied with risk reduction for colorectal cancer. Thus, data are inconsistant and contradictory and more research is needed. (71)

Chronic obstructive pulmonary disease

Chronic obstructive pulmonary disease (COPD) is a disease of the lung that is characterised by respiratory disorders and a blockage of the airflow of the lung. COPD typically appears in the elderly. Its prevalence (in the USA) is about 12% in the age group of 64+ years. (75)

COPD often has many comorbidities in the elderly. Therefore, its recognition is problematic. Furthermore, cognitive impairment and depression may occur in people with hypoxemia and hypercapnia. It is life-threatening and not fully reversible. (76) COPD patients are at risk for malnutrition due to their increased energy expenditure from higher breathing effort. Moreover, hypoxie and hypercapnia induce a loss in lean body mass due to the effect of elevated AMP-activated protein kinase.

Musculoskeletal diseases

Sarcopenia, cachexia, frailty

"Sarcopenia" is an age-related loss of muscle mass and strength. As the body ages, muscle mass decreases and is usually replaced by fat tissue. The measurement of the circumference of the lower leg can give information about muscle mass. The circumference should be above 31cm. For the diagnostic criteria of sarcopenia, see Table 4.

Diagnostic criteria for sarcopenia (Documentation of criterion 1 plus 2 or 3)
1. Low muscle mass
2. Low muscle strength
3. Low physical performance

Table 4: Criteria for the diagnosis of sarcopenia (77)

Sarcopenia is a primary process of ageing which is influenced by internal and external processes. It is furthermore an interaction of the supply of macro- and micronutrients as well as changes in the peripheral nervous system, the muscles, cytokines and hormones. In a subsample from the National Health and Nutrition Examination Survey III (1988–1994), a cross-sectional survey of non-institutionalised adults, the overall prevalence of sarcopenia that increased with age was 35.4% in women and 75.5% in men. The prevalence of sarcopenic obesity was 18.1% in women and 42.9% in men. Older women with sarcopenia have an increased independent all-cause mortality risk whether the person is obese or not. (78)

"Cachexia" is related to diseases (proinflammatory processes, like chronic heart insufficiency, cancer or chronic kidney insufficiency) and is accompanied by a loss of fat or muscle mass. Pathophysiologically, cachexia is developed through a change in cytokines, especially a rise in proinflammatory cytokines. Furthermore, hormonal interactions seem to be relevant.

Diagnostic criteria for cachexia in adults

Weight loss of at least 5 % in 12 months and the presence of an underlying disease

PLUS at least 3 of the following 5 criteria

- reduced muscle strength
- fatigue
- anorexia
- low fat-free body mass
- anormal biochemistry like high inflammatory markers (CRP > 5mg/dl, Interleukin-6 > 4pg/ml), anemia (Hb < 12 g/dl), low serum albumin (<3.2g/dl)

Table 5: Diagnostic criteria for cachexia (79)

Regarding pathophysiology, consequences and therapeutical options, cachexia, sarcopenia and also malnutrition (described later) partially overlap. Furthermore, all these syndromes influence the development of frailty, which is decreasing functional performance caused by stress. (80) In Table 7, the diagnostic criteria for frailty according Linda Fried are shown. The major danger of frailty are falls, which belong to the fifth most frequent causes of death among elderly people and are one of the main causes for reduced quality of life and disability. (81) Frailty is an incidence of "infirmity, invalidity, loss of autonomy and nursing care". (19)

Diagnostic criteria for frailty:

- unintentional weight loss (muscle mass) (> 4.5kg/year)
- exhaustion (self-reported)
- weakness (handgrip strength lowest 20%, by gender, BMI)
- slowness (walking time/4.5 meter, slowest 20% by gender, height)
- low physical activity (kcal/week, lowest 20%)

1-2 criteria: pre-frail, ≥ 3 criteria: frail

Table 6: Diagnostic criteria for frailty according Linda Fried (82)

Among nursing home residents, 67% had skeletal muscle mass abnormalities, of which there were more men than women. Of these, 51.4% had muscle wasting/atrophy, 40.3%

sarcopenia and 9.7% cachexia. (83) Sarcopenia and other forms of muscle mass abnormalities are common in adults over the age of 65 and increase with age. (71)

Osteoporosis

Osteoporosis is "a chronic skeletal disease that causes reduced bone mass and deterioration of the bone microarchitecture, resulting in an increased risk of fracture." (84) Osteoporosis is very common worldwide. The WHO generally defines osteopenia as a bone mineral density (BMD) level of 1.0-2.5 standard deviations below the mean and osteoporosis as BMD level ≥2.5 SD below the mean.

In a study including nine industrialised countries (also European countries), the prevalence of osteoporosis for people aged 50 and above was recently shown to range from 9-15% for women and from 1-4% for men. For the BMD (bone mineral density) of the spine, the prevalence rates of osteoporosis are even higher. (85) Hip fractures are even two to three times higher among nursing home residents compared to community-dwelling people of the same age and sex. (86) 80% of the fractures happen in women. Their bone loss accelerates after menopause. (9)

Following fractures, the quality of life is negatively influenced and deterioration can ultimately end in death. Particularly, the elderly with co-morbidities are at great risk of a poorer outcome. There is very effective prevention available, but osteoporosis is often underdiagnosed. When diagnosed, it is treated with adequate nutrition and calcium and vitamin D supplements (always in consideration of the state of the kidney). Furthermore, falls can be prevented very effectively through exercise interventions. Often additional pharmacological therapy is needed. (84)

Two other topics that are important in my thesis are related to musculoskeletal diseases: *immobility* and *pressure ulcers*. These are described in the next section.

Immobility

Mobility is necessary for performing the activities of daily life and for being independent. It indicates health and function in age. Immobility predicts more severe difficulties that affect the quality of life and lead to a high burden for the caregiver as well as to the health care system and society. Immobility in the elderly is caused by physical, psychological or environmental factors. Particularly, the high loss of muscle mass or acute injuries through falls can lead to functional impairment. However, many diseases can also cause immobility in old age, like osteoporosis, stroke, arthritis, hip fracture, and Parkinson's disease. (87)

Associations of mobility and nutrition are well known. Immobility, for example, was related to a low BMI in a recent review on malnutrition. (88) Severe functional impairment especially was more present in residents at nutritional risk. These persons had a worse nutritional screening score (MNA), a low BMI, weight loss and low food intake. (89) A positive correlation between low MNA scores (MNA < 17 points = malnourished) and immobility ($r=63;p<0.001$) was also presented in a study conducted in Prague. (90) The factors immobility (OR 2.516, 95% CI 1.144-5.532), high care dependency and malnutrition are predictive for falls. The early identification of these risk factors is therefore of special importance. (91) Recent studies suggest there is an association between low food intake, serum concentrations of nutrients and poor mobility outcomes. Some authors have summarised that protein consumption is essential for the maintenance of muscle mass and strength. (92) Low protein intake and the higher risk of falls were also the subjects of the InCHIANTI study (93) In addition, vitamin-C intake correlated with measures of physical performance and a low intake of vitamins D, E and C was prevalent for frailty. (94) A relation to physical function impairment has been demonstrated by lower plasma concentrations of α- and γ-tocopherol and lower serum concentrations of vitamin D, E, B6, B12, selenium and carotenoids. Antioxidants may be preventive for muscle damage. A high dose of vitamin-D supplementation was associated with fewer falls. (95) There are more and more efforts to show the effects of dietary patterns rather than single nutrients. A mediterranean diet, for instance, has been studied several times and is argued to be beneficial in preventing lots of diseases and in preserving physical function. Still, more confirmations through dietary intervention studies are needed in order to provide stronger rationals and justifications for the associations of nutrition and mobility outcomes. (92)

Pressure ulcers

Pressure sores are mainly caused by immobility. After a longer period of pressure on a certain part of the skin, the tissue is not optimally supplied with blood. The nerve cells get damaged and metabolites cannot be transported in that area, leading to an ulcer developing in that area. Four stages, grades or categories of injuries are known:

I Non-blanchable erythema

II Partial thickness

III Full thickness skin loss

IV Full thickness tissue loss

Pressure ulcers cause pain, delay rehabilitation and increase the costs of long-term care tremendously. A prevalence study in Germany showed an incidence of pressure ulcers in 24% to 39% of acute hospital patients aged 65 and over. (96) Adequate nutrition cannot prevent the development of ulcers, but it influences skin health. (97) Some nutrients play an important role in wound healing. They are commonly known as "immunonutrients" and they play a major role in the critical care setting. For example, arginine is a precursor of proline and essential for collagen synthesis. It is also a precursor of ornithine that is critical for polyamine and nitric oxide synthesis. Other nutrients that influence inflammatory response are ω-3 fatty acids, although their overall effect on wound healing is not yet clearly shown. Vitamin C and vitamin A supplementation, on the other hand, shows benefits in wound healing. Although zinc deficiency has a negative impact on wound healing, supplementation is not proved to be beneficial. The antioxidant properties of selenium furthermore positively influence wound healing. Immunomodulating formulas consist of vitamins, trace elements, and key amino acids, including arginine. Their use in long-term care settings is not common practice. (98)

In addition to a normal diet, oral supplements rich in protein should be administered to persons at nutritional risk and pressure ulcer risk because of an acute or chronic disease or after a surgical intervention. (99) Undernutrition is a reversible risk factor for the development of pressure ulcers. Therefore, it is important to regularly screen for malnutrition. Vice versa, people at risk for pressure ulcers are at risk for malnutrition. (100, 101)

Cerebral diseases

Dysphagia

The process of swallowing is quite complex and happens 1500-2000 times per day. Many muscles are involved. Disorders are common in the elderly population and are often related to stroke, dementia or morbus parkinson. Dysphagia was shown to be highly related to malnutrition and poor outcomes (102). Swallowing is important for the transportation of saliva, food and liquids from the mouth to the stomach and, at the same time, it protects the respiratory tract. A functional swallowing process is dependent on the good status of teeth. The prevalence of dysphagia lies at 16-22% for the general population above 55 years old in Germany (56), 8% of the population worldwide (103) and at about 50% of the population in NHs (104). The main causes are neurological diseases, but also congenital

diseases and tumours or infections of the mouth, throat or oesophagus can cause dysphagia. The development of dysphagia can arise very slowly and is often unrecognised as the person compensates for the dysfunction quite well at the beginning. After some time, however, the process of swallowing becomes very difficult for the affected person, leading to fears of harmful swallowing and probably to a selection of certain food (soft, cooked vegetables and fruit, puddings etc.). This again favours the development of malnutrition.

In the treatment of dysphagia, it is first of all important to ensure adequate nutrition to protect the respiratory tract. The swallowing process needs to be regained with the help of physicians, nurses, speech therapists, good training and special treatments. Help with eating is necessary in the care of people with swallowing disorders in long-term care. The modification of food texture and liquid thickness are the most important factors as well as the sensory appealing presentation of food. Eating and drinking aids are available on the market. (56)

Dementia

Dementia is "the decline of memory and other cognitive functions in comparison with the patient's previous level of function as determined by a history of decline in performance and by abnormalities noted from clinical examination and neuropsychological tests'' (105). 65-70% of all cases are Alzheimer dementia, the rest are vascular dementia or Lewy body dementia. For people over the age of 65, prevalence rates vary between 5.9% and 9.4%. (106) In German nursing homes, more than half of the residents suffer from dementia (107).

Dementia is one of the biggest public health problems and a major cause of disability and death that also leads to a burden for the caregivers and costs to society. (108) Nearly all people with dementia develop weight loss and malnutrition in the course of the disease. Often, weight loss occurs before dementia is diagnosed. Recently, also for weight trajectory over 20 years in women, associations with dementia developement were shown. (109)

People with dementia are often very mobile and restless, leading to high energy requirements (up to 3 000-4 000 kcal/day). Dysphagia is a frequent problem that accompanies dementia. As far as sensory taste is concerned, people prefer sweets. The perception changes and food and drinks are not recognised as such. Table manners get lost in the course of the disease. To cope with the high energy needs, high caloric nutrition is

recommended, especially in between meals. (110) Every person with dementia should be screened for malnutrition. (111) The biography of eating (Essbiographie), which records the eating habits and preferences of the residents, needs to be taken into account in order to find out about the meals they like. Offering fingerfood is a good method for coping with dementia patients that cannot use cutlery. All senses of the cognitive impaired person need to be stimulated for proper success in adequate food intake. Nurses can promote food intake, while eating in company and in a surrounding in which the people feel comfortable enhances appetite as well. (56) Hanson et al. showed that advanced dementia was associated with a mortality rate of 28% due to infections and nutritional decline. 86% of advanced dementia patients had feeding problems. At the terminal stage, dying LTC residents showed a 72% reduced food and water intake. (112) Furthermore, Meijers et al. showed that malnutrition prevalence declines in the non-demented patients, while it does not do so in the demented. (113) Nutritional status screening is therefore indispensible for patients with dementia.

Depression

Depression is a further frequent syndrome in the elderly that needs to be recognised and treated in order to avoid loss of appetite and malnutrition. Depression can also lead to increased appetite and overweight. (56, 88)

Visual impairment

Blindness and visual impairment are further restrictions that many elderly suffer from, but these are not going to be discussed here.

The next section concentrates on malnutrition, which is a central interest in this thesis and is referred to often.

Malnutrition

Malnutrition can accompany or cause many diseases. Malnutrition is most simply defined as any nutritional imbalance. This includes overnutrition as well as undernutrition. (114) The European Society for Clinical Nutrition and Metabolism (ESPEN) defines malnutrition as “a state of nutrition in which a deficiency or excess (or imbalance) of energy, protein, and other nutrients causes measurable adverse effects on tissue/body form (body shape, size and composition) and function, and clinical outcome.“ (115) (116) In this thesis, the term “malnutrition“ is used synonymously with “undernutrition“.

Several clinical groups have argued that malnutrition is caused by inflammatory activity and undernutrition. In their last years, the elderly often develop a cachectic state. This status starts with sarcopenia. (117) A "gold standard" for detecting malnutrition does not exist. The diagnosis is usually based on weight loss, a low BMI and low food intake. (118) (119) Malnutrition leads to an unfavourable clinical outcome. (120) (121) (122)

The development of malnutrition is diverse and influenced multifactorially. In general, there are three etiology-based terms for malnutrition diagnosis, shown in the figure below (123) (124):

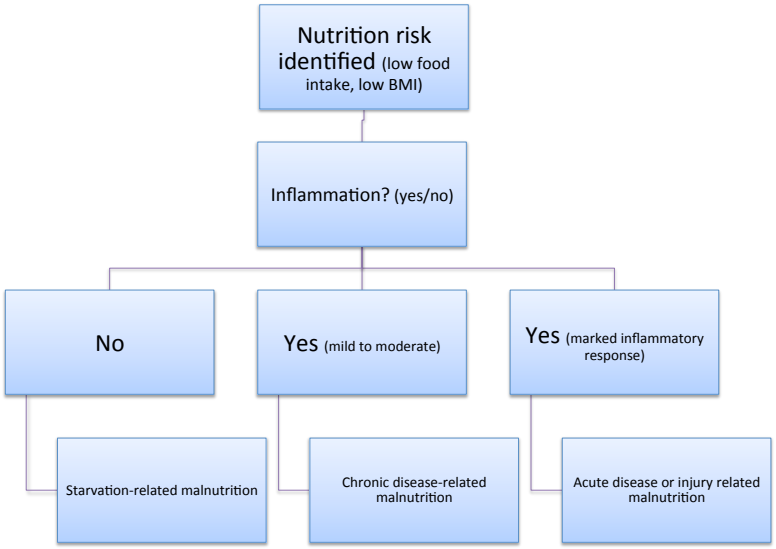


Figure 6: Etiology-based malnutrition terms, adapted from (114) (125)

Age-related restrictions of food intake are primary causes for the development of a bad nutritional status. It is a complex interaction of enteral, endocrine and neuronal mechanisms that regulate hunger and satiety as well as the speed of the stomach emptying. Bad taste and sensory skills with age are further trigger factors for the development of malnutrition. Drug intake, for example, is associated with xerostomia, low appetite and vigilance. Diseases can either influence appetite or increase energy needs. Dementia particularly influences food intake, as well as several biographical factors. (80) It is very important to prevent malnutrition and to stop risk factors for malnutrition at an early stage.

Malnutrition is frequent in the elderly. However, residents in nursing homes and geriatric patients are usually more prone to suffer from malnutrition. Studies show that the

prevalence of malnutrition lies between 10-20% in nursing homes. Additionally, about 50% of the residents are at risk for malnutrition. (126) (127) A recent study from Italy (12 NHs) showed malnutrition, according to the Mini Nutritional Assessment (MNA), in 23.1% of the female and 20.4% of the male residents and respectively 60% and, 52.8% at risk for malnutrition. (128) In 32 German nursing homes (n=2 444), Bartholomeyczik at al. found 26% of residents with indicators of malnutrition and another 28% at risk for malnutrition. Diagnostic criteria were a BMI below 20 kg/m^2 (which is an indicator of malnutrition in the elderly), unintentional weight loss or reduced nutritional intake in combination with a BMI of 20-23 kg/m^2. For Austria, Kulnik and Elmadfa published a malnutrition prevalence of 37.8% in 245 NH residents. (129) First data from the nutritionDay initiative in 2007 showed that 16.7% of 2 137 German and Austrian residents had a BMI below 20 kg/m^2. (121) In 12 international studies, 2-38% of the people were malnourished according to the Mini Nutritional Assessment and another 37-62% were at risk for malnutrition. Again, people who were functionally impaired or in poor health were more affected. (130) (131) (132) Malnutrition can be prevented with good nutritional care in institutions. Nutritional care consists of nutrition screening, assessment, intervention and monitoring. (133) These procedures are described later in chapter 1.5.4. It was also shown that malnutrition is associated with the degree of care dependency, i.e. the more dependent the person was, the higher his/her risk of being malnourished (see next chapter). (126) (127)

Care dependency

Dependent persons “have limited, health-associated abilities to meet their self-care demands” and care dependency “is a subjective, secondary need for support in the domain of care to compensate a self-care deficit.” (134) Usually, disability in old age is defined as having difficulties with the basic tasks of self-care, which are called physical activities of daily living (PADLs). PADLs include e.g. bathing, dressing, continence. Instrumental activities (IADL) furthermore determine the state of dependency, e.g. shopping, using the phone and preparing meals. In epidemiological studies, mobility disability is becoming more frequently used as an essential outcome marker for an independent life. (135) In many countries, old dependent persons are classified according different levels of care. In Austria, for example, there are seven care levels that are determined by the required hours of monthly care. In the lowest category of level 1, the person requires 60 hours of basic care per month; while in the highest category, more than 180 hours of monthly care are needed. At the same time

the person is immobile and totally dependent. The care allowance ("Pflegegeld") is graded according to this classification. (136)

A common disablement model, developed by Nagi (137), consists of four components: pathology, functional impairments, functional limitations and disability. These characteristics are affected by factors of personal behaviour such as physical exercise, alcohol consumption, smoking, social activities and nutrition. They are also influenced by basal characteristics such as gender, age and genetic factors. Relatively privileged socioeconomic groups face fewer risk factors for disability. Environmental factors like social support, services or physical characteristics of the living place play a major role in the development of a disability. Naturally, changes in body structures with age contribute to the disablement process, like weaker sensory or motor performance and an increasing number of illnesses of the cardiorespiratory, nervous and musculoskeletal systems. The main underlying causes of disability are aging processes, injuries and diseases. However, it is difficult to draw a border between these causes and study them separately. A WHO report from 2003 stated that besides physical environment, nutrition has been largely neglected in past research regarding disabilites.

Overall, about 20% of the people aged 70 years or older and 50% of those over 85 have problems with the daily activities of life and need help. The older the people, the more dependent they are. (135) It is striking that women who are the same age as their male counterparts are more dependent. Of the persons between 85-90 years old, 42% of the women need daily care, whereas only 28% of the men need the same amount of care. However, not just the health development and disability are responsible for this. Women are more likely to spend late life alone, therefore, as soon as they become dependent, they apply for care, while men are more often cared for by their spouses. (46)

Care dependency leads to dependency with eating and drinking. In Germany, 76% of the people in nursing homes needed daily support with food and drinks (138), 54.7% of the residents needed help with cutting their food into pieces and 32.7% needed support with drinking. (139)

The high frequency of disability in old people leads to a lower quality of life, limited autonomy, dependency, increased risk of NH admission and also premature death. Disability is an enormous burden for society. It strains the limited ressources for assistance, rehabilitation and care. Prevention measures are of urgent public concern. (135) The most

important prevention targets for disability in old people are: chronic illness, depression, functional decline and sedentary lifestyles. Prevention is a matter of great concern regarding humanity and economy. High evidence exists that physical activity prevents disability in old people, even for the chronically ill. (135)

In the last chapter, individual implications of longevity were discussed. In order to preserve the best health status and to provide good conditions for optimal aging in long-term care, it is important to provide adequate nutrition and to comply with quality criteria. The description of these is going to be content of the next section.

1.5. Nutrition for elderly in nursing homes

1.5.1. Challenge of nutritional support for elderly living in nursing homes

Adequate nutritional support for the elderly living in nursing homes is a big challenge for caregivers. It is not only known that malnutrition is a problem insofar as malnourished residents show impaired physical and psychosocial functions, both leading to a reduced quality of life, but it also causes increased healthcare costs. (115, 130, 131, 140, 141) The British Society for Parenteral and Enteral Nutrition calculated the disease-independent costs of malnutrition for society at 120 billion Euros annually. 20 million individuals are at risk of malnutrition in the EU. (142)

Due to missing nutrition protocols and procedures in institutions, malnutrition is not recognised by the staff. Even if identified, further nutritional assessments and therapeutic measures are not done consequently. Staff complains about the little time available to promote optimal nutrition as well as about lack of nutritional knowledge. (143) (144) It has been recommended by the Council of Europe that malnutrition be approached in a multidisciplinary manner, including the residents and staff in nursing homes and finally also the media and decision makers in policy. (145) (146)

In this chapter, the nutritional situation of elderly people in nursing homes is described, quality terms are defined, then details are shown on how to screen for malnutrition and recommendations for the nutrition of the elderly as well as for communal catering are

given. Lastly, the initiative "nutritionDay in nursing homes" is introduced, in order to start with the methods and results.

1.5.2. Nutritional situation of the elderly in nursing homes

Among older people, low weight, small appetite and low nutrient intake is more common than being overweight. 30% of people living at home do not meet their daily recommended requirements. This problem is more severe for institutionalised people. (58) In the following paragraph, rare data on the nutritional intake of seniors in nursing homes are summarised. Reference values for recommended intake are the same for community-dwelling and institutionalised elderly. The Austrian nutritional report from the year 2008 compared the food intake of old people living in private households and residents in nursing homes (NH). The general nutrient intake of people in residential facilities was less than that of the community-dwelling old. Persons living in private households had a higher intake of folate, magnesium and manganese. People in NHs had a higher intake of vitamin A, B12 and iodine. It was striking that people in NHs had a higher intake of salt (sodium) and sugar, while people at home drank more alcohol. Among the groups of persons in nursing homes, men were the worst supplied group. In a study from the year 2009, the food intake in Viennese NHs was assessed and compared to actual recommendations, published in the “D-A-CH reference values for nutritional intake” (n=68) (147) (148). Results showed a critical situation regarding the intake of energy, fiber, folic acid and vitamin D. About 24% of the old people didn´t cover their basic metabolic rate and 50% didn´t meet their estimated energy requirement. The intakes of protein, fat, vitamin B_1, vitamin B_6 (men), vitamin B_{12}, calcium, magnesium and zinc (men) were insufficient. 45% of the residents showed an intake of less than 0.8g protein/kg BW. Fat intake, especially of saturated fats, was too high. The nutritional status of this group of persons showed that 48% were at risk for malnutrition and 38% were malnourished according to the Mini Nutritional Assessment. The risk factors for malnutrition were drug intake (97%), difficulties with cutting food (71%), depression (63%), immobility (57%) and cognitive impairments (52%). The mean energy intake of the residents was 6.6 MJ (1 577 kcal)/day. The more risk factors the residents had, the worse their nutritional status was. (147) In my own master thesis from 2005, the exact food intake of 12 female Viennese NH residents at risk for malnutrition over 5 days

(weighing protocols) was evaluated. As in the study above, the energy, protein and fiber intake was too low while fat intake was above recommendations. Vitamins D, E, B_1, B_{12}, C, pantothenic acid, folic acid, calcium and magnesium showed the highest deficits. Of all residents involved (n=54), 53.7% showed nutritional risk or malnutrition according the AKE-screening for long-term care. (149) (150) A recent German study among 60 NH residents showed that energy intake was low and more than 50% of participants fell below the recommended values for vitamin C, B_1, B_6, D, folate, calcium and iron. (151) A study in Finland showed in its analysis of 375 NH residents´ food intake that the diet was low in energy, protein, micronutrients (esp. vitamin E, vitamin D, and folic acid) and fiber. (152) Sturtzel et al. recently showed that energy intake was significantly below 24 kcal/kg BW/day and, after nine months, the intake of NH residents even decreased. (153)

An association between nutritional status and the frequency of consumption of certain food groups was found. Diet variety was also higher (and therefore better) at a younger age and associated with a better clinical, functional and cognitive status. Thus, diet variety was worse in more clinically complex residents. (58) A recent study from Mila et al. presents data from the food intake of 62 individuals in Spanish nursing homes. The results show that milk products were served most (376g/day), followed by a large amount of potatoes (110g/d), sweets and pastries (62g/d). It was concluded that most energy came from energy dense, more unfavourable food while certain healthy food types needed to be enriched. (154) A Polish article confirmed the above findings. Elderly people in NHs ate too much meat (with every main meal) and too few fruits and vegetables. The diet was imbalanced and in need of improvement. (155) As one of the main changes in the eating behaviour of the elderly is “food choice”, there should be a strong emphasis on the optimisation of the food served in long-term care institutions. In conclusion, the nutritional status of NH residents is in need of improvement. Although nutrition plays a major role in the quality of life and life expectancy, little attention is paid to it.

1.5.3. Nutritional quality management in nursing homes

Quality management is a recurring process that assesses and improves the quality of services in organisational structures. Quality is the appropriate delivery of agreed services

or products and, therefore, the assessment of quality in a system needs defined standards and outcome measures. Outcome measures are especially difficult when the quality of life and user satisfaction are demanded, compared to measures of clinical outcome on personal data. In comparison to the health care sector, which has a long tradition, quality systems in long-term care (LTC) are not yet well established. Quality of care in NHs is multidimensional, difficult to define and assess.

Various approaches of quality assessment in LTC have been implemented. First of all, one approach to quality measurement is based on structural data, such as the size of the rooms or levels of staff, that require minimum standards. A second approach measures quality on behalf of professional norms and guidelines that improve the care process, like food safety. A third approach regulates quality as a kind of "self-regulation" as the market expands and becomes more and more competitive. The providers want their service to be transparent and improve their image. Finally, the fourth approach is based on the establishment of basic rights of and responsibility for the elderly people in care. On the EU level, this approach works especially on the prevention of abuse of the elderly in LTC. In reality, quality measurements are mostly a mixture of these different approaches and different local, regional or national governments are responsible for quality assurance. As the quality of care and quality of life are especially difficult to measure, an EU project was founded in 2010 that concentrated on identifying and validating indicators in these fields. Now, a range of indicators are used for quality ratings, public reporting and inspection. These indicators also include nutrition-related evaluations (weight loss of residents, clinical nutrition, satisfaction with meals, etc.). (156) The German Network for Quality Development in Nursing (DQNP) developed several standards, including one on adequate nutrition. (157, 158)

Benchmarking is an instrument of comparative analysis with a fixed reference value that complements guidelines and standards. It is effective in identifying improvements or negligence in an organisation and goes along with quality-related initiatives. The idea behind benchmarking is to determine existing differences and what the possibilities for improvement are. (159) (160) While process quality indicators aim at activities between the health professionals and the residents, outcome research is aimed at finding out about the efficacy of health care practices and interventions. It especially includes the experiences of the people who receive care regarding their functioning or quality of life. However,

mortality or symptoms can also be endpoints for outcome. Since the early 1980s, outcome research has steadily gained in importance because endpoints are often missing and there are few available comparative studies about the effectiveness of interventions. Outcome information is necessary for staff and residents in decision making and it is important for the improvement of quality and value of care. It not only shows what quality can be achieved, but also how. (161) (156) Among the large number of reports, there are only a few controlled studies that have observed changes in outcome when quality assurance interventions in health care were conducted. The changes were often too small and difficult to quantify and the significance for the clinic was not clear. As an answer to the uncertainty in choosing what method is best, a combination of methods for quality assurance is recommended. It should produce synergy and cumulative effects. "The most important single condition for the success of quality assurance is the determination to make it work", says Donabedian, an outstanding researcher in that field. (162)

As the population ages, there is more ambition and need to increase efficiency and effectiveness in care homes, finally aiming to reduce costs. As more and more residents and their relatives increasingly have to pay themselves for the nursing home care, they want to know what they get for their money. These facts have led to the installation of compulsory or voluntary quality management systems and also enhanced external controls. This attention has increased not only in individual Member States but also in EU policies aiming to support the promotion of the quality of social services more systematically. There is a growing desire for EU standards in quality assurance. In connection to quality assurance, Donabedian suggested consumers contribute enormously to defining quality and standards and therefore should be involved in the survey. (162) As elderly people with dementia can rarely be interviewed, special instruments are recommended (e.g. Heidelberg instrument). Quality management, standards, guidelines and benchmarks are still not regularily accomplished in care homes and there is an ongoing search for methods and improvements in that field. (163)

An example of a European quality management system is E-Qalin®. It is oriented towards practice and is especially designed for residential care for older people. It is characterised by practice-oriented learning in all hierarchical levels of an organisation and by staff´s active participation. Some of the key objectives of the programme are to increase the quality of care and assistance for residents and also to increase staff´s satisfaction. (164)

In Austria, quality insurance in nursing homes is seen as a very important issue that is still not implemented everywhere. In all but two Austrian provinces, legal regulations or guidelines/standards exist for implementing and managing nursing homes. More and more quality standards are compulsory and gain importance. Quality requirements for the staff are regulated by standards for nursing directors. Supervision and continuous staff training are dealt with differently. The contribution of the residents as well as the director's supervision are regulated by special laws. (30) The National Quality Certificate (NQZ / Nationales Qualitätszertifikat) is an Austria-wide voluntary assessment method specific for nursing homes. It allows for an objective external evaluation of the quality of service provision with the aim of making the quality of nursing homes visible and appealing to quality development. NQZ is an autonomous supplement to existing quality systems (like E-Qalin, QAP or ISO) which are based on self-evaluation. (165) For quality assurance regarding nutrition in institutions, there is the "ÖGE-Gütesiegel" of the Austrian Nutrition Society. It ensures optimised nutrients in food and ecological menus. (166)

In Germany, the MDK (Medical Board of the Health Insurances), which arose after the introduction of the German LTC Insurance in 1994, is the central body for needs assessment and quality assurance in LTC. In terms of nutrition, the "DGE-Qualitätsstandard für die Verpflegung in stationären Senioreneinrichtungen" from the German Nutrition Society is an instrument for quality assurance in communal catering in nursing homes. (167)

A Dutch (Maastricht) research group initiated "LPZ" in 1998. Initially, the prevalence of pressure ulcers was measured in this longitudinal study, while later on, incontinence, malnutrition, intertrigo, and the problem of falls and physical restraints were parts of the evaluation. To date, participants in five countries (incl. Austria) with a total 400 institutions and 40 000 patients annually use this care quality measurement system. (168)

The RAI (National resident assessment instrument) is a widespread assessment tool for LTC that was introduced in 1990 and later on distributed to all US NHs. It collects data on the needs, potentials and ressources of elderly care and help-dependent people. It enables the assessment of the actual care situation, the planning of the activities and the evaluation of the effectiveness of interventions. Furthermore, the RAI helps to enhance the quality of care. The RAI consists of the Minimum Data Set (MDS), 18 Resident Assessment Protocols

(RAPs) and a “trigger system”, which is a kind of alarm system that refers to special problem areas. Meanwhile, the interRAI in its 3rd version is used in many countries all over the world. The RAI includes questions on nutrition in its questionnaire on Activities of Daily Living and also asks for eating patterns and nutritional status in the Minimum Data Set. In connection with fluid balance, the weight situation (any weight gain or loss) is requested. In section K of the MDS, “nutritional status” is evaluated: oral problems, height and weight, weight change, nutritional problems (taste, appetite, food intake), nutritional approaches (kind of diet) and enteral or parenteral intake. (169) (170) In a study by Fries at al. (1997), it was shown that 6 months after the implementation of the RAI, fewer residents had declined in nutritional status. (171)

The recently published French IQUARE study involving 175 NHs with 6275 residents searched for the effects of an intervention (education and support of staff) on quality indicators (QI), functional ability and transfers to an emergency unit. A control and an experimental group were built and the follow up lasted 1.5 years. Generally, the QIs showed poor results and the transfers to emergency units per year were high in both groups. The intervention led to better results in the assessment of pressure sore risk, pain and depression. Emergency unit transfers were fewer. Significant effects on functional ability could not be found. (172)

As media and press regularly report on poor quality standards in long-term care institutions (e.g. report from the MDK about „Pflegemissstände“ in Germany in 2008 (173)), governments are continuously required to develop better evidence-based quality measurements to improve the situation in LTC institutions. Long-term care markets are changing and authorities are becoming more and more decentralised, which requires more reliable data on the quality of services. (157) All in all, nursing homes fear public pressure enormously. Bad image and press reactions already have caused increased and tougher controls but have also made NHs cautious and less open, especially to non-obligatory external controls.

The nutritionDay in nursing homes initiative that underlies this thesis is a worldwide audit and benchmarking instrument for nutritional quality assurance in nursing homes. Participation makes it possible to compare the results of institutions and results can be pursued over the years by repeating participation. In the nutritionDay initiative, the results

are linked to the outcome of residents, such as death, hospital stay or weight changes. The newest evaluation, that started in 2016, included questions on quality indicators. See chapter 1.6. (174)

1.5.4. Assessment of the nutritional status

To ensure a good quality of nutritional care in nursing homes, it is important to follow some basic recommendations. The measurement of weight and height during admission to a nursing home is inevitable. Furthermore, the nutritional status has to be assessed in order to be able to provide adequate nutrition.

1.5.4.1. Weight, height, body mass index

Weight and height are the most commonly used anthropometric parameters and therefore important for further nutritional assessment. Height and weight are easy to assess and give information about differences in populations. Nevertheless, these parameters are often invalid or not measured. (175) (176)

Body weight

Body weight should be measured in the morning, lightly dressed, after the toilet, with an empty stomach. It is important to examine the fluid balance of the person, avoiding oedema and exsiccosis. The calibrated scale is placed on a smooth and solid surface. For people with restricted mobility, bed scales or sitting scales are used. (177) The body weight of persons with amputations is calculated as follows:

Original body weight (kg) = [actual body weight (kg) / (100% - % of the amputation)] * 100. (178)

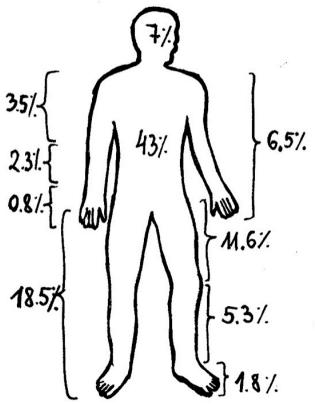


Figure 7: Body parts as percentage of total body, adapted from (179)

The observation of weight changes is a very important parameter in the management of malnutrition. It was shown in several studies that weight loss is a good predictor of increased morbidity and mortality and decreased quality of life in elderly people, patients (180, 181) or nursing home residents (182, 183). Not every weight loss (WL) is dangerous for the individual; intentional and unintentional WL have to be distinguished. Unintentional WL especially needs to be detected at an early stage. Guidelines (from the German Society for Clinical Nutrition (DGEM) as well as ESPEN) state that unintentional WL of more than 5% in three months or 10% in six months are factors for the diagnosis of malnutrition. The Long-Term Care Minimum Data Set in the US indicates that already a WL of 5% in 30 days should be regarded as risky. (184) (185) (186) The so-called "biographical weight" is important. If the person had a low weight and BMI his/her whole life, a low BMI should also be accepted later in life. To be able to assess the biographical weight, data on the weight trajectory of the last years need to be known and documented. Moreover, influencing factors like state of health, appetite and mobility need to be taken into account in order to be able to assess a low BMI. (187) Weight loss in young people is not as dangerous as in elderly people. As was nicely shown by Roberts et al. in 1994, older men failed to regain their weight after underfeeding while younger men had no problem. The authors concluded that aging may be associated with a significant impairment in the ability to control food intake after periods of overeating or undereating. (188) The prevention of unintented weight loss is therefore very important.

Body height

Body height is ideally measured in an upright, elongated position without shoes, with a stadiometer placed on a straight wall. Alternatively, a measuring tape fixed on the wall can be used. The measurement has to be carried out with an object placed at a right ancle to the wall. The ground must be solid and smooth. (179) Alternatively, measurements of long bones in arms or legs may be more accurate because the length of those bones do not change with age, as compared to vertebral height. (189)

Knee height

When a person is unable to stand or suffers from kyphosis, standing height can be estimated by measuring and calculating the knee height by the use of a sliding caliper and the equation by Chumlea. The accuracy of this method is ±7.5 cm for men and ±8 cm for women. (179)

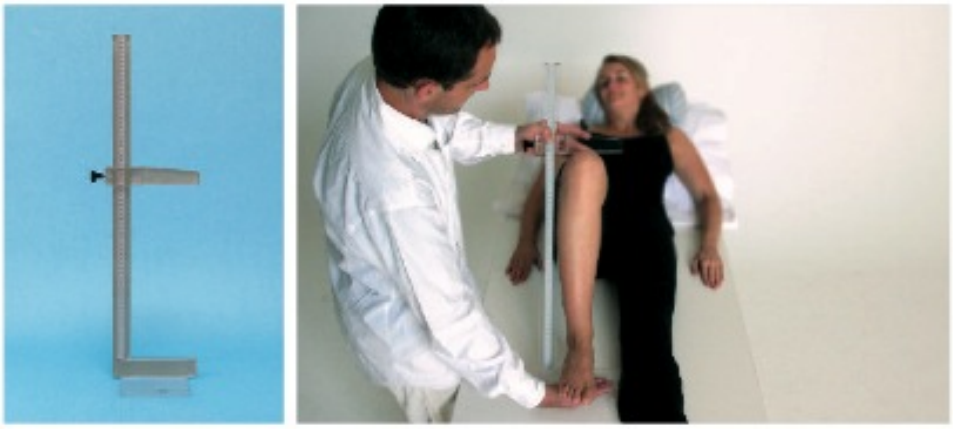


Figure 8: Measuring body height with the help of a sliding caliper (177)

Equations for calculating the estimated knee height (190)

Men: Body height (cm)=78.31+(1.94*knee height in cm)-(0.14*age in years)

Women: Body height (cm)=82.21+(1.85* knee height in cm)-(0.21*age in years)

Demi-span

Another horizontal measurement device is demi-span. It is measured from the suprasternal notch to the web between the 3rd and the 4th finger with the arm outstretched and requires no special equipment. (191) Height is calculated from a formula:

Female (cm) = (1.35 x demispan in cm) + 60.1

Male (cm) = (1.40 x demispan in cm) + 57.8

Arm-span

A similar method to demi-span is the measurement of arm-span, taking the reach from one end of an individual´s arm to the other when raised parallel to the ground. On average, this length correlates to the person´s height. (192)

Body mass index

The body mass index (BMI), or Quetelet index (QI), is an anthropometric measurement method. It is most commonly used in connection with the assessment of the nutritional status of individuals and helps to estimate under- or overnutrition simply and easily as well as weight-related health risks. In comparison to other indices, the BMI considers differences in height. The BMI correlates with body fat mass, which has a well-known association with health risks. (193) It is defined as the individual's body weight divided by the square of the body height and results in a unit of measure of kg/m^2: $BMI = mass(kg)/[height(m)]^2$

Nevertheless, BMI calculation is inappropriate for very muscular persons and pregnant women. It underestimates the fat mass of persons with muscle loss. With the same BMI, women and the elderly have a higher fat mass than younger people and men. The exact calculation of the BMI depends on the accuracy of the measurement, e.g. clothes, shoes, bad posture. (175) (147) (176)

The WHO classifies underweight at BMI <18.5 kg/m^2, normal weight ranges from 18.5 - 24.9 kg/m^2 and overweight at BMI 25 kg/m^2 or more for adults. Due to different body proportions, the BMI may not correspond to the same degree of fatness in various populations. The health risks in association with an increasing BMI are continuous and the interpretation of BMI classifications in relation to risk may be different for different populations. (194) Another criterion for the use of the BMI as the basis of weight standards is associated with the lowest overall risk to health. For example, the minimal death rate in several prospective studies is associated with a BMI of 22 to 25 kg/m^2. (195) In the elderly, higher BMI values show diminished mortality risk in comparison to the younger population. That is why there exist higher limits for the elderly population. These age dependent limits have also been considered by the National Research Councils of the United States (see table below). (147)

Desirable body mass index in relation to age

Age Group (years)	BMI (kg/m2)
19-24	19-24
25-34	20-25
35-44	21-26
45-54	22-27
55-65	23-28
>65	24-29

Table 7: Body mass index in relation to age (195)

Height is lost with age and therefore the normal BMI range is inflated, leading to a higher cut-off value of 22 between normal and undernourished. This is in comparison to BMI 20 for the younger age group. The European Society for Clinical Nutrition and Metabolism (ESPEN) recommends a range of between 22 and 26.9 kg/m^2 BMI for the elderly in order to warrant a better and earlier malnutrition risk recognition. (191) The BMI is a wide-spread tool for evaluating nutritional status. Nevertheless, its impact is reduced due to age-related changes in body composition, concomitant reduction in height and frequently occuring disturbances in the liquid balance (oedema or exsiccosis). These factors as well as limitations in measuring height and weight influence the validity of a single BMI value. (126)

1.5.4.2. Nutritional screening

Besides the anthropometric measurements of the body, the nutritional status needs to be assessed in further detail and with special methods. Generally, it is recommended to perform nutritional screening with every resident after admission to the NH. This enables taking a quick and easy picture of the nutritional status and considering several aspects at the same time. The development and detection of malnutrition is quite complex; therefore, a screening instrument that includes several parameters should be used as a standard. (57)

The European Society for Clinical Nutrition and Metabolism (ESPEN) states that the purpose of nutritional screening is “to predict the probability of a better or worse outcome due to nutritional factors, and whether nutritional treatment is likely to influence this“. (196) Nutritional screening is the basis for a possible need for nutritional therapy.

1.5.4.3. Nutritional assessment

A nutritional assessment should identify any specific risk(s) or causes of malnutrition. It helps to recommend strategies for improving nutritional status or for rescreening. ESPEN defines nutritional assessment as "a detailed examination of metabolic, nutritional or functional variables by an expert clinician, dietitian or nutrition nurse. It is a longer process than screening and it leads to an appropriate care plan considering indications, possible side effects, and, in some cases, special feeding techniques." (196) The clinical nutrition assessment is a continuous process. The Austrian Society for Clinical Nutrition (AKE) decided in an expert consensus that the following algorithm is recommended for geriatric long-term care institutions to ensure high quality in nutritional management. The algorithm in Figure 9 was adapted from Volkert D. (197) (177):

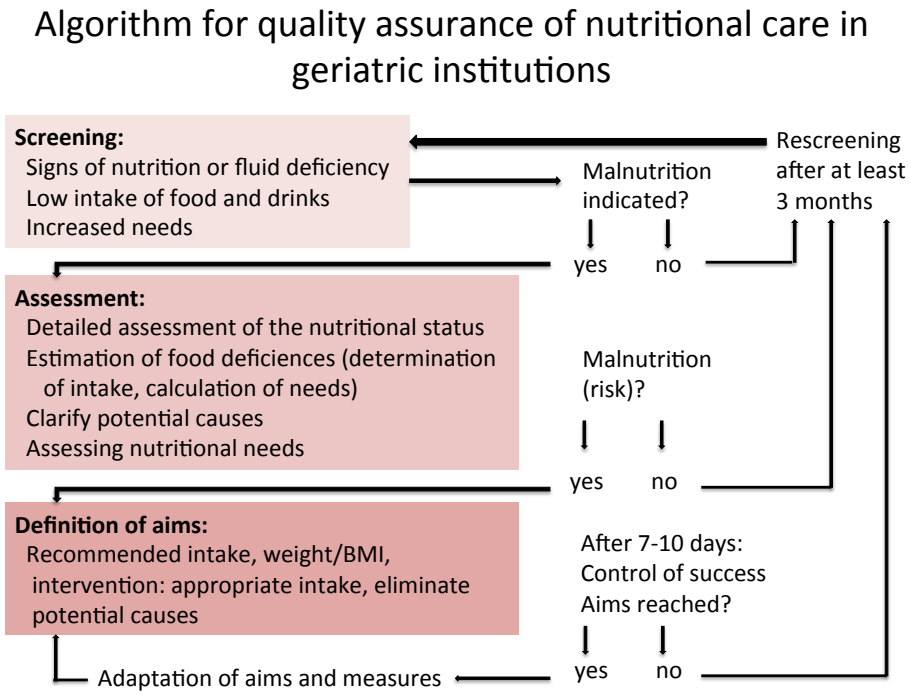


Figure 9: Algorithm for nutritional care in geriatric institutions adapted from Volkert D. (197)

1.5.4.4. Methods for screening and assessment

Meanwhile, several screening instruments with different risk indicators are available. For the right choice of screening instrument, the screening person needs to be taken into

account as well as the setting and whether or not electronic documentation is available. Screening should be repeated after a certain period of time in order to check whether residents' nutritional status has worsened. In case a risk for malnutrition is identified, further detailed assessment of the nutritional status is required and a nutritional care plan needs to be formulated. Screening and assessment instruments combine several parameters to identify malnutrition risk systematically.

The minimum requirements for a screening instrument are the evaluation of appetite, actual food intake, weight changes, BMI and actual health status. Screening instruments usually work with numerical scales and certain cut-offs, without the need of blood parameters or diagnostics. The main and best known international screening tools for screening residents in long-term care institutions are described shortly in the following (validity tested):

- Mini Nutritional Assessment MNA® - Short Form (MNA-SF®)
- Short Nutrition Assessment Questionnaire Residential Care (SNAQ RC)
- Malnutrition Screening Tool (MST)
- Malnutrition Universal Screening Tool (MUST)
- Screening Checklist DETERMINE (+ Screen Level 1+2 incl. serum albumin)
- GNRI (incl. serum albumin)

The use of the AKE screening instrument for elderly in LTC institutions is widespread in Austria and comparable to the MNA-SF. There are differences in the scoring and weight loss information (percentages instead of kilograms). (177) In Germany, the PEMU („Pflegerische Erfassung von Mangelernährung und deren Ursachen") was initiated, which is a detailed malnutrition assessment tool for nurses. (198)

A recently published systematic review on malnutrition screening tools for the nursing home setting points out that the use of existing screening tools for the nursing home population carries limitations. No existing screening tool "performs better than 'fair' in assessing nutritional status or in predicting outcome". No "superior tool" could be recommended either. The systematic review suggests further considerations regarding malnutrition screening among nursing home residents. (199)

Nutritional assessment is used to find and define the causes of existing nutritional risk or malnutrition. The most important and widespread, validated tool is the Mini Nutritional

Assessment (MNA®) - Long Form. The MNA was specially developed for the elderly population. The long form of the MNA includes screening and assessment. The MNA short form (MNA-SF) is easy to use and includes questions on food intake, appetite, digestive or chewing problems, dysphagia and anorexia. Furthermore, BMI or calf circumference is requested as well as weight loss, mobility, acute diseases and psychological status. (200) Since 2010, nutritionDay uses the MNA-SF as one of the questionnaire sheets.

The SNAQ RC was developed in the Netherlands by Kruizenga et al. (201) It includes the evaluation of involuntary weight loss, need for help with eating, recent appetite and BMI. Instead of scores, the SNAQ uses a traffic light system.

The Malnutrition Screening Tool (MST) can be used easily and quickly. It asks for weight loss and appetite. There are no parameters to calculate. (202)

Originally developed for the ambulatory field by the British Society of Parenteral and Enteral Nutrition (BAPEN), the MUST is now used in hospitals and LTC institutions. Besides the acquisition of the BMI and involuntary weight loss, the expected duration of diet restriction is required, which is not easy to answer for unskilled staff. (203)

The screening checklist DETERMINE is an American tool published by the Nutrition Screening Initiative (NSI). It was developed to be answered by non-medical personnel or patients themselves. The same initiative is behind the Nutrition Screening Initiative Level 1 Screen and Level 2 Screen for professionals. The checklist requests many facts of daily life and nutrition-related parameters. The Level 1 Screen demands BMI, food intake and appetite as well as functional parameters and the Level 2 Screen uses upper sleeve circumstance and triceps skinfold as well as laboratory data. (204)

At last, the GNRI (Geriatric Nutrition Risk Index) identifies elderly people that need nutritional therapy or training. Serum albumin is required for that index, therefore the usage in daily routine is complex. (205)

Whatever method for screening and assessment is used, it is of most importance to use it. Malnutrition is widespread in institutionalised elderly. With higher functional impairment and disability, the prevalence of malnutrition increases steadily. Screening is recommended every 3-6 months in LTC institutions. (130) (71) After nutritional screening and assessment, the aims for nutritional therapy are defined. This can either be weight goals, food pursuits or certain interventions. If the nutritional needs or other aims are not reached or covered through normal oral food, it is often suggested to enrich food with protein supplements

and/or calories. If this is still not sufficient to stop malnutrition, further dietetic treatments are indicated (e.g. tube feeding). Additive nutrition is recommended if food intake is insufficient for more than three days, when actual food monitoring for one week shows a lack of nutrients, when the BMI is too low or if, in case of acute disease, a hypercatabolic state is present. In any case, 7-10 days after the intervention, success needs to be controlled, measures adapted or rescreening recommended. Adherence to the algorithm of nutritional care in the elderly, as shown in Figure 9, promises good results and success in the nutritional management of (LTC) institutions. (71)

Besides assessing the nutritional status, it is important to feed the residents in NHs according to actual recommendations, which are described in the next chapter.

1.5.5. Nutrition recommendations for elderly and communal catering

„While the acknowledgement of the importance of good food in residential care homes in the standards is welcomed, the regulations still do not define the nutritional content of meals needed to sustain and improve the health of residents.“ (206)

In Austria, nutritional recommendations for the elderly in residential facilites are based on the D-A-CH reference values for elderly above 65 years. There is no differentiation for people aged 75/85 or older ("oldest old"). The WHO defines the elderly as people 60+. In Europe, the Caroline Walker Trust (UK) and the Nordic Nutrition Recommendations (Denmark, Finland, Iceland, Norway and Sweden) refer to people aged 75 or older. Uncertainty exists about whether dietary guidelines that reflect experts' opinions and are based on intake levels that prevent diseases or maintain health are appropriate for the oldest old. For malnourished or ill people, general recommendations are not valid. Malnourished persons need individual medical care, advice and recommendations. (187) (207) (177)

Furthermore, nutrition recommendations are not based on the direct study of the old population but are extrapolated from young adults' results. Physiological and degenerative changes with ageing or influences of pharmacology on nutrient bioavailability are not considered. The old population is very heterogeneous. For all those reasons, it is tricky and complex to work with existing recommendations. Much more research on nutritional recommendations is needed in order to differentiate the oldest old from the younger, the healthy from the ill and those people living in long-term care facilities or at home. (207)

Communal catering is the supply of consumers with food, drinks and appropriate services in special facilities. The “care“ sector of communal catering includes hospitals and residential facilities. About 70 000 peaople above 60 years received communal catering in Austria´s residental facilities in 2013. (71) In Germany in 2011, 743 000 people lived in nursing homes and accordingly received communal catering. (47) The food in communal catering should be delightful, diverse and balanced. It strengthens well-being and health, is optimised in nutrients and responds to special needs and wishes. Eating should take place in a pleasant surrounding. The nutritional recommendations for communal catering are also based on the D-A-CH reference values and refer to people 65+. (208) Special quality labels already exist (e.g. “ÖGE or DGE seal of quality“) that ensure healthy nutrition in institutions. Meeting nutritional requirements through the appropriate use of recommendations for elderly in communal institutions is the basic condition for the prevention of malnutrition and worsening nutrition-related outcomes.

1.5.5.1. Nutritional recommendations and guidelines for the elderly

In this thesis, nutritional recommendations for elderly in residential facilites are based on the D-A-CH reference values for elderly above 65 years old. (148)

With age, energy needs are reduced due to changed body composition (more metabolically inactive fat) and reduced physical activity. Still, single nutrient needs (of proteins, vitamins, trace elements) are more or less the same. Therefore, nutrient dense food is required and strongly recommended. About 50% of the daily intake should consist of carbohydrates, a maximum of 30% fats and about 15% proteins. Food rich in starch and fiber are recommended. The elderly are a very heterogenous group with regard to status of health, functionality and activity. Given this heterogenity, regular weight measurements, physical capacity and force may help to determine whether amount and composition of diet is appropiate for a given person. Individual differences in energy needs and requirements are possible. (148)

Energy

The demand of energy is the sum of the basal metabolic rate and active metabolic rate. The basal metabolic rate is reduced with age as the (metabolically) active muscle mass is

reduced and replaced by fat. The energy needs are a multiple of the basal metabolic rate depending on activity and performance. The PAL (physical activity level) is a measure for the physical activity with units as stated below:

PAL 1.6 mainly walking or standing activity (e.g. patient with Alzheimer´s disease)

PAL 1.4 sedentary activity, temporarily walking or standing

PAL 1.2 only sedentary activity or bed-ridden

The general basal metabolic rates for people aged 65+ that are multiplied with the PAL are

for men	5.9 MJ/d	for women	4.9 MJ/d
	1 410 kcal/d		1 170kcal/d

Reference values for the total energy needs are

for men	2 300 kcal/d	for women	1 800 kcal/d (148)

A rule-of-thumb exists for calculating the caloric needs of patients (209)

immobile: ca. 20-25 kcal/kg BW/day

mobile: ca. 25-35 kcal/kg BW/day

The individual energy need is calculated with the Harris-Benedict formula. Although this formula is poor in the prediction of basal metabolic rate of individuals, it works quite well for groups of individuals:

Women: Basal metabolic rate [kcal/24h] = 665,1 + (9,56 x body weight [kg]) + (1,85 x body height [cm]) - (4,67 x age [years])

Men: Basal metabolic rate [kcal/24h] = 66,47 + (13,75 x body weight [kg]) + (5 x body height [cm]) - (6,76 x age [years]) (71)

Nutrients

Nutrients that supply the body with energy are carbohydrates, proteins and fats. At least 50% of food intake should consist of carbohydrates. Complex carbohydrates in bread, noodles, rice and potatoes are preferred, whereas foods rich in simple sugars should be neglected. Fiber-rich food should especially be given preference in order to influence digestion positively. Normally, the needs for carbohydrates are easily covered in the elderly as they prefer sweet tastes. It is therefore important to keep in mind the WHO

recommendation stating a max. of 10% of the total energy should be from sucrose (or added sugar). (175)

Proteins and amino acids are essential for building body protein and other metabolically active substances, like nitric oxide generation from ornithine. According to the DACH-reference values, elderly above 65 should eat the same amount of proteins per kg BW as younger people, which is 0.8g. A higher recommendation of protein intake for the elderly is being discussed as some experimental studies show advantages. Layman states in his article that protein intake should not be calculated on the basis of "15% of the total energy intake" (for an adult female about 68g/d). This proportion could be too little in absolute amount of required protein, if the person generally eats little. (210) Increased protein intake may enhance protein anabolism and prevent the reduction of muscle mass that is so common with age. Protein intake is also positively associated with bone mineral density and bone structure in cases of osteoporosis. (71) Meanwhile, expert groups, including the PROT-AGE study group that represents the European Union Geriatric Medicine Society (EUGMS), the International Association of Gerontology and Geriatrics (IAGG), the International Academy on Nutrition and Aging (IANA), the Australian and New Zealand Society for Geriatric Medicine (ANZSGM) and ESPEN, recommend that the intake of proteins in the elderly should amount to 1-1.2g/kg BW/d. Older adults with chronic or acute diseases may need even more protein (1.2-1.5g/kg BW/d) (177, 210) In contrast to other nutrients, proteins are not stored for a daily supply, therefore protein should be consumed at more than one meal. The PROT-AGE group et al. recommend that at least 25-30g of protein (2.5-2.8g of Leucine) should be eaten at every meal (breakfast, lunch, dinner) as it is important for appetite and the regulation of daily food intake. (210, 211) ((212) Among proteins, branch-chained amino acids, in particular leucine, influence signaling pathways for muscle synthesis proteins positively. Similarily, beta-hydroxy beta-methyl butyrate (b-HMB), an active metabolite of leucine, may also help increase muscle mass in elderly people and some clinical populations. Protein from animal sources is of higher value as it is more easily used and transformed into body protein. By selecting and combining food sources, vegetable protein can increase its usability. Nevertheless, the potential risks of very high-protein diets (2 g/kg BW/d or 20-23% of total energy) need to be taken into account in case of impaired renal function. Persons with severe chronic kidney disease are required to reduce their protein intake (0.6-0.8g protein/kg body weight/day) with the exception of

multi-morbid patients on palliative care. Protein intake needs to be combined with daily physical activity or exercise. More studies are needed in order to cause a general change in official worldwide recommendations. (213) (214) (175, 215)

Fat is an important provider of energy. The DACH-reference-values recommend a max. fat intake of 30% of the total energy needs. A max. of 10% of energy should derive from saturated fatty acids, min. 13% from mono-unsaturated fatty acids and max. 7% from poly-unsaturated fatty acids. There is a separate recommendation for the intake of essential fatty acids. Linoleic acid (ω6) should account for 2.5% of the energy and linolenic acid (ω3) for about 0.5% of the total energy. The intake of cholesterol should not exceed 300mg/day. Fat is also important for carrying fat-soluble vitamins as well as flavourings. The high consumption of (saturated) fat is associated with diseases like dysproteinemia, arteriosclerosis, colon cancer and obesity. In developed countries, fat consumption is at the upper level of recommendations and mostly even above. To achieve a good, balanced, nutrient-dense diet, it is important to comply with maximum recommended fat intake. (147, 148)

In contrast to reduced energy requirements with age, the needs for vitamins and minerals stay more or less the same. Thus, the percentual needs of vitamins and minerals are higher. When the intake of micronutrients is too low, nutrient deficiences can develop. This is strengthened by impaired digestion and absorption capabilities with age. It is important to choose well-tolerated and gently processed nutrient dense food. Some micronutrients are especially critical for the elderly and are therefore discussed in more detail.

Vitamin D is a critical nutrient. The effects of vitamin D are involved in muscle function. Muscle cells have vitamin D receptors that decrease with age. Vitamin D is important for sustaining bone mass that is generally lost with age. Through adequate vitamin D intake, fractures and a high-risk factor of osteoporosis can be avoided. Further, vitamin D is important for stimulating calcium absorption into the colon, transportation into the cells and for an optimal bone metabolism. The association between vitamin D and physical performance has been shown several times. The higher the serum 25-(OH)D levels were, the better the test persons performed at walking and standing up tests. Vitamin D is supplied by food and synthesised endogenously through solar exposure. Usually the RDA of vitamin D (20μg/d) cannot be covered by nutrition. In addition, an age-related decrease of

receptor expression in the duodenum was shown. Therefore, the recommended intake needs to be covered by endogenous synthesis or via supplements. Since the time spent outdoors by older people, especially those in need of care in NHs, is very limited and endogenous production is reduced in the elderly skin, the supplementation of vitamin D is strongly recommended. Nutrition intervention studies show a mixture of positive and null findings. To summarise, they indicate a role for vitamin D in the development and preservation of muscle mass and function. Calcium is closely linked to vitamin D. The absorption of calcium is reduced with age and the supply was shown to be deficient (in Viennese) elderly. Still, the supplementation of calcium or vitamin D is rather rare and should be given to NH residents on a regular basis. (148) (71) (216-218)

20-50% of the elderly people are affected by atrophic gastritis, leading to a lower absorption of vitamin B_{12} because of reduced secretion of intrinsic factor. A lack of vitamin B_{12} is often accompanied by a lack of folate. Both vitamins are necessary for the degradation of homocysteine. People who do not eat meat have an especially high risk of vitamin B_{12} deficiency. (71)

The actual recommendations of daily intake of micronutrients for people above 65 years according to the D-A-CH reference-values (148) are:

Recommendations for micronutrients intake 65+	**male**	**female**
Vitamin A (mg retinol-equivalent/d)	1	0.8
Vitamin D (µg/d)	20	20
Vitamin E (mg tocopherol-equivalent/d)	12	11
Vitamin K (µg/d)	80	65
Thiamin (mg/d)	1	1
Riboflavin (mg/d)	1.2	1.2
Vitamin B_6 (mg/d)	1.4	1.2
Niacin (mg niacine-equivalent/d)	13	13
Folic acid (µg folic acid-equivalent/d)	300	300
Panthothenic acid (mg/d)	6	6
Biotin (µg/d)	30-60	30-60
Vitamin B_{12} (µg/d)	3	3
Vitamin C (mg/d)	100	100
Sodium (mg/d)	550	550

Chloride (mg/d)	830	830
Potassium (mg/d)	2000	2000
Calcium (mg/d)	1000	1000
Phosphorus (mg/d)	700	700
Magnesium (mg/d)	350	300
Iron (mg/d)	10	10
Iodine (µg/d)	180	180
Fluoride (mg/d)	3.8	3.1
Zinc (mg/d)	10	7
Selenium (µg/d)	30-70	30-70
Copper (mg/d)	1.0-1.5	1.0-1.5
Manganese (mg/d)	2-5	2-5
Chrome (µg/d)	30-100	30-100
Molybdenum (µg/d)	50-100	50-100

Table 8: Recommendations of micronutrients intake for people 65+

Salt intake should be limited to 5-6g per day according to WHO and DGE (Deutsche Gesellschaft für Ernährung) recommendations. Overconsumption of salt enhances non-communicable diseases. (219) (148)

Total water intake should amount to 2 250ml per day, thereof 1 310ml should originate from drinks (the rest is water from food and oxidation water). As an approximate value, 30ml/kg BW total water intake per day are recommended. These recommendations vary according to the individual cardial and renal situation or in case of acute diseases. Another method for calculating the needs for fluids is shown in the following paragraph (220):

1ml fluid/kcal

or

100ml fluid for the first 10kg BW,

50ml fluid for the second 10kg BW

15ml fluid for every further kg BW.

With regard to the often existing multimorbidity of elderly people, it is necessary to consult a physician for the individually recommended fluid intake. (71) (148)

The DACH reference values are quite similar to other food recommendations like the NNR (Nordic nutrition recommendations), the CWT (Caroline Walker Trust) or WHO recommendations. Differences to the DACH reference values can be found in, for example, total energy intake, vitamin C, vitamin A and fiber intake recommendations where the above-listed organisations recommend slightly lower intake. (71) It is important to regard nutritional recommendations critically as, especially for the oldest old, appropriate reference values do not exist. Further research on nutritional recommendations is needed for this population group. The often existing multimorbidity always needs to be taken into account.

1.5.5.2. Recommendations for communal catering

About 70 000 people above 60 years of age received communal catering in Austria´s residental facilities in 2013. (71) Communal catering is nutritional care at a limited price and to a confined group of people in a place where a longer stay of the person is required due to organisational reasons. (221) It is especially important that the growing share of the elderly population in institutions receive catering that strengthens well-being and health, is optimised in nutrients and responds to special needs and wishes. The Food Standards Agency recommends that elderly people in NHs should at least be supplied with the average recommended daily nutrients for the healthy population. Furthermore, on one hand, the intake of salt and saturated fats should be limited and, on the other hand, the intake of folate, riboflavin, potassium, magnesium, iron and zinc should be elevated. (71)

The nutritional recommendations for communal catering that are described here are based on the D-A-CH reference values and refer to people 65+. (222) Meeting nutritional requirements through the appropriate use of recommendations for elderly in communal institutions is the basic condition for the prevention of malnutrition or worsening nutrition-related outcomes in residential facilities. The nutrition societies of Germany, Switzerland and Austria, as well as the Caroline Walker Trust in the UK, advise meeting the recommended nutrient and energy requirements for people in residential homes within one week. The reference values cannot and need not be fullfilled in a single meal or day. Recommendations appeal to the people responsible for the food planning in the NH. For economic and organisational reasons, it is not possible to provide menus for each sex in which individual reference values are considered. Instead, the values are averaged. Lunch in NHs should contain at least a quarter of the recommended daily nutrients.

While nutrients should generally be proportioned at 30% fats, 55% carbohydrates and 15% proteins, lunch in Austria and Germany can be proportioned 30%:50%:20% to meet dietary habits. At least five meals per day should be eaten as older people typically prefer small portions that are served more often. The reference values for communal catering are not recommended for malnourished people. These require individual solutions under the responsibility of a physician in charge. The following table shows the recommended daily nutrient contents of the daily food in residential facilities for people 65+ at PAL 1.4 and PAL 1.2 (222):

Recommended daily food composition in NHs

	full board, PAL 1.4	full board, PAL 1.2
Energy (kcal)	1 800	1 540
Energy (kJ)	7 530	6 460
Protein (g) (15% of total energy)	≤67	≤57
Fat (g) (30% of total energy)	≤61	≤52
Carbohydrates (g) (55% of total energy)	≥244	≥209
Fibers (g)	≥ 30	≥30
Vitamin E (mg)	12	12
Vitamin B_1 (mg)	1.0	1.0
Folate (μg)	300	300
Vitamin C (mg)	100	100
Calcium (mg)	1 000	1 000
Magnesium (mg)	350	350
Iron (mg)	10	10

Table 9: Recommended daily food composition for people 65+, full board

Money spent on food in NHs is often very restricted and not enough to provide proper, good and high-quality food. According to the CWT, the residential care accommodation should spend at least €22.69 per resident per week to ensure adequate nutritional content in food. (206, 222) For example, a number of a privatly operated NHs in Munich in 2006 showed expenses for food at €32.2/week/person. (223) Generally, expenses for food in NH facilities in Germany per person and day are declared as €5.-, which is not much, compared

to the prices someone pays when he/she only wants to buy a single lunch. (224) Savings in NHs are often at the expense of the quality of food.
Otherwise, according to the society of the Austrian´s dietitians, the quality of the offered meals from communal catering is steadily improving. Regional and organic products are on the rise while convenience food, finished products and functional food are not requested so much any more. (221) Often it is not known how much of the provided food is eaten by the residents. Therefore, more reasearch is needed in that field; also in order to find out how the service can meet the needs of its users best. Food and nutrition are very important aspects for older people that they associate with good personal care. (206)

In the previous chapters of the introduction, the background of nutrition of elderly in nursing homes was explained. In the next section, the initiative that lies behind this thesis is going to be introduced.

1.6. The nutritionDay in nursing homes

Data on nutrition in nursing homes are scarce. Especially, data on food intake and nutrition-related malnutrition are missing. This consideration provided the crucial impulse to develop the initiative "nutritionDay in nursing homes". Starting in 2005, a network of experts under the leadership of Univ. Prof. Dr. Michael Hiesmayr (Medical University of Vienna) designed the project "nutritionDay in European hospitals" – a one-day, cross-sectional, multi-centre audit with outcome evaluation – to suggest action based on recent and relevant malnutrition data. This idea was a result of the publication of the "Resolution ResAP(2003)3 on food and nutritional care in hospitals" by the Council of Europe that didn´t reach the expected level of awareness. (225) The bases of the nutritionDay network are the national representatives of the clinical nutrition societies active in Europe and epidemiologists in the field. After successful initation in hospitals, "nutritionDay in nursing homes" was created and started a pilot run in Austria and Germany in 2007 and, in the following years, expanded worldwide. (174)

nutritionDay´s mission is to improve the safety and quality of care for residents in nursing homes by raising awareness and increasing knowledge about disease-related malnutrition. Its vision is to provide methods for nursing homes (NHs) to assess and minimise malnutrition. nutritionDay becomes an ongoing collection and analysis of data in nursing

homes worldwide and is going to be a standard method for evaluating nutritional behaviour and status. (174) The nutritionDay in NHs can be repeated annually to achieve structural and ongoing awareness of the problem within health-care organisations, as well as to raise national awareness of the approach. Currently, nutritionDay is performed worldwide in more than 63 countries involving around 222 500 patients or residents in 7000 units. (174) A detailed description of the nutritionDay audit process can be found in the methods of this thesis. An overview of the aims of the initiative is given by the graph in Figure 10.

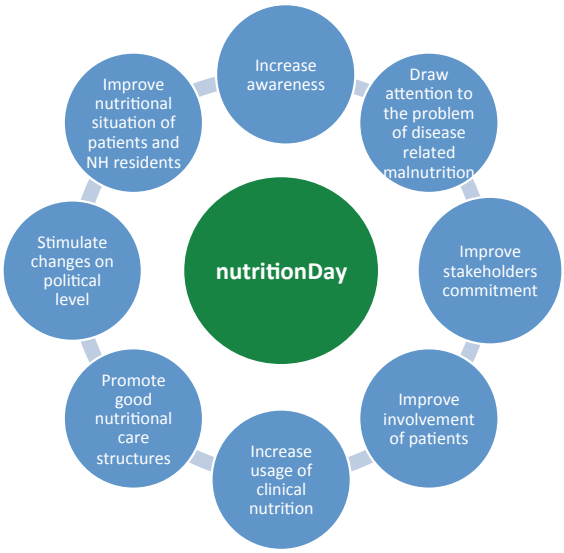


Figure 10: Missions and visions of nutritionDay (graph provided by the nutritionDay office, www.nutritionday.org)

When the project “nutritionDay in nursing homes” started, I was part of the organisational team in the nutritionDay office. I was enthusiastic about the idea of possibly raising the quality of care, especially nutritional care, in nursing homes by participating in an annual one-day audit. From the beginning, being involved in this initiative also raised my awareness and supported my interest in nutrition in the elderly. At this point, the starting signals for this thesis were given.

1.7. Aim of thesis: Nutrition-related influencing factors on death and hospitalisation in nursing homes

The aim of this thesis is to identify influencing (risk) factors on "weight change" and "mortality" of residents in European nursing homes on the basis of the data from the audit "nutritionDay in nursing homes" from 2007-2010. Great attention to "weight changes" and "nutritional status" in elderly persons in nursing homes is very important for the prevention of hospitalisation and death. In the following paragraphs, the key terms of the aim of this thesis are going to be described.

1.7.1. Weight changes and associations

Weight changes can either mean weight loss, weight gain or weight fluctuation. Very early studies in 1987 by Dwyer et al. showed the association of weight loss with a lower survival rate in 335 institutionalised elderly adults. A loss of 4.5 kg or more led to a lower 4-year survival rate compared to people who gained weight or had stable weight. (226) Another study that proved the significance of monthly weight changes on prognosis was carried out by Sullivan et al.. Among 900 NH residents, those who lost 5% or more weight in a month had a 10-fold increased risk of dying compared to those who gained weight. (183) In their GAIN-study, Sullivan et al. also showed that weight loss during a six-month period was associated with a nearly two-fold increased risk of dying (adjusted RR: 1.95, 95% CI 1.43 - 2.66). (227) More recent studies confirm these findings in ambulatory living people or the elderly in general. For example, Woods et al. found an association between weight loss and factors such as lower hip abductor strength, a longer time for standing and walking, slower walking speed, higher C-reactive protein and lower serum albumin levels. They concluded that unintentional weight loss led to death or to a higher care level. (228). Furthermore, weight loss (>5% of body weight (BW)), compared to stable weight, was related to a higher mortality risk in men (181) as well as in community-dwelling older adults. (229) In line with these findings, the European Prospective Investigation into Cancer and Nutrition-Elderly Network in Ageing and Health Study revealed an association between weight change in later life and risk of death. In Bamia et al.´s study, elderly people with a weight loss of more than 1 kg/year had a significantly increased death risk compared to people with smaller weight changes. This association was especially significant in the period of one year before

death (short-term). (180) In 2007, Nguyen et al. described that individuals (60y+) with a weight loss of 1%/year or higher had a greater risk of dying from all-causes compared to people with stable weight. (230) In 2004, Sullivan et al. showed the same effect on NH residents with the highest average random weight fluctuations (i.e. upper 10^{th} percentile). (183) Recently, also for weight trajectory over 20 years in women, associations with dementia developement were shown. (109) Most of these studies do not take into account the difference between intentional and unintentional weight loss. Severe diseases are often accompanied by unintentional weight loss (WL). Earlier studies indicated that both voluntary or involuntary WL were associated with elevated all-cause mortality. (231) At first, Shea et al. showed in overweight/obese patients with osteoarthritis of the knees or patients treated for hypertension the effect of intentional WL on total mortality. Interestingly, there was no higher mortality risk for the patients who lost weight intentionally. (232) (233)

1.7.2. Malnutrition risk identification by nutritional assessment

The nutritional status of people can be assessed or measured in different ways. There is no "gold standard". The use of specific nutritional screening and assessment methods is recommended by clinical nutrition societies all around the world as well as by the European Council. (133, 196, 225) Back in 1988, Agarwal et al. published nutritional variables and their predictability regarding mortality in elderly people. At this time, blood markers, such as serum albumin (<30g/L), were mainly used for nutritional assessment. (234) Nutritional deficiencies led to adverse clinical outcomes in NH residents. (132) Later on, assessment tools were used to estimate nutritional status. In 2005, Saletti et al. showed that 3-year mortality was highest (50%) in elderly people receiving support at home who were malnourished according to the MNA (Mini Nutritional Assessment, MNA<17 vs. MNA>23.5, p=0.03) and with BMI <20kg/m^2 (BMI <20 vs. BMI>28, p=0.037). The MNA is the best validated and most represented nutritional status evaluation tool for the elderly. The cut-off point of the "full MNA" for the risk of malnutrition lies at points below 24. A low MNA score independently predicted mortality in multivariate analysis. On the other hand, a BMI below 20 kg/m^2 is an indicator of malnutrition. (235) In 2011, Yang et al. showed a similar association of malnutrition (identified by MNA) and 1-year mortality in older adults with home care services. Also, mortality, hospitalisation, emergency room visits and home health aide use were increased for malnourished or people at malnutrition risk. (122) In

nursing home residents in Helsinki, Kuikka et al. showed in 2009 that a MNA<17 is correlated with a poor outcome, i.e. infections or death after the 8-year follow up. (236) The "weight loss" question in the MNA predicted the total MNA score best, as shown in the study of Serrano-Urrea (237). A relation between a low Geriatric Nutrition Risk Index (GNRI) and a higher hospitalisation, and respectively mortality, risk was shown. (153, 205, 238) The GNRI combines serum albumin and weight. Although its validity as a single predictor for nutritional status is restricted, the BMI alone is often used to assess nutritional status. The associations of a low BMI to mortality risk and care dependency or BMI´s predictive ability for diverse nutrition-related problems were shown in numerous studies. (65, 83, 239, 240) Apart from the BMI, a simple, validated screening tool and connected nutritional assessment is recommended for nutritional status evaluation. (185)

In the year 2013, Thomas J.M. et al. published a review presenting studies on elderly persons in hospitals or nursing homes and the associations of their (health) characteristics with mortality within one year. They found that in studies with nursing home residents, measures of nutrition and physical function were most frequently mentioned in connection with short-term death in multivariate analysis. Measures of nutrition included low BMI, certain weight losses or special amount of food uneaten. (100) Beck A. published results of a Danish follow-up study that was carried out among 441 NH residents in 11 NHs, showing that the risk factors of eating dependency, uneaten food, as well as chewing and swallowing problems were associated with weight loss and death. Furthermore, enteral nutrition showed a significant relationship with the outcome death. (241) In 2015, Lilamand et al. presented the following terms of the Mini Nutritional Assessment - Short Form (MNA-SF) as significantly related to one-year mortality: age, female sex, baseline weight, total MNA-SF score, weight loss, decreased food intake, BMI, and recent stress. 773 older people were included in this study. (242)

The aim of this doctoral thesis is to compare available knowledge in a big sample and to find other relevant risk factors associated with weight loss and mortality in NH residents.

2. Methods

This thesis is based on data from the initiative "nutritionDay in nursing homes" (ND NH) that is part of the audit "nutritionDay worldwide" (ND). ND was developed and initiated in Vienna by a network of experts under the leadership of Univ. Prof. Dr. Michael Hiesmayr

(Medical University of Vienna) in cooperation with the "National representatives council" of the European Society of Clinical Nutrition and Metabolism (ESPEN) and the Austrian Society for Clinical Nutrition (AKE). The initiative started with evaluations in acute care settings in 2006 (120). Nursing homes settings were first evaluated in a pilot run in 2007 (121). The analyses in this thesis are based on data evaluation for the years 2007-2010.

The ND NH initiative gathers information on nutritional care in nursing homes worldwide. On a typical day in a nursing home, a snapshot of the nutritional care from the caregiver´s as well as from the residents´ view is gained.

2.1. Design

The study design in this thesis aims to describe the nutritional management in European NHs. The focus of the analyses is on the relationship of nutritional parameters of residents in NHs with the outcomes weight loss and death within 6 months. In detail, the objectives are the evaluation of the status quo in NHs (staff, nutritional procedures, residents´ characteristics and their actual nutritional intake) as well as the relation of nutritional factors to the outcomes of weight loss and death for the residents. The underlying data collection follows all principles of the general "nutritionDay in hospitals" audit, explained earlier by Hiesmayr and colleagues (120). In NHs, it is based on a one-day cross-sectional multi-centre audit with outcome evaluation after six months. It is implemented by the local caregivers without external support and is done with the help of five questionnaires. The questionnaires were conceptualised as simple and precise questions without necessitating mathematical calculations and expert knowledge. The selected test day for the first ND audit in nursing homes (ND NH) was February 22nd, 2007 and the outcome date was six months later on August 22nd, 2007. Table 10 shows the timetable of all runs in the years 2007-2010.

	nutritionDay in nursing homes one day - 0	**outcome evaluation one day - 180 (6 months)**
test run	February 22nd 2007	August 22nd 2007
1st run	January 31st 2008	July 29th 2008
2nd run	January 29th 2009	July 28th 2009
3rd run	January 21st 2010	July 20th 2010
4th run	November 4th 2010	May 3rd 2011

Table 10: Dates of the nutritionDay in NHs 2007-2010

The ND NH initiative aims at nursing homes that care for the elderly. Nevertheless, some younger residents (<65 years) were involved too, the results of which are distinguished in the main results. Inclusion and exclusion criteria are listed in the table below (Table 11). Only European data are included in this thesis. Units with less than five beds were not seen as representative and therefore excluded. Units should not be involved more than once, i.e. only the data of the first year of their participation were included. Finally, residents needed to consent to participation.

Inclusion criteria	**Exclusion criteria**
Unit characteristics	
European units of nursing homes	Non-European units*
Units with more than 5 actual beds	Units with less than 5 actual beds
Units in their 1st year of participation	Units in the years of repeated participation
Resident characteristics	
Residents in European nursing homes	Residents in non-European nursing homes
Given oral or written consent or answer "not selected"	Consent rejected
Residents in units with more than 5 actual beds	Residents in units with less than 5 actual beds

Table 11: Data inclusion and exclusion criteria

*For later uni- and multivariate analyses all Hungarian data were excluded due to missing outcome data

The ND NH questionnaires were primarily based on the drafts of the 2006 run in the acute care setting and were modified to special needs for the NH environment by PD Dr. Luzia Valentini, Dr. Hubert Bucher and PD Dr. Karin Schindler. Finally, they were approved by ten additional NH experts (121). The questionnaires can be downloaded on the nutritionDay website in 30 different languages currently. English versions are shown in the appendices and are shortly summarised in the following:

Sheet 1, or unit sheet (every ward was referred to as a "unit"), addresses the unit structures of an NH including questions on capacity, operators, staff and nutritional management. The questionnaire was completed once per ward/unit by the staff. Every unit was part of a centre, which is the nursing home.

Sheet 2, or resident description sheet, queries individual resident characteristics: weight, height, time since admission, hospital stays, level of care, nutritional therapy, age-related complications, diseases and medications. The sheet was completed by unit staff.

Sheet 2b was introduced in 2010. It assesses the nutritional status of the residents by the Mini Nutritional Assessment (MNA) tool and is not part of the analysis in this thesis.

Sheet 3a is a resident questionnaire including general questions on weight course, recent eating habits and social contacts. It was completed by the residents, supported by relatives or staff if necessary.

Sheet 3b, a second resident questionnaire, reflects the resident´s actual nutritional and fluid intake at lunch on the day of the nutritionDay evaluation. The sheet was filled in by the resident with assistance if needed.

The outcome evaluation sheet re-assesses the resident´s outcome six months after nutritionDay: residence, actual weight and hospitalisation. The sheet was completed by the unit´s staff.

A detailed description of each item in the questionnaires and explanations were available in several languages for the participants (see appendix). (174)

In the following, some details of the data acquisition are described. The participants were asked to scale rather than self report weight and height. Since those simple measures are time consuming in the NH environment, NHs were allowed to complete these within two weeks before the appointed date. Furthermore, the staff was asked to subjectively classify each resident as either well-nourished, at risk of malnutrition or malnourished. Pressure ulcers were specified according to the Pressure Ulcer Classification System of the European Pressure Ulcer Advisory Panel (EPUAP) in grade 1 (“non blanchable erythema”), grade 2 (“blister”), grade 3 (“superficial ulcer”) and grade 4 (“deep ulcer”) (99). Cognitive status was classified according to the criteria of the Mini Mental Status Test (MMST) (243). Mobility was judged by the following categories: “mobile” - the resident can walk at least 50m without walking helps, except walking sticks, “semimobile” - locomotion is only possible with major walking helps (like walking frames) or without external help in a wheel chair, or “immobile” - bed-ridden or locomotion only possible in a wheel chair with external support. The number of drugs per day was strictly defined as the number of different substances and not as the total number of pills. For antidepressants, neuroleptics or tranquillizers, the collective term “psychoactive substances” was used. Current intake of antibiotics was used as a surrogate marker for bacterial infections and actual intake of opiates as a surrogate marker for pain. Types and calories of clinical nutrition were required, without documenting the number of calories from "normal" food.

With optimum preparation, the time necessary for data acquisition on nutritionDay was about 5-10 minutes per resident. Relatives were invited to support the completion of the forms. After the main assessment as well as after the outcome evaluation six months later, the NHs were asked to either transfer the data online via the ND website or send the questionnaires to the nutritionDay central coordinating center in Vienna by mail. After data collection and further processing, individual benchmarking reports were developed for each participating unit, presenting all univariate information given by the specific unit in one column and a summary of the data from all other units in the second column. The continuation of data acquisition in the following years was recommended in order to be able to compare results over the years. For further data processing, all data from the years 2007-2010 were summarised in a Microsoft Access database.

After the pilot run in 2007, the questionnaires were slightly modified for the next run (see Table 12). Sheets and modifications are provided in the appendix.

Changes in questionnaires after the pilot run	
NEW	**OLD**
time needed for basal care of each resident	time needed for basal care summarised for a whole unit
staff (number and FTE)	staff (number, number of patient contacts in hours per week, FTE)
---	question for severe visual disturbances
antidepressants	psychoactive substances
number and maximum grade of pressure ulcers	pressure ulcers: yes or no?
4 answer categories for “weight loss last year”	6 answer categories for “weight loss last year”

Table 12: Changes in questionnaires after pilot run

The translations of the questionnaires into the different languages were done either by interested national representative council members or personal contacts. A Microsoft excel sheet including all wordings and phrases was translated and then back-translated. The final questionnaires were finished in the central coordinating office.

2.2. Ethical considerations

The concept of the ND NH was approved by the ethical committee of the Medical University of Vienna. Amendments of the ethical approvals were requested for the further runs. All documents can be looked at in the nutritionDay office (www.nutritionday.org). The participating centers were not required to get approval from their own ethical committees.

However, each competent resident was asked to give his or her oral or written consent. Furthermore, each NH was required to announce the audit on a pre-printed information sheet placarded in an easily visible place in the unit at least one week before the audit. The information sheet also targeted relatives or nominated proxies of residents who were incompetent to consent, informing that participation could be rejected. No personal data like first name, family name or date of birth were transferred to the central coordinating center or stored in a database. Ethic commitee approval was obtained according to national requirements.

2.3. Center recruitment and sample

Participation was open and free of charge to any unit of an NH (centre) that registered on the website and requested an anonymous centre and unit code. At the beginning, recruitment occurred mainly via the Clinical Nutrition Societies of Austria (AT) and Germany (GER) by a singular postal invitation to all NHs. Later on, several contact points in other European countries were proposed by the ND advisory board members. A detailed protocol and step-by-step guidance of the whole ND NH procedure was available for participants via the website www.nutritionday.org. The participating units (wards) are unique in that each unit was only part of the data analysis once. As far as the participating residents of the units are concerned, the same person could have taken part more than once, even up to five times in five runs (2007-2010). The residents were anonymised and therefore it was not possible to identify them or separate them for analysis. As the data of the resident sheets referred to the actual nutritional status, like food intake, weight, etc., it was supposed that this circumstance was negligible. Nevertheless, for sensitivity analysis (SA) later on, this aspect was considered and only residents of units in a single year of participation were included.

2.4. Data quality

Data clearing was performed by the central coordination center and if any data was unclear or illogical, the respective unit was contacted and could revise data within a given period of time. The raw data were transferred via MS excel to IBM® SPSS® statistics version 21. Data were checked for outliers and implausible information by looking at minimum and maximum values as well as average or median values (e.g. not accepting BMI > 150kg/m^2,

etc.). In the appendix, each variable of the database is listed and defined; invalid and valid data are explained.

2.5. Statistics and analysis

Most data are presented as proportion or mean±sd and range (= min – max). The median value (min-max) was used for single non-parametric data sets, like month since admission. For evaluating differences between groups, Student's T-Test was used for normally distributed numerical samples, Mann-Whitney Test for unparametric numerical samples, χ^2-Test for nominal or ordinal samples and Kruskal-Wallis Test for differences in more than two groups of numerical samples. I performed univariate correlation analysis with binary logistic regression to describe the relationship of each baseline independent variable for the outcome death or weight loss of at least 10% in six months. All independent variables are listed in table 40 of the results. The dependent variable was either "bad outcome" (incl. weight loss or death), "weight loss of at least 10%" or "death" within six months. I clustered residents within nursing homes with the method of general estimation equations (GEE) with exchangeable covariance structure. As residents in the same NH were supplied by the same source, management and nutritional care, NHs, respectively the units, were taken as clusters. Factors rendered significant at univariate analysis were seen as possible influencing variables (or confounders) in the GEE analyses and were therefore included in the multivariate regression model. Model effects typ III were also tested. Confounders were checked by performing correlations. For all the calculations, sensitivity analyses were subsequently performed with a restricted data set. This data set included only wards with at least 60% of participation by residents and at least 80% of outcomes recorded. P values less than 0.05 were considered statistically significant. 95% confidence intervals (CI) were given for odds ratios (OR). All analyses were done with the help of a statistical program (IBM® SPSS® v21, SPSS Inc., Chicago, IL).

3. Results

Overall, data of 20 205 residents from the "nutritionDay in nursing homes" evaluation from the years 2007-2010 were received in the coordinating center in Vienna. 1 038 residents were excluded because they either rejected consent (n= 517), were residents on units with less than five actual staffed beds or were not from a European country (n= 517), according to the exclusion criteria (Figure 11). The remaining 19 167 residents came from 14 European countries (94,86% of the initial sample). The residents were situated in 234 nursing homes (=centers) and 470 wards (=units).

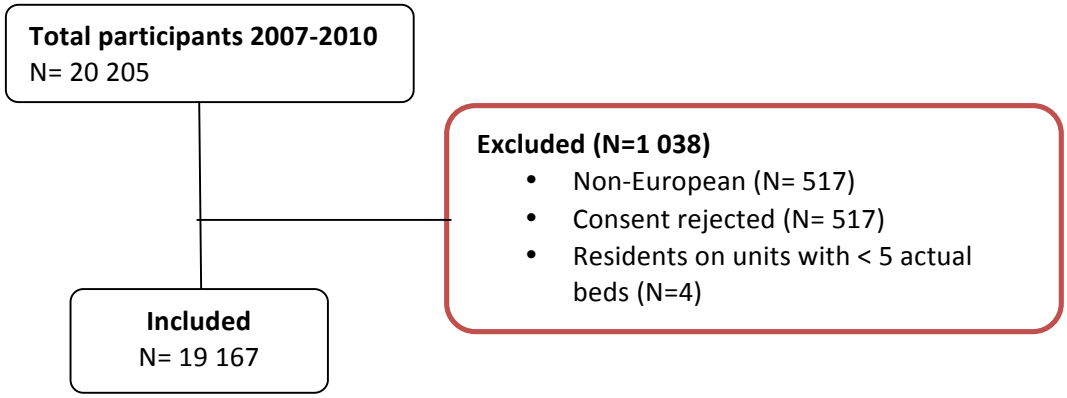


Figure 11: Flow diagram of study participants

3.1. Characteristics of the units

Of 470 units, the countries with the highest participation were Hungary (n=128), Austria (n=115) and Germany (n=87). The remaining units (n=140) were situated in other countries that were grouped according WHO European Regions to allow for easier comparisons and interpretations in the analysis (Table 13, Figure 17) (244).

Regions/ countries	**Hungary (n=128)**	**Austria (n=115)**	**Germany (n=87)**
Nordic (n=61)	**Southern Europe (n=48)**	**Western Europe (n=21)**	**Countries of central and eastern Europe (CCEE) (n=10)**
Denmark Norway Sweden	Italy Portugal Spain	France Switzerland United Kingdom	Czech Republic Poland

Table 13: Categories of countries/regions (according to WHO European regions) used

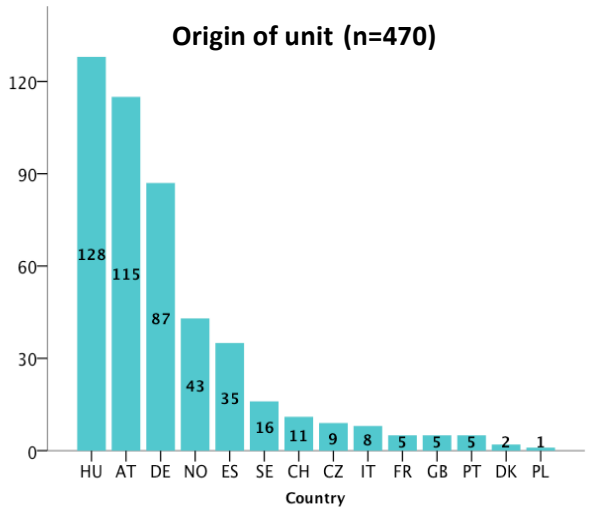


Figure 12: Participating units and countries where they come from; total count; HU=Hungary, AT=Austria, DE=Germany, NO=Norway, ES=Spain, SE=Sweden, CH=Switzerland, CZ=Czech Republic, IT=Italy, FR=France, GB=Great Britain, PT=Portugal, DK=Denmark, PL=Poland

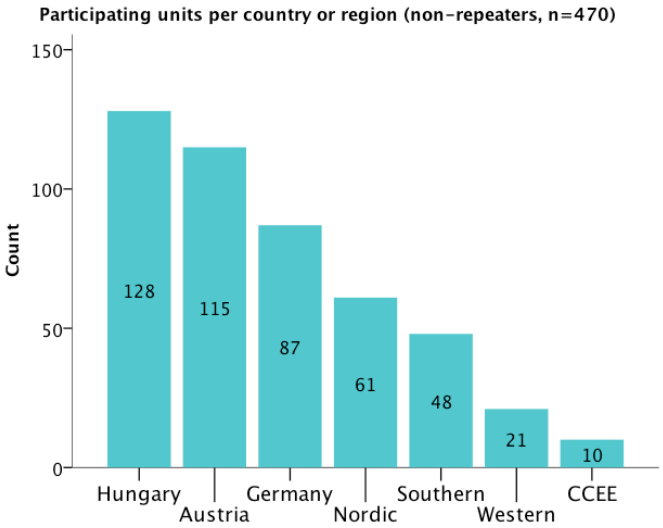


Figure 13: Total count of units in different European countries/regions; CCEE=Countries of central and eastern Europe

The number of participants rose each year (Figure 14).

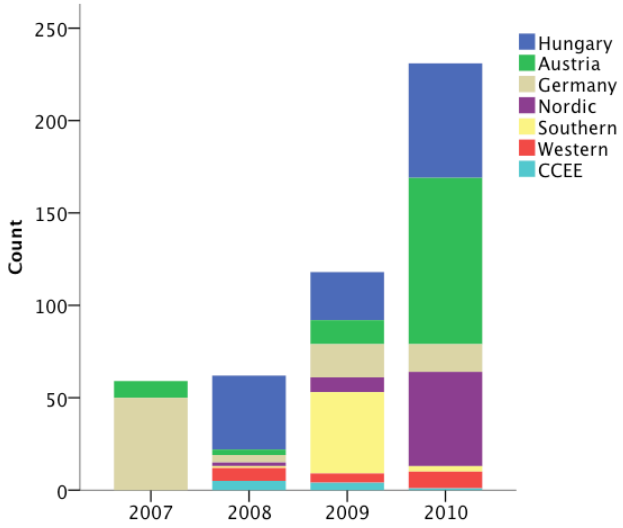


Figure 14: Participation of units in each year of data evaluation; total counts; CCEE= Countries of central and eastern Europe

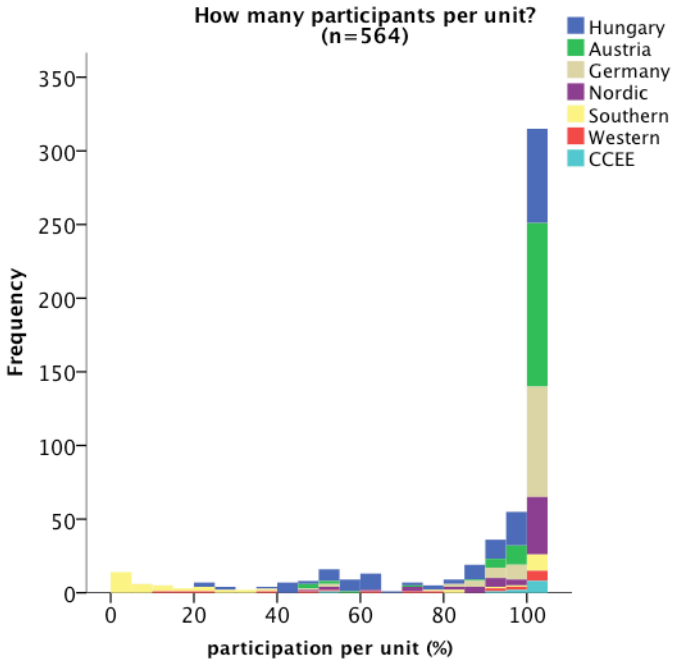


Figure 15: Number of units that delivered data in different percentage of totally staffed beds (according to countries/regions)

The participating units were encouraged to gather data from all residents who were actually on the ward. Nevertheless, participation in some cases was below 100%. Figure 15

shows data completeness in the different regions/countries. It is striking that especially Southern countries contributed only a part of a unit´s residents to the data pool. This needs to be considered in the later data discussion.

The operators of the nursing homes were mainly communal (58.9%), i.e. cities and municipalities were referred to as the communal owner. Non-profit organisations as operators came in second (22.1%) and private-industrial owners third (18.9%). Participating nursing homes in CCEE and Hungary had the highest proportion of communal operators (90% and 83.6% respectively); those in Germany and other Western countries were mainly operated by non-profit organisations (43.7% and 42.9%). NHs in Southern and Western countries were mainly privately-owned (52.1% and 38.1% respectively) (Figure 16).

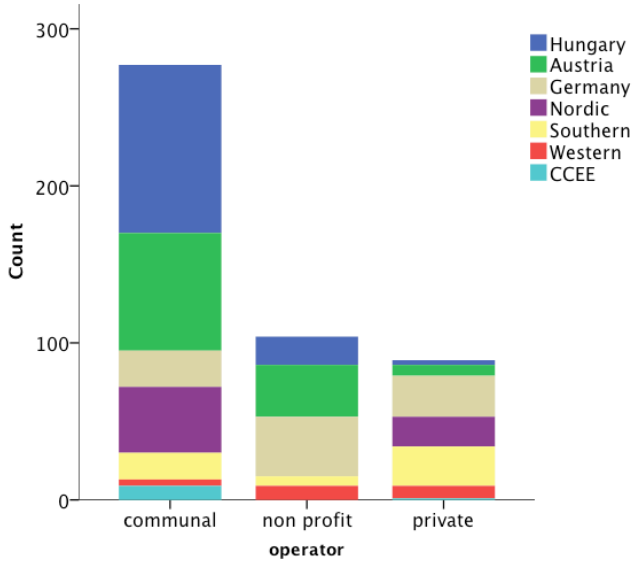


Figure 16: Operator of the nursing home in different regions or countries; total unit counts

The units had a median of 32 staffed beds. The number of beds varied from 14 beds in Nordic countries to a median of 51 beds in Southern countries ($Q_{.05}$;$Q_{.95}$: 10;100). Within countries, the number of beds showed a high variety, especially in Hungary and Southern countries (Figure 17).

The median duration of residents´ time since admission to the nursing home was 36 months. In Hungary, residents had the longest stay of 60 months in NHs, while in Nordic countries they had been in the NH 21 months (Figure 22). The shortest durations since admission were two months ($Q_{.05}$) compared to 256 months for the "long-stayers" ($Q_{.95}$).

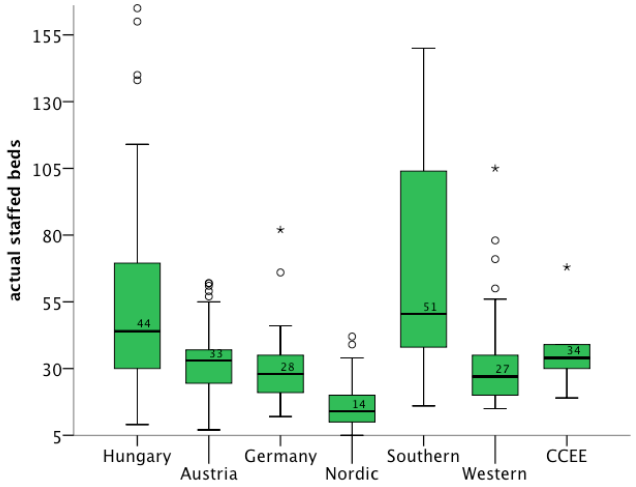


Figure 17: Actual staffed beds per country/region per unit; Box-plots; $Q_{.50}$=median

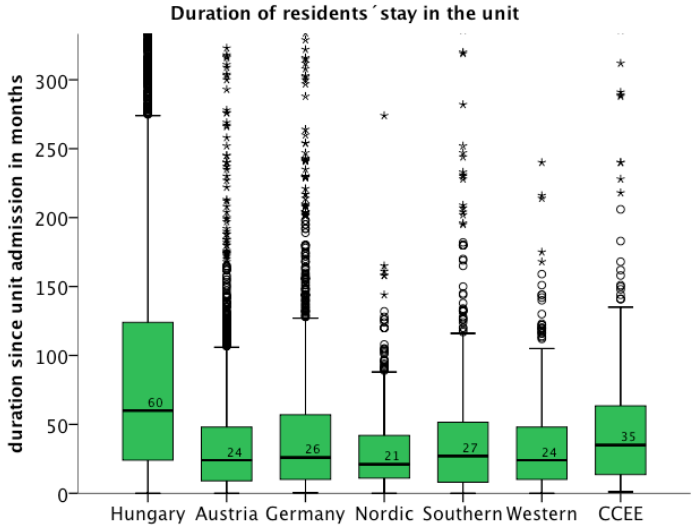


Figure 18: Average duration in months of residents´ stay in the unit; box-plots Q_{50}

3.1.1. Staff in units

The most frequent professional group employed in nursing homes were nurses and nursing aides. Their median number in a unit varied from 9 people in Nordic countries to 21 people in Austria. There was one director of nurses in each unit. Physicians were mainly external consultants. Dietetic assistants, physiotherapists, music therapists and volunteers were rarely or never available (Table 14).

Median number of staff per country or region										
		permanent physicians	external physicians	director of nurses	nurses**	nursing aides	dietetic assistants	physiotherapists, speech therapists, ergotherapists	music-therapists	volunteers*
Hungary	N=87-127	0	2	1	10	1	0	0	0	0
Austria	N=84-112	1	5	1	13	7,5	1	1	1	2
Germany	N=22-84	0	10	1	6	5	1	2	1	1
Nordic	N=44-60	1	0	1	2	7	0	0	0	0
Southern	N=27-46	2	1	1	6	10	1	1	1	1
Western	N=13-21	1	3,5	1	6	10	0	1	1	1
CCEE	N=4-10	1	2	1	4	6	1	1	0	0,5

Table 14: Number of staff per country/region and unit; median; total count

*volunteers: new category starting 2009; **nurses: incl. "registered nurses" before 2009

One full time equivalent (FTE) is comparable to a working time of 40 hours per week. In table 15 the median FTE for each member of staff was calculated for a unit with 30 residents. Data availability was rare in some countries, e.g. in Hungary; nevertheless, FTE showed great differences compared to the number of staff.

Staff´s full time equivalent per 30 residents (median)										
		permanent physicians	external physicians	director of nurses	nurses**	nursing aides	dietetic assistants	physiotherapists,	music therapists	volunteers*
Hungary	N=37-118	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Austria	N=76-99	0,30	0,04	0,61	8,57	3,80	0,03	0,33	0,08	0,78
Germany	N=10-56	0,00	0,33	0,30	4,68	3,41	0,11	0,51	0,22	0,11
Nordic	N=27-49	0,09	0,00	1,25	2,08	4,09	0,00	0,00	0,00	0,00
Southern	N=16-25	0,58	0,01	0,30	1,46	8,44	0,03	0,55	0,26	0,11
Western	N=12-21	0,38	0,06	1,11	4,38	8,16	0,00	0,25	1,00	0,11
CCEE	N=1-7	0,77	0,47	0,91	2,91	2,57	0,11	0,05	0,00	0,00

Table 15: Staff´s full time equivalent per country/region and unit; median

*volunteers: new category starting 2009; **nurses: incl. "registered nurses" before 2009

Figure 19 and Figure 20 show the variety of FTE nurses and nursing aides in the different European regions or countries. In a typical unit with 30 residents, both occupational groups together comprised 5.5 FTE in CCEE and 12.5 FTE in Western countries and Austria. The availability of a permanent (salaried) physician in the unit was highest in CCEE with 32

hours (median), followed by Southern countries with 20 hours and Western countries with 15 hours per week. Permanent physicians were not available in Germany and Hungary (Figure 25). Figure 22 and (Figure 23) show the proportion of units with at least one (FTE) physician per region/country.

Dietetic assistants were rare in nursing homes. 41% of the units answered that they had a dietetic assistant, but in only 10% of the units was he/she tasked for at least 4 hours per week. With a maximum of 4 hours/week in Germany and CCEE, they were generally underrepresented (Figure 24, Figure 25). No data on staff FTE were available from Hungary.

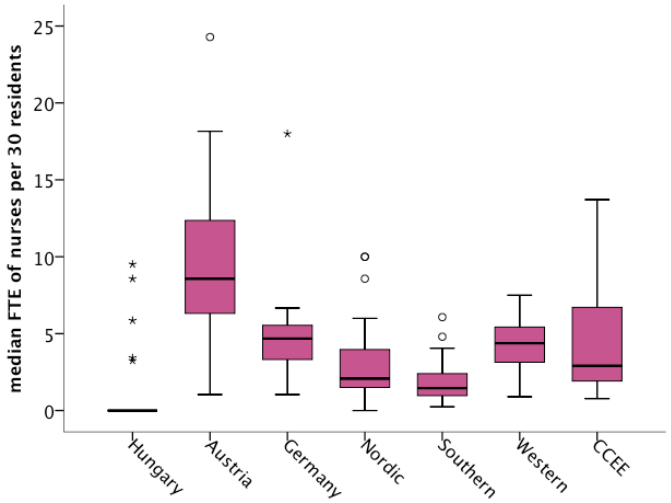


Figure 19: Full time equivalents (FTE) of nurses per 30 residents per country/region; median

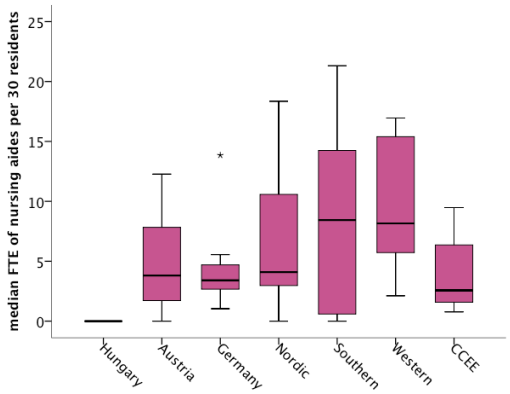


Figure 20: Full time equivalents (FTE) of nursing aides per 30 residents per country/region; median

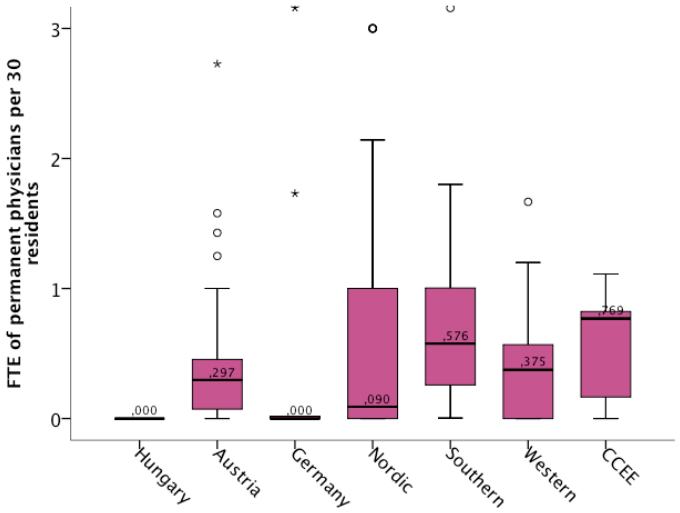


Figure 21: Full time equivalents of permanent physicians per 30 residents per country/region; median

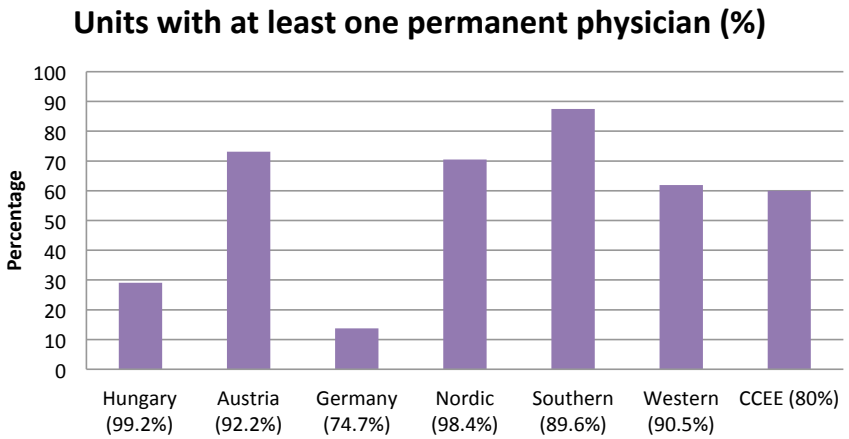


Figure 22: Proportion of units with at least one permanent physician per country/region, % (Frequency of response in brackets)

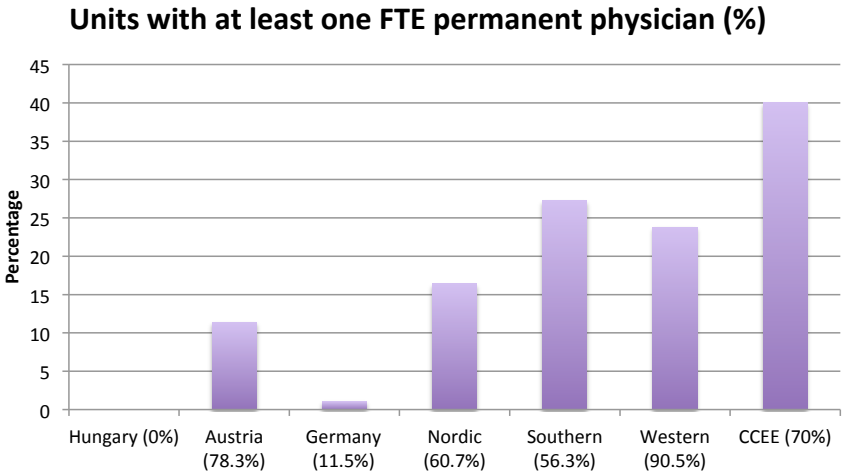


Figure 23: Proportion of units with at least one permanent full time equivalent physician per country/region, % (Frequency of response in brackets)

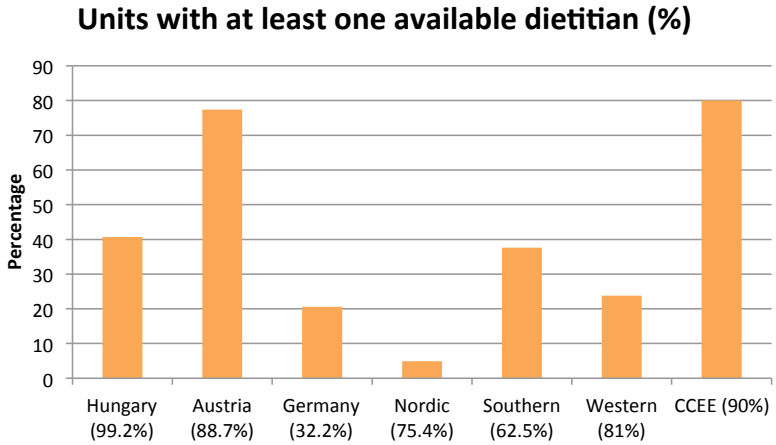


Figure 24: Proportion of units with at least one dietitian per country/region, % (Frequency of response in brackets)

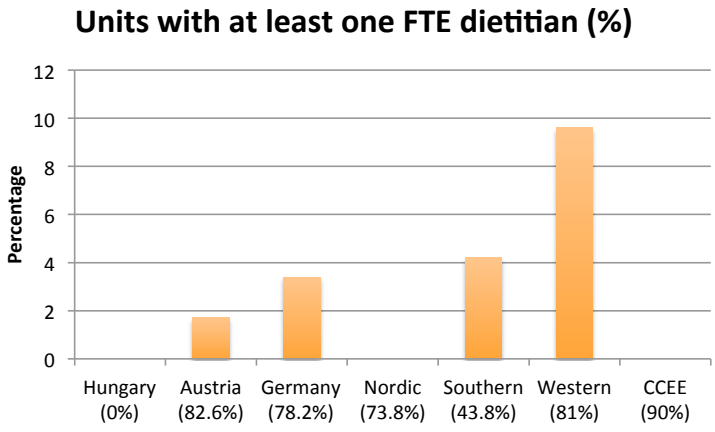


Figure 25: Proportion of units with at least one full time equivalent dietitian per country/region, % (Frequency of response in brackets)

3.1.2. Nutritional procedures in the unit

Nutritional management and procedures varied a lot between the units in the nursing homes. 44% said that they had a person for nutritional care who was either a dietitian or a selected person dedicated to nutrition. For example, 70% of the units in CCEE had a nutritional care person, while in Western countries only 19% had one (Figure 30). With the exception of units in CCEE (20%), between 60-90% of the units in all regions/countries used written procedures for nutritional care (Figure 31). Figure 28 shows the kind of written procedures used. Local protocols were mainly used, then individual care plans and national guidelines. However, the differences here are striking.

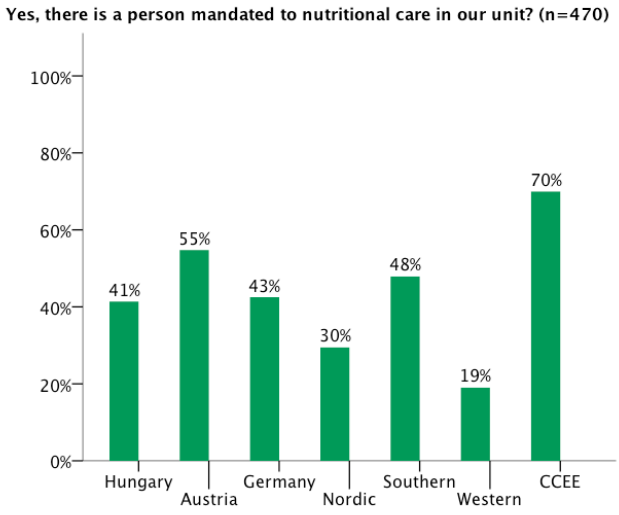


Figure 26: Proportion of units with a person for nutritional care per country/region

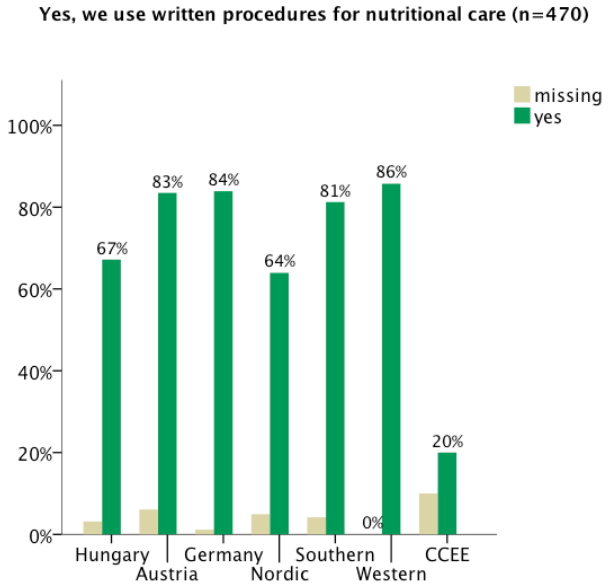


Figure 27: Percentage of use of written procedures for nutritional care (missing= when answer was not given)

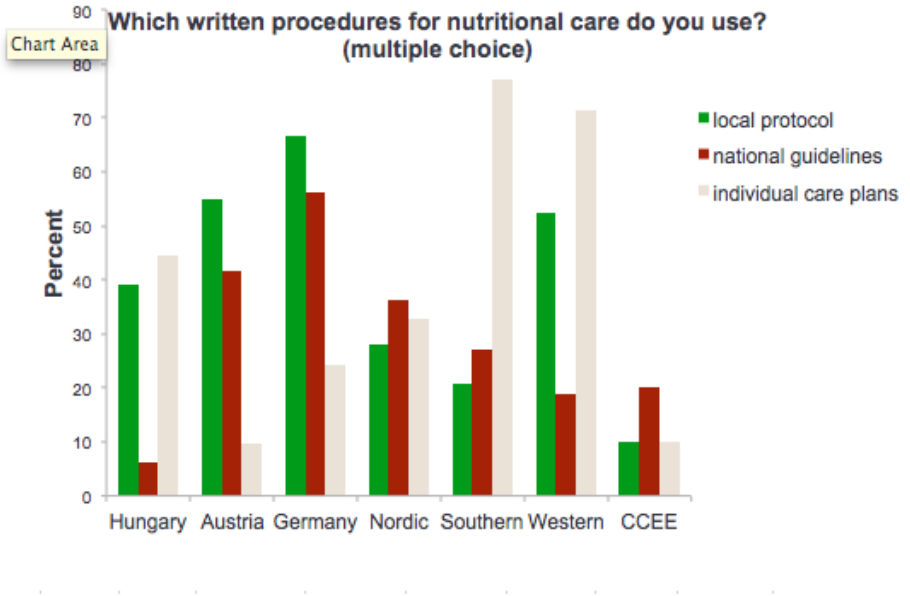


Figure 28: Use of written procedures for nutritional care in percent per country/region

Figure 29 shows the nutritional procedures that are used monthly in the units. "Weighing" means the residents´ body weights were measured. "Screening" means that monthly screening for malnutrition was routine. As can be seen, regular weighing was widespread in nursing homes in Austria, Germany and Western countries. Monthly screening was used at the highest rate in Austria (86%) and at lowest rate in the Southern countries (12.5%).

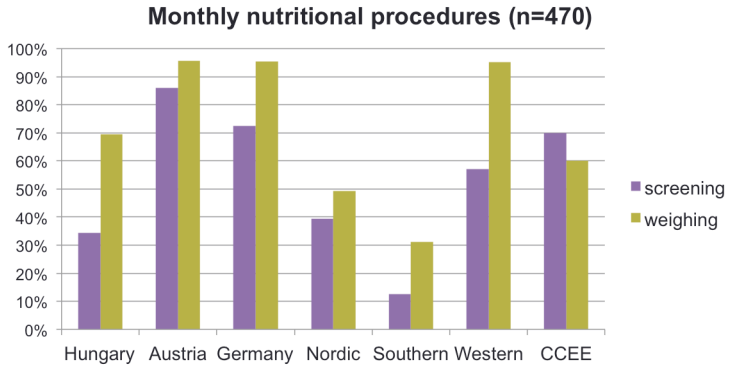


Figure 29: Percentage uses of monthly nutritional procedures per country/region (screening and weighing)

3.2. Characteristics of residents

Residents were situated in 14 different countries, but mainly in Hungary (n=9 221), Austria (n=4 611) and Germany (n=2 803) (Figure 34). Figure 35 shows the proportion of participants aged below 65 and over 65 per country/region. The high proportion of "young" residents in Hungary was surprising.

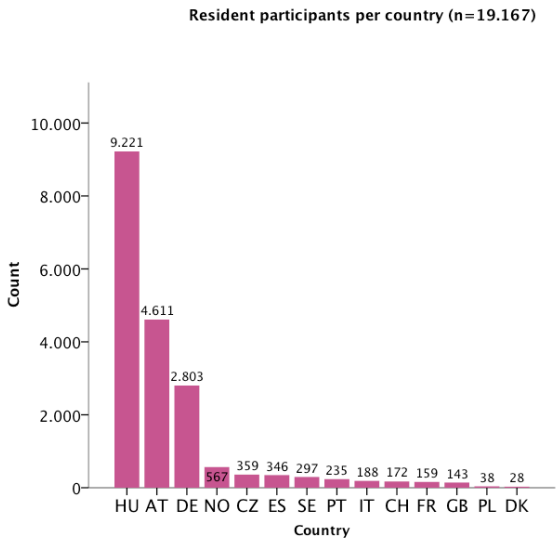


Figure 30: Resident participants in different countries, total count; HU=Hungary, AT=Austria, DE=Germany, NO=Norway, ES=Spain, SE=Sweden, CH=Switzerland, CZ=Czech Republic, IT=Italy, FR=France, GB=Great Britain, PT=Portugal, DK=Denmark, PL=Poland

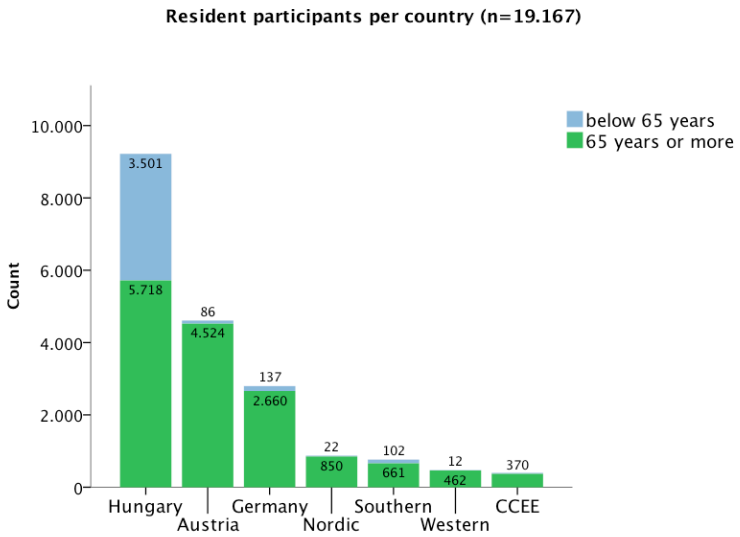


Figure 31: Resident participants in countries/regions; total count; the blue part of the columns shows proportion of people aged below 65

All together, 70.8% of the residents were female. There was a regional variation in residents' gender (Figure 32). While Austria was the country with the highest proportion of women in nursing homes (84%), Hungary, for instance, had a proportion of only 62.8%.

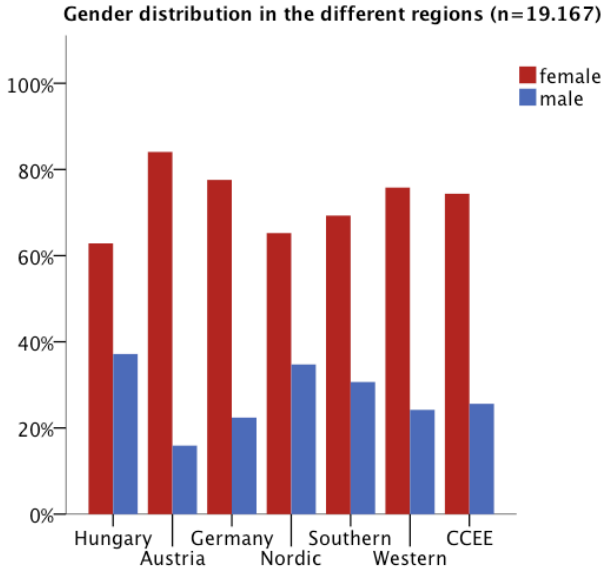


Figure 32: Gender distribution (%) in different countries/regions

The residents´ mean age was 76.8 ± 16.8 years. The Hungarian study population was much younger, with a median age of 72 years. The oldest residents lived in Austrian nursing homes, where the median age was 88 years (Figure 37). In all regions/countries, the main care-causing diagnosis was "illness of brain and nerves". "Illness of heart and circulation" was the second most frequent diagnosis, followed by "muscle, skeleton and bones diseases". In Hungary, "other" diagnoses were more often indicated than diseases of the skeleton, bones and muscles. (Figure 34, Table 16).

Figure 33: Residents´ age in years in different countries/regions; box-plots Q_{50}

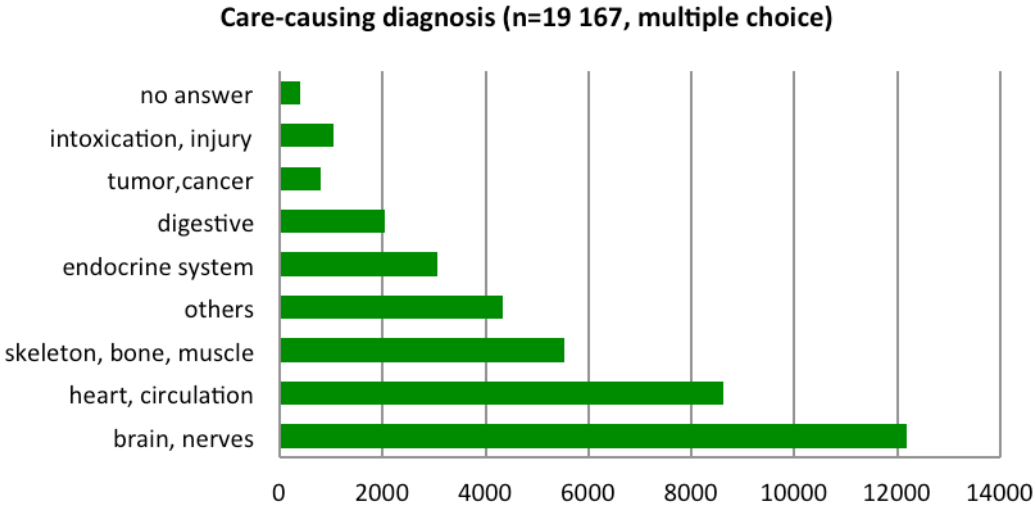


Figure 34: Care-causing diagnosis of residents; total counts; multiple choice

	1. care-causing diagnosis	2. care-causing diagnosis	3. care-causing diagnosis
Hungary	brain, nerves (50.5%)	heart, circulation (43.2%)	others (29.3%)
Austria	brain, nerves (80.7%)	heart, circulation (49.2%)	skeleton, bone, muscle (48.8%)
Germany	brain, nerves (72.5%)	heart, circulation (51.8%)	skeleton, bone, muscle (36.5%)
Nordic	brain, nerves (75.3%)	heart, circulation (24.8%)	skeleton, bone, muscle (18.4%)
Southern	brain, nerves (60.2%)	heart, circulation (31.7%)	skeleton, bone, muscle (30.5%)
Western	brain, nerves (71.1%)	heart, circulation (35.9%)	skeleton, bone, muscle (17.1%)
CCEE	brain, nerves (76.7%)	heart, circulation (68.6%)	skeleton, bone, muscle (47.3%)

Table 16: Main care-causing diagnoses in different countries/regions (percentage frequency)

Figure 35 shows the distribution of levels of care among residents per region. The level of care was defined in four groups, from the lowest level of less than 45 minutes of basal care per day to the highest level of more than 240 minutes. It is striking that Austria had the largest proportion of residents at the highest level of care. Germany, on the other hand, showed a nursing home population at the lowest levels of care.

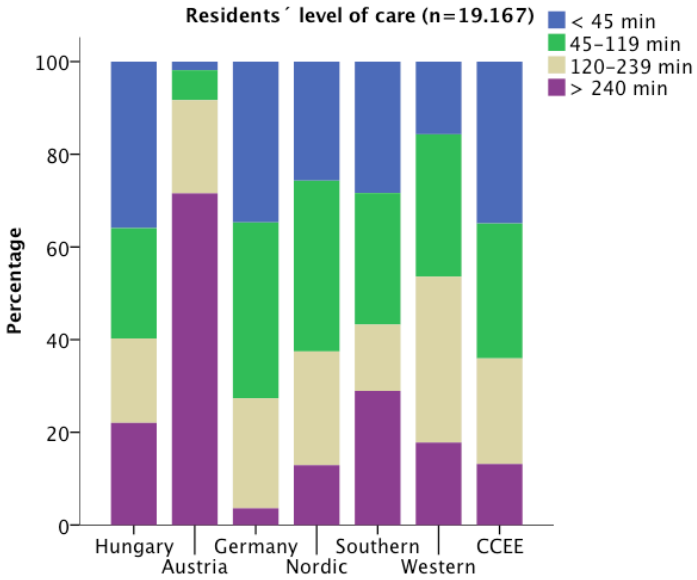


Figure 35: Residents´ level of care in different countries/regions; percentage frequency

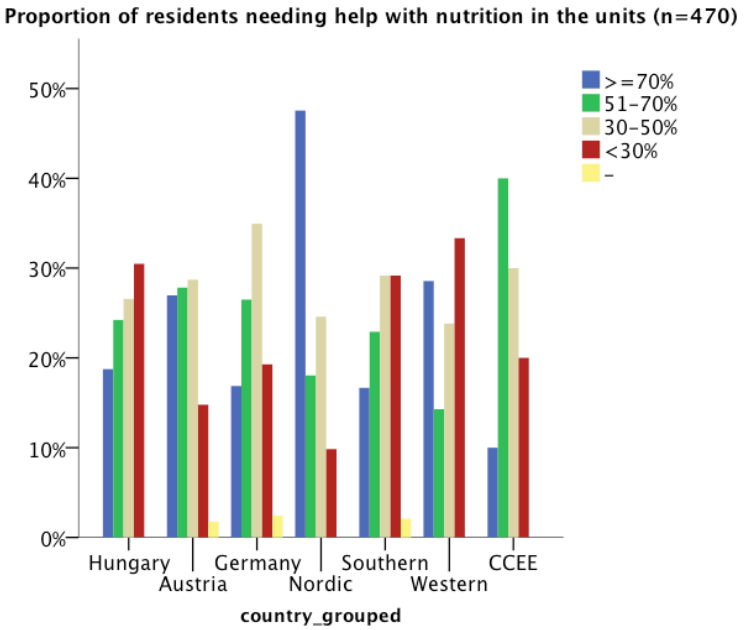


Figure 36: Estimation of the proportion of residents needing help when eating; per country/region

Figure 36 shows an estimation by the staff on how "helpless" its residents were, especially when they needed help with nutrition. Here, Nordic countries showed the highest proportion of units with at least 70% of people needing help when eating (blue columns). On the other hand, Hungary and Southern countries had fewer residents that were dependent when eating.

Furthermore, the question "Was the resident helped with this meal?" was asked regarding each resident. 63.8% answered with "no" because “they didn´t need any help”. “Having no time for help” was hardly a reason not to provide help at ND lunch. 22.6% specified that meals were cut into pieces and 6% indicated that a certain amount of help with eating was provided (Table 18, Figure 41). Figure 38 shows a comparison of help received for cutting the meal in different European countries/regions.

Was the resident helped with this meal (at ND lunch)? N=19 167, multiple choice	**%**
no, because doesn´t need any help	63.8
no, because there was no time to do so	0.1
yes, the meal was cut into pieces	22.6
yes, he/she was helped eating for	6.0
no answer	9.0

Table 17: Answers to: "Was the resident helped with this meal?"; in percent

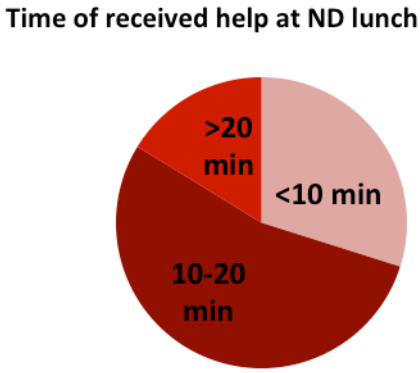


Figure 37: Proportion of time of help received at ND lunch; categories in minutes

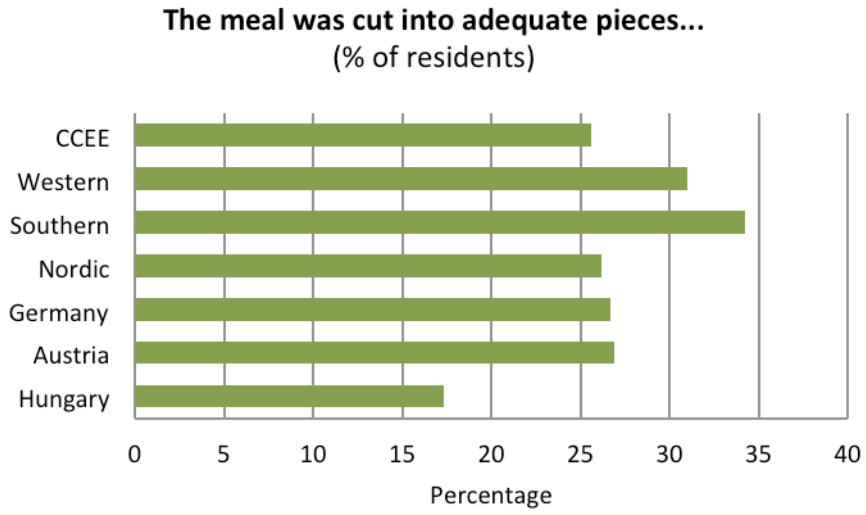


Figure 38: The meal was cut into pieces (% of residents)

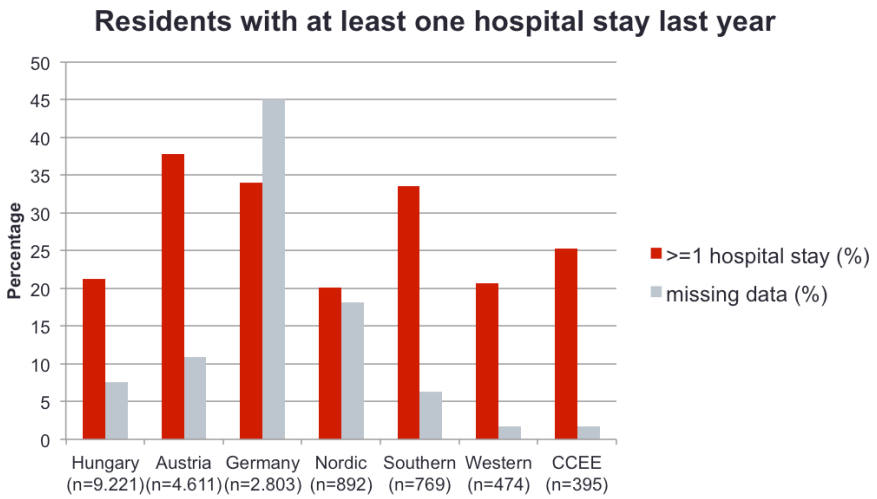


Figure 39: Proportion of residents with at least one hospital stay in the last year per country/region; total participants of the particular country/region in brackets

Overall, 27.6% of the residents had at least one hospital stay in the previous year (Figure 39). Hospital stays were most common among residents in Austria, Germany and Southern European countries. The residents in Hungarian and Western and Northern European countries´ NHs were less often hospitalised (20%).

The residents of NHs took 6.4 ± 3.7 different types of drugs per day on average. Figure 40 demonstrates the differences in the European countries/regions. The range was between 5 and 7 drugs/day in the median. The most common form of medication was psychoactive substances (38.6%), the second most common was opiates (23.8%) and third most antibiotics (2.8%). The high usage of opiates in Hungary (above 35%) was particularly remarkable, while psychoactive substances and antibiotics were less often administered compared to other countries (see Figure 45, Figure 46)

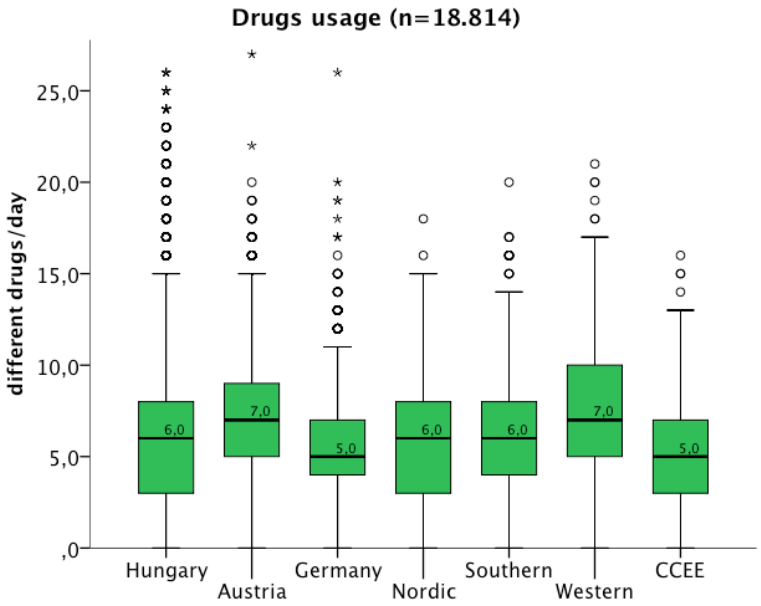


Figure 40: Daily drug intake per country/region; box-plots Q_{50}

Figure 41 and Figure 42 demonstrate the occurrence of frequent nutrition-related problems in residents in different regions/countries. Dementia (or light to severe impaired cognitive status) was the most often occuring disturbance for residents in nursing homes, with up to 77% being affected. Restricted mobility, with up to 70% of the residents having limitations, was another frequent problem of the elderly. Between 30-50% took psychoactive substances, etc. Again, Hungarian data show a large difference to the rest of the countries/regions.

In Western and Southern countries and Austria, about 60% of the residents in the nursing homes received regular visits, at least once a week. In other countries, this percentage was smaller. Rare or no visits were most often found in Hungary (Figure 43).

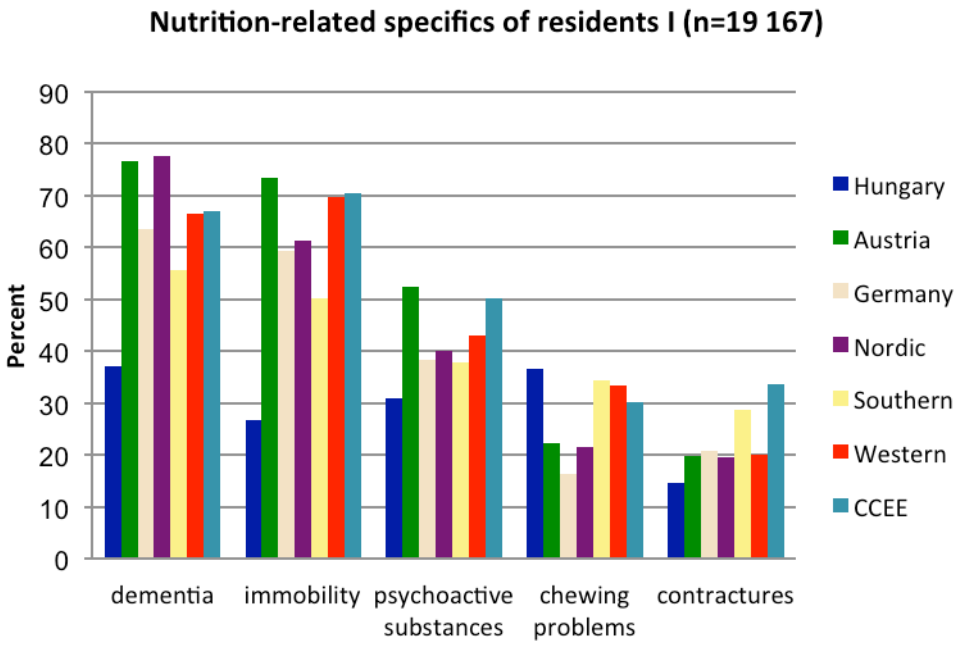


Figure 41: Residents´ nutrition-related problems I; percentage frequency, per country/region

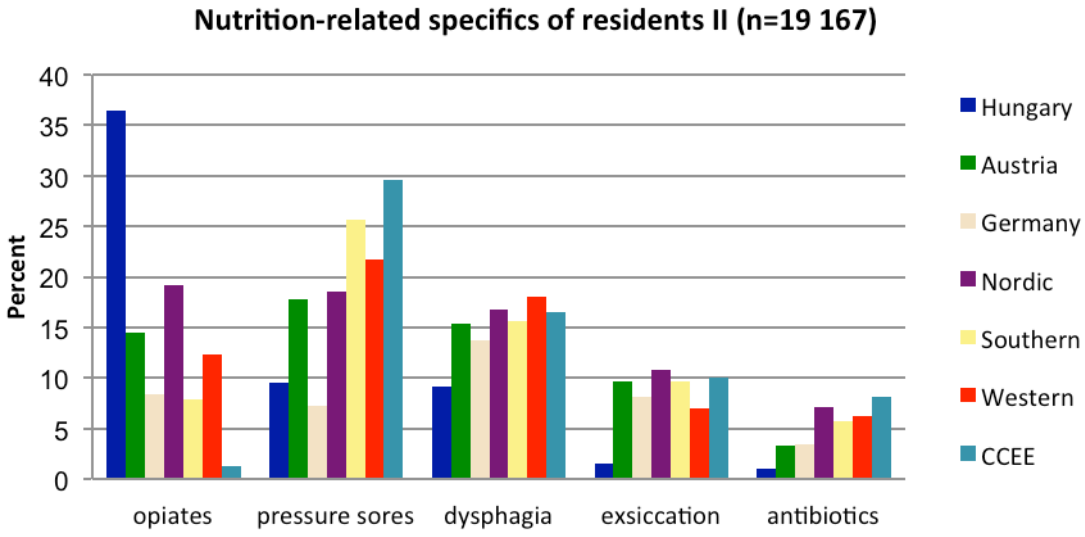


Figure 42: Residents´ nutrition-related problems II; percentage frequency, per country/region

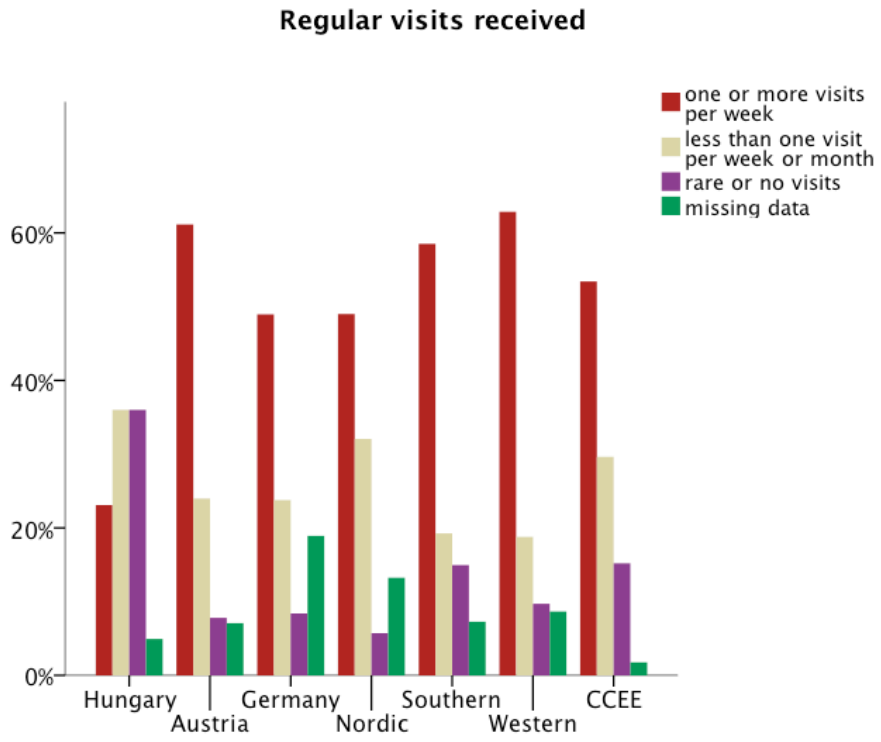


Figure 43: Proportions of visits received by residents per country/region (%)

3.2.1. Nutritional status of residents

Parameters like BMI, weight change, appetite and nutritional intake – optimally all these data together – give a certain picture of the nutritional status of a resident. As a result, a person can either be classified as malnourished, at risk of malnutrition or as having a good nutritional status.

The mean body mass index (BMI) of all residents was 25.1 ± 5.8kg/m^2. 30.4% had a BMI below 22kg/m^2, respectively 16.8% below 20kg/m^2 (Figure 44). For Figure 49, people below 65 years of age were excluded and BMI was classified according to geriatric criteria (191). Based on the BMI, the most malnourished and "at risk" residents could be found in Northern, Western and CEE countries, while residents in Hungary and Germany had a BMI below 22kg/m^2 less often. Also high BMI is an issue since malnutrition may occur in obese elderly.

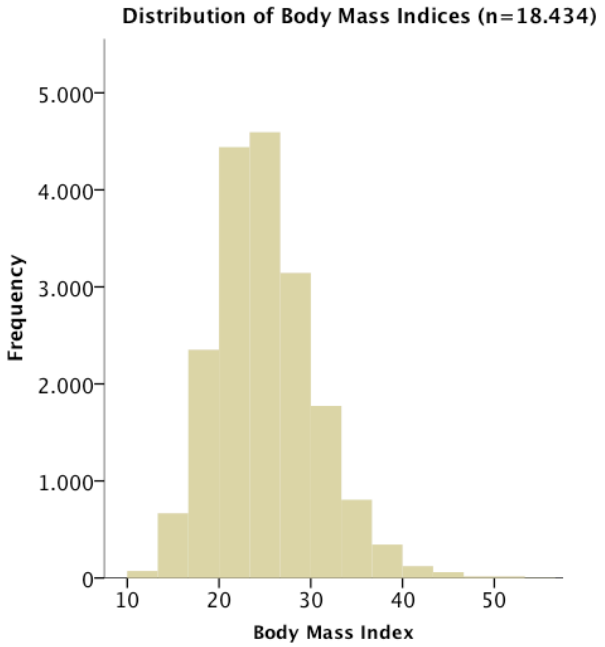


Figure 44: Body mass indices distribution; total counts of residents; BMI in kg/m^2

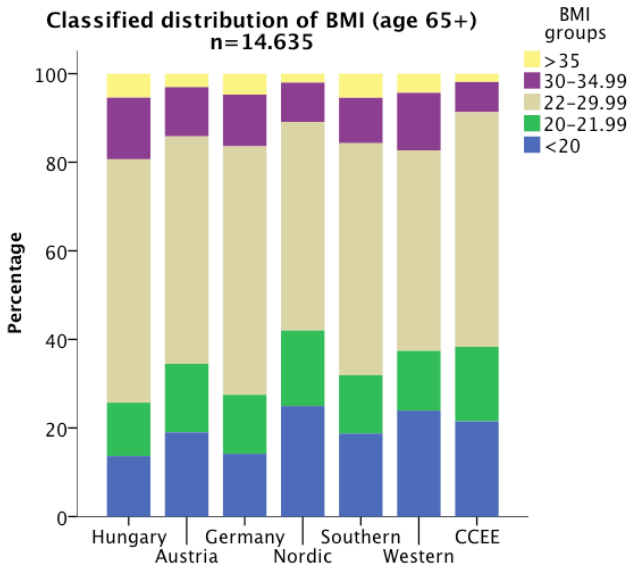


Figure 45: Distribution of classified BMI groups in percentage of residents 65+ years per country/region

Figure 46 shows how the staff estimated the nutritional status of the residents ("overall clinical view"). How this overall clinical view on malnutrition compared to BMI data is presented in Table 18. As a result, the staff of Austrian NHs identified the highest

percentage (46.1%) of people with BMI below 20kg/m^2 according to their "clinical view", followed by the staff in Germany (40.3%). Up to 80% of the residents with a BMI below 20 kg/m^2 were not identified as malnourished (e.g. in Western countries).

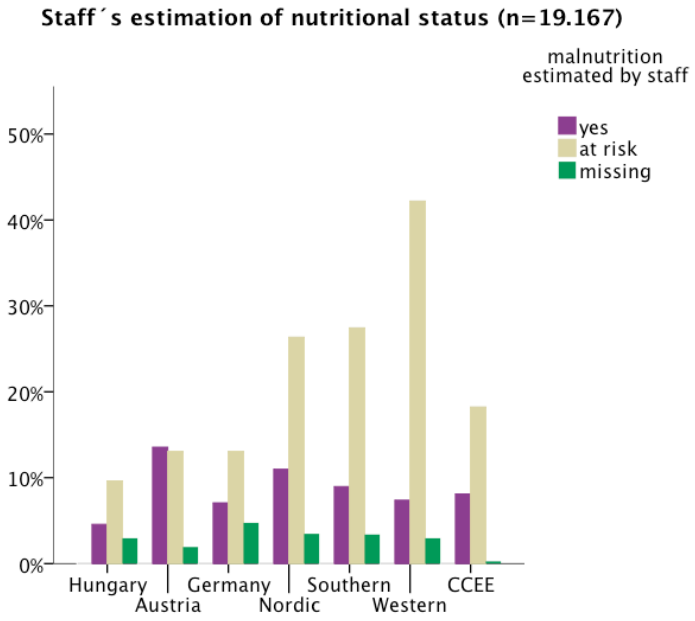


Figure 46: Percentage estimation of malnutrition by clinical view of staff per country/region

Staff´s estimation of residents with BMI<20 (%)	Malnourished	At risk of malnutrition	Normal	Missing data
Hungary (n=755)	22	29.4	40.5	8.1
Austria (n=861)	46.1	27.2	23.8	2.9
Germany (n=380)	40.3	32.1	24.5	3.2
Nordic (n=187)	33.2	37.4	28.3	1.1
Southern (n=117)	35	43.6	18.8	2.6
Western (n=94)	18.1	60.6	20.2	1.1
CCEE (n=81)	23.5	42	34.6	-

Table 18: Staff´s estimation of nutritional status of residents with BMI<20kg/m^2 in percent; number of people with BMI<20kg/m^2 in brackets

The observation of weight changes is very important. When people lose more than 10% of their body weight in six months or more than 5% of BW in one month unintentionally, malnutrition is strongly indicated (185). In the present data evaluation, weight from five years ago, weight change in the previous year and the actual weight of the residents were collected. Furthermore, six months later, weight data were gathered with the outcome analysis. The weight changes of residents during the five year period are shown in Figure 51. As can be seen, the residents lost 2.17% of their BW on average. In Table 19, this information is split according countries/regions. The available data were limited (5-53%).

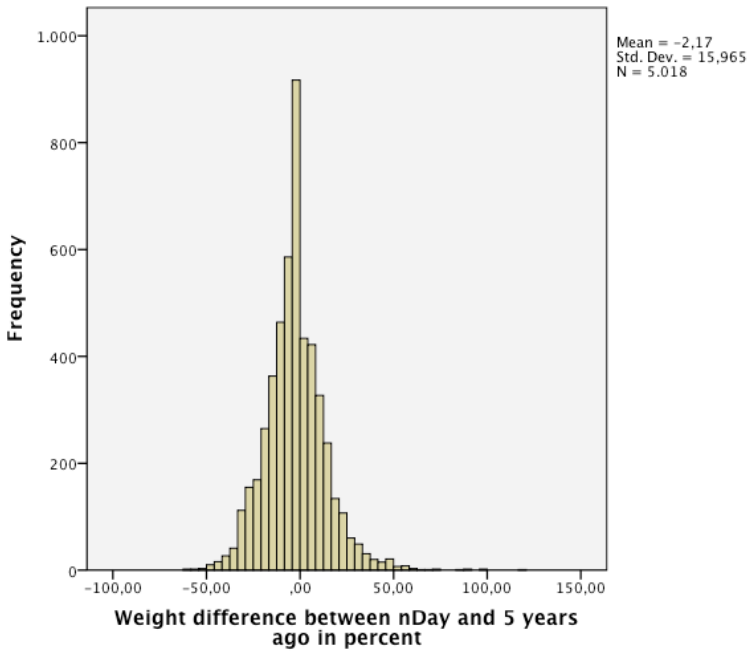


Figure 47: Weight difference from today and five years ago in percent of BW; total numbers of residents

Weight change during 5 years prior ND (n=7 209)		
	available data (%)	difference (%)
Hungary	53.3	-0.9
Austria	28.7	-3.5
Germany	22.2	1.0
Nordic	5.0	0.1
Southern	39.3	-2.3
Western	22.4	-0.4
CCEE	48.4	-2.8

Table 19: Weight changes of residents during five years prior to ND per country/region; available data in percent and weight difference in percent of BW

Figure 48 presents data on weight changes in the previous year. Weight losses dominated weight changes everywhere except in Germany, where the proportions of residents that lost and gained weight were equal. Overall, 31.1% (25.7-38.6% according to region/country; n=5 936) of the residents lost weight ("weight losers") and 18.8% (9.9-25.3%) gained weight. Others maintained weight or indicated that they "didn´t know" whether their weight had changed. Of the “weight losers”, 20.2% lost between 1-5kg, 9.7% lost between 5-15kg and 2.2% lost more than 15kg of their BW. Another 2.5% didn´t know how much weight they had lost. Differences between the countries/regions were minimal (Figure 53).

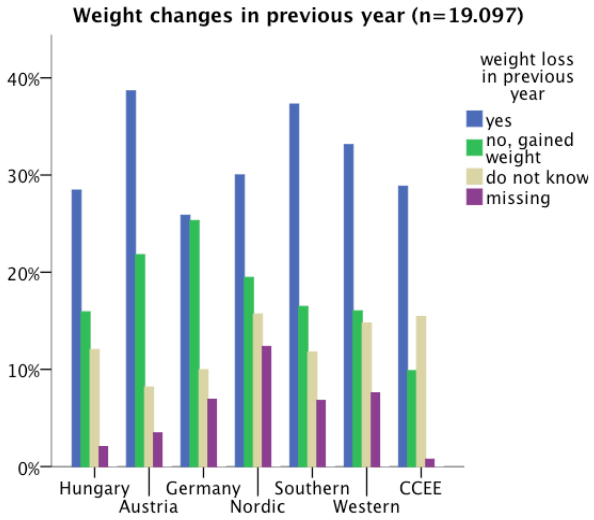
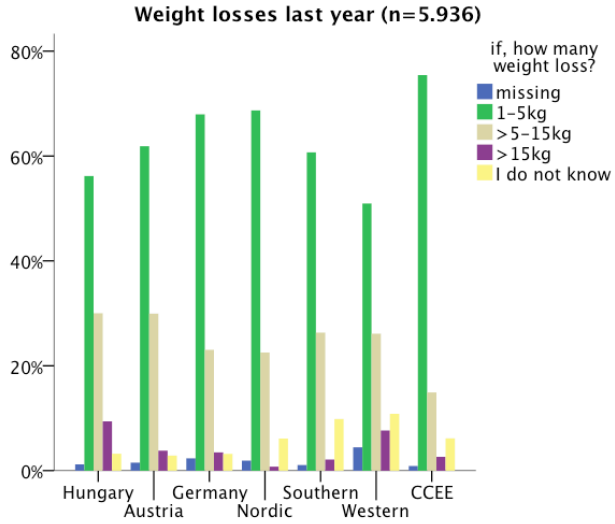


Figure 48: Proportions of weight changes in the previous year per country/region in



percent

Figure 49: Weight loss last year in groups per country/region; in percent of all "weight losers"

An unpaired t-test compared the weight changes of the last five years of residents that were in the NH for a long period (> 5 years) with those who were in the NH only a short time (<1 year). The significant result (p<0.0001) showed that "short-time" residents had lost -2.97% of their BW on average, while "long-staying" residents lost -0.39% (Table 20).

Group Statistics

	duration since unit admission (2 groups)	N	Mean	Std. Deviation	Std. Error Mean
5 years weight change (%)	< 1 year ("short stayers")	1 096	-2.9730	15.67411	.47345
	> 5 years ("long stayers")	6 052	-.3904	16.53536	.21255

Table 20: t-test for weight differences between residents who stayed short- or long-time in NH

Another very important question for the assessment of the nutritional status of people is the actual amount of food eaten. For example, "How well have you eaten during the last week?" or "What did you eat today?" While 73.9% (64.3-76.6% according to country/region) ate as they normally did, 15% ate a bit less than normal, 3.5% ate less than half as usual and 1.2% less than a quarter to nearly nothing. 1.6% didn´t know how much they had eaten the week before and 4.9% of the data were missing.

The main reasons for eating less were "loss of appetite" (55.5%), "others" (23.8%) and "swallowing/chewing problems" (13.4%). (Table 21)

Reasons for eating less in the previous week (n=3 752, multiple choice)

No answer	8.0%
Loss of appetite	55.5%
Other reasons	23.8%
Swallowing/chewing problems	13.4%
Tooth problems	9.4%
Meals not adequately prepared	8.6%
Nausea	7.5%

Table 21: Reasons for eating less in the previous week in percent of those who ate less

Generally, it is recommended to document what is eaten every day for a week (185). This data included the estimated amount of food intake on nutritionDay. Plate symbols helped to indicate whether the whole meal, half the meal or a quarter of the meal was eaten that day (Table 32). The focus was on lunch. Beverages and the oral supplementation usage of every resident was documented as well. If the whole lunch was not eaten, the residents noted the reasons for eating less. 62% of the residents ate everything at lunch on nutritionDay, 27% ate half a portion, 6% a quarter of the meal and 2% ate nothing. Half a percent of the people didn´t know what they had eaten that day and 4% didn´t answer. Nordic countries´ NHs recorded the highest proportion of "all-eaters" (67%), people in CCEE NHs the lowest (55%). On the other hand, Western and Nordic countries´ NHs had the highest percentage of "non-eaters" (4% each) among their residents while Hungarian NHs had the lowest (0.4%).

Nutritional intake on nutritionDay (%)						
n=19 167					**Don´t know**	**Missing**
NH all (%)	**62**	**27**	**6**	**2**	**0.5**	4
Hungary	63	28	5	0.4	0.4	3
Austria	56	27	9	3	0.3	5
Germany	63	21	6	2	0.6	8
Nordic	67	16	9	4	0.9	4
Southern	61	23	7	1	1.3	6
Western	58	25	9	4	0.8	3

Table 22: Nutritional intake at nutritionDay lunch per country/region in percent

Reasons for eating less (n=6 016, multiple choice question)			
	Main reason (% of all)	**2. main reason**	**3. main reason**
Hungary	too much (17.4%)	not hungry (7.5%)	don´t like taste/smell (5.7%)
Austria	too much (17.3%)	not hungry (8.8%)	don´t like taste/smell (4.5%)
Germany	too much (9.7%)	not hungry (7.5%)	can´t eat without help (4%)
Nordic	not hungry (7.1%)	too much (6.7%)	can´t eat without help (2.2%)
Southern	not hungry (11.8%)	too much (11.1%)	don´t like taste/smell (8.1%)
Western	not hungry (13.1%)	too much (10.5%)	too hard (3.4%)
CCEE	too much (21.8%)	not hungry (15.9%)	can´t eat without help (5.8%)

Table 23: Main reasons for eating less at lunch on nutritionDay per country/region in percent

The reasons for eating less at lunch are presented in Table 23. The main reasons were "too big portions" and "not being hungry". The third most common reasons of "I don´t like the smell/taste", "can´t eat without help" and "meal is too hard" were mentioned. Table 24 shows the amount of drinks and supplements the residents consumed at lunch on nutritionDay. 85.3% drank at least one drink (à 200ml) and 4.6% received one or more oral supplements.

Statistics on drinks and supplements at lunch

		number of **drinks** (à 200ml)	number of **supplements** (à 200ml)
N	Valid	**17 434**	**1 623**
	Missing	1 733	17 544
Mean		1.57	.74
Standard Deviation		1.24	.90
No drink/supplement		243	682
≥1 drink/supplement		**16 355 (85.3%)**	**788 (4.6%)**

Table 24: Statistics on drinks and supplements at lunch

3.2.2. Diet and nutritional support

The majority of the residents in nursing homes received a normal diet. Nevertheless, there are differences in the frequency of blenderized, fortified or other special forms of diets in the regions/countries. While in Western European countries more than 20% of the residents received a blenderized diet, not even 10% did so in Hungary. Fortification was most common in Austria, Germany and Nordic countries, where it was still rarely used (5-9%). (Figure 55)

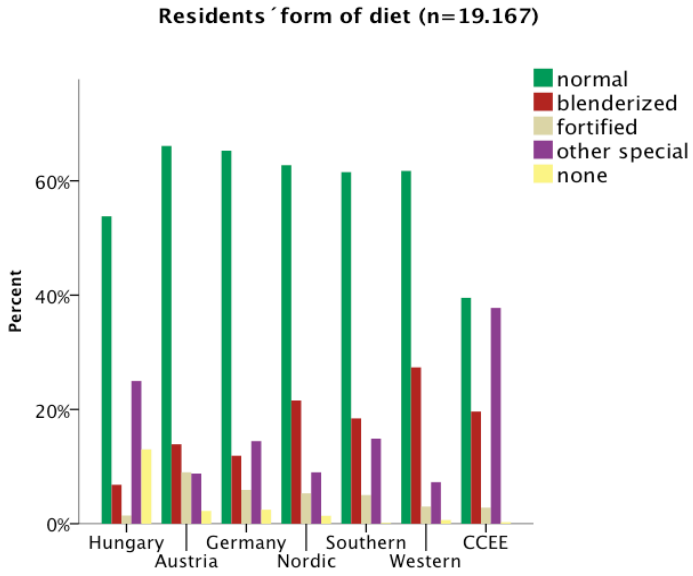


Figure 50: Form of residents´ diet in percentage frequency per country/region

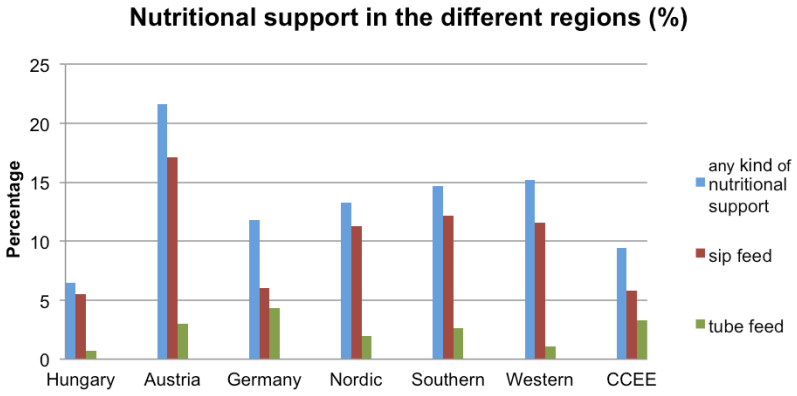


Figure 51: Nutritional support in different countries/regions; percentage of all (n=19 167)

Figure 56 provides data on the frequency of nutritional support in different European countries/regions. "Nutritional support" or "clinical nutrition" included sip feeds, tube feeds, parenteral nutrition, subcutaneous nutrition, others and combinations thereof. As can be seen, Austria presented the highest frequency of clinical nutrition (22%), mainly oral supplements, while the usage of any kind of nutritional support was lowest (7%) in the Hungarian population. The occurrence of lines and tubes is summarised in Table 26. The following answer categories were given: central venous (CV), peripheral venous (PV), nasogastric (NG), percutaneous endoscopic gastrostomy (PEG), percutaneous endoscopic jejunostomy (PEJ) and others. The number of residents that answered the question is shown for each region/country separately; other data was missing. The residents in Germany had the highest usage of lines and tubes (22.1%), but at the same time, had a low answering rate. Again, Hungarian residents showed the lowest usage of lines and tubes. PEG was the main mode of feeding clinical nutrition, followed by "other" modes of supply.

Lines and tubes (%)

region (n, % of all)	CV	PV	NG	PEG	PEJ	others	all
Hungary (n=8 445, 92%)	0.1	-	0.1	0.5	-	0.2	0.9
Austria (n=3 918, 85%)	0.8	0.9	-	6.0	-	2.4	10.1
Germany (n=1 541, 55%)	1.3	0.1	0.2	10.5	0.2	9.8	22.1
Nordic (n=455, 51%)	1.2	0.2	0.2	5.2	-	-	6.8
Southern (n=585, 76%)	-	0.2	2.5	3.2	-	0.2	6.1
Western (n=356, 75%)	-	-	0.6	2.2	-	1.4	4.2
CCEE (n=340, 86%)	0.8	0.3		7.7	0.8	-	9.6

Table 25: Usage of lines and tubes per country/region in percent (number and percentage of residents that answered the question in brackets)

Altogether, 11.8% of people in the NHs received some kind of clinical nutrition. Table 26 lists residents' intake from lunch and clinical nutrition. For example, 9.6% (n =1844) ate lunch as well as received nutritional support. 68.6% (= 13 144) ate lunch only. 0.8% (n=155) of the residents received neither clinical nutrition nor regular lunch on nutritionDay.

Intake from clinical nutrition and lunch (n=19 167)			
Clinical nutrition	Lunch	N	%
yes	yes	1 844	9.6
	no	119	0.6
	don´t know	16	0.1
	no answer	296	1.5
no	yes	13 144	68.6
	no	155	0.8
	don´t know	57	0.3
	no answer	434	2.3
no answer	yes	2 943	15.4
	no	32	0.2
	don´t know	14	0.1
	no answer	113	0.6

Table 26: Intake from clinical nutrition and/or lunch, number of residents and percentage

Figure 52 illustrates caloric intake from clinical nutrition. It also shows whether lunch was eaten as well. As can be see, those who ate (at least a quarter of the) lunch most often received the highest amounts of calories from nutritional support. On the contrary, half of the non-eaters did not receive any nutritional support. Figure 53 demonstrates how often nutritional support was given to “non-eaters“ in the different regions/countries. According to the data, they received nutritional support most often in Austria (48.1%) and least often in Hungary (8.3%).

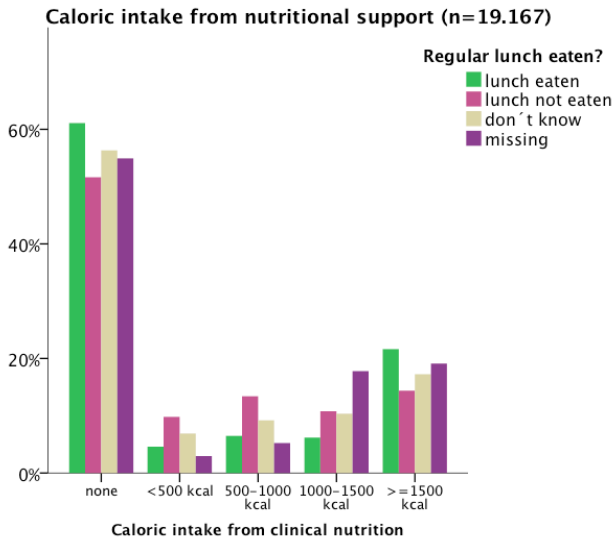


Figure 52: Caloric intake from clinical nutrition in percent; grouped by lunch eaten

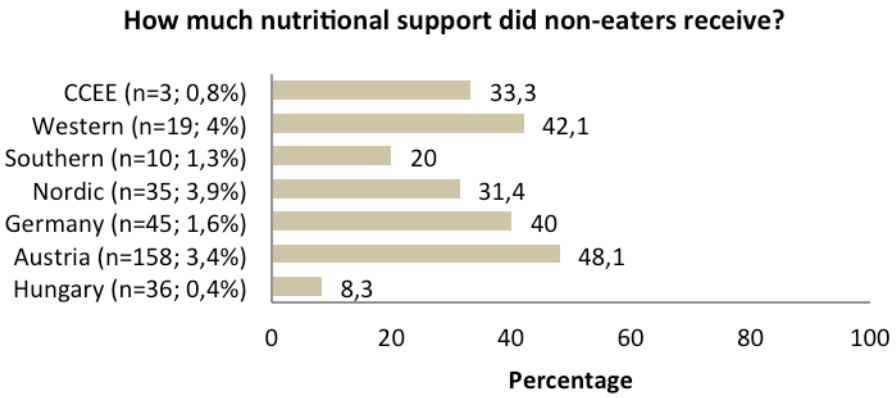


Figure 53: Percentage frequency of nutritional support for non-eaters (number and percentage of residents that ate nothing at lunch in brackets)

The four charts in Figure 54 present all residents that received some kind of clinical nutrition. They are subdivided into a group of lunch eaters, those that "did not know" whether they had eaten lunch, "non-eaters" and, lastly, those for whom no information on lunch eating was given. As spelling, "lunch eaters" mainly received oral supplements. It is noticeable that those without information on lunch on ND (last chart) had the biggest proportion of tube feeding, parenteral nutrition and combinations thereof.

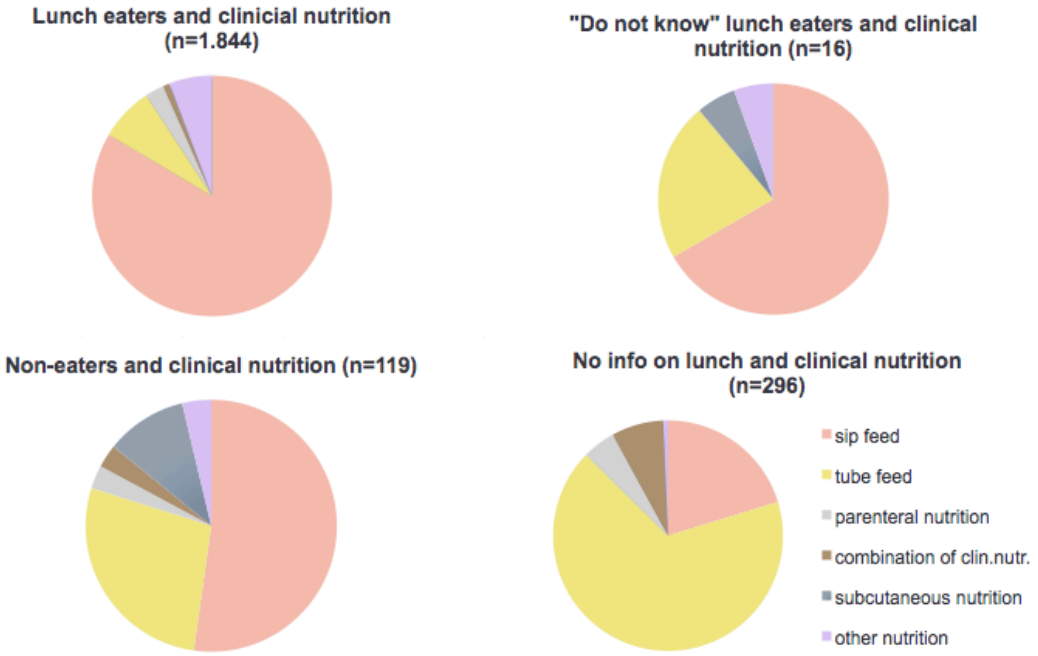


Figure 54: Percentage proportions of kind of clinical nutrition and information on lunch eaten (number of residents with clinical nutrition in brackets)

3.3. Outcome

The collection of outcome data was a very important part of the nutritionDay project. Outcome data were gathered six months after nutritionDay. On that day, participating centers filled in data according to a list of residents that was created on nutritionDay. This list clearly identified the residents that were in the unit six months before. For outcome, the actual location or status (for example, whether the resident was still in the nursing home, had died or been transferred) of the respective resident was noted as well as the date of transfer, death, etc. Furthermore, the actual weight was filled in and the number of hospital stays in the last six months was requested.

Outcome data were recorded for 54.4% (n=10 422) of the residents. The response rates differed in the various countries/regions, with Austria contributing the most (87.8%) and Hungary the least data (31.9%) per total participants (Figure 56). As listed in Table 28, the main part of the residents were still in the NH (85%), 1.1% of the residents were transferred to another unit or NH, 1.2% were discharged home and 12.1% died within the six month period. Figure 57 shows that the outcome was similar in all regions/countries.

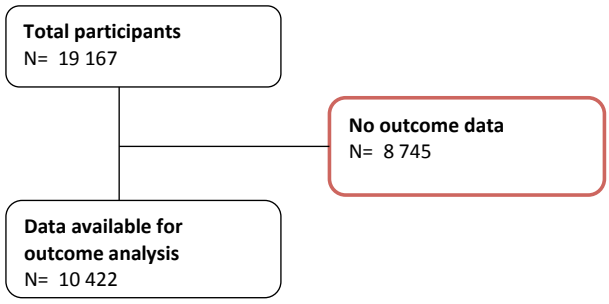


Figure 55: Flow diagram of outcome analysis

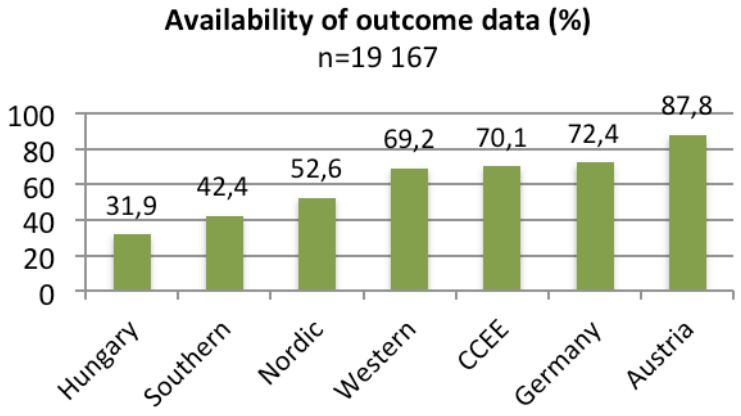


Figure 56: Availability of outcome data per country/region in percent of participants

Outcome six months after nutritionDay			
	Frequency	Percent	Valid percent
still in NH	8 854	46.2	85
transferred	113	0.6	1.1
discharged home	121	0.6	1.2
death	1 262	6.6	12.1
others	72	0.4	0.7
Total	10 422	54.4	100
Missing	8 745	45.6	
Total	19 167	100	

Table 27: Outcome six months after nutritionDay; total counts; percent; valid percent

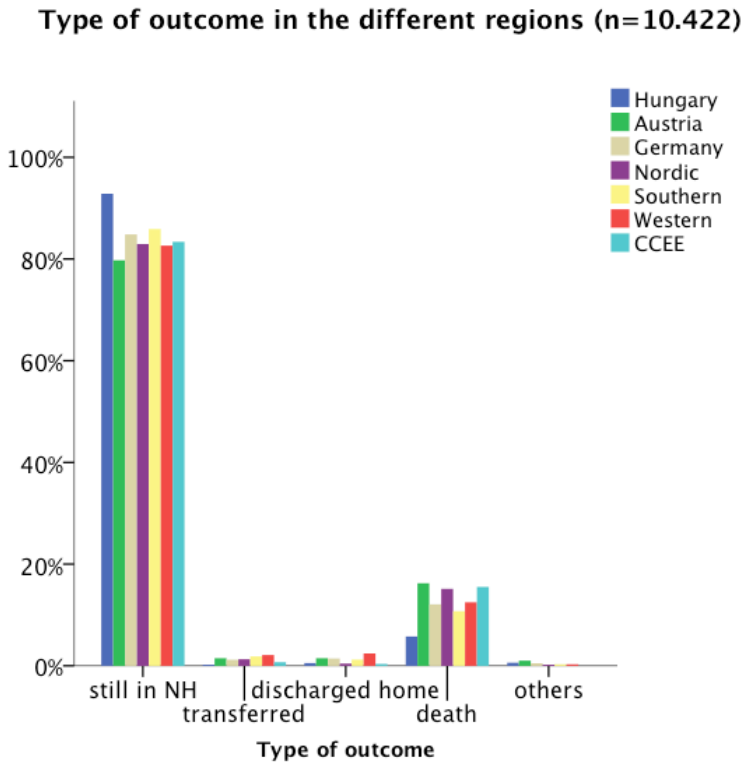


Figure 57: Type of outcome in different countries/regions in percent

As shown in Table 28, 15% of the outcome population had at least one hospital stay during half a year. On average, there were 1.9 hospital days per resident, respectively 6% of the population was in hospital for at least one week.

Another question that arose was whether the malnourished spent more time in hospital than residents with a normal nutritional status (Table 29). Residents with a BMI<20 didn´t have more hospital stays than the residents with a BMI≥22. A difference in hospital stays between people who ate less lunch on ND versus who ate normal portions wasn´t shown either. Significant differences regarding hospitalisation were observed for the question of intake during the previous week. Residents that ate less in the week before ND were significantly (p<0.001) more often in hospital during the outcome period compared to those that had a normal appetite. Furthermore, weight loss before ND was significantly associated with more frequent hospital stays during the outcome period (p=0.024).

Hospital stays during outcome period (n=10 422)			
Valid answers hospital stays	7 376	70.8%	
Mean hospital stays	0.303 ± 0.79	0;15 (min;max)	
≥ 1 hospital stay (n)	1 567	21.2%	15% of all
≥ 2 hospital stays (n)	398	5.4%	3.8% of all
Valid answers hospital days	6 057	58.1%	
Mean hospital days	1.931 ± 6.1	0;120 (min;max)	
≥ 7 hospital days (n)	630	10.4%	6% of all
Total hospital days	11 694		

Table 28: Hospital stays during the six month outcome period; min=minimum; max=maximum

Do malnourished have more hospital stays during outcome period?		
	t-test (p<.05)	
BMI<20 vs. BMI≥22	no	-
Lunch eaten on ND (less vs. normal)	yes	n.s.
Appetite in week before ND (less vs. normal)	yes	p<0.0001
Lost weight before ND (yes vs. no)	yes	p=0.024

Table 29: Hospital stays during outcome period in malnourished versus normally nourished residents; n.s.=not significant; p=calculated probability

The 8 857 residents that were still in the NHs documented their weight on day 0 and day 180 (after the outcome period). Thereof, 46.3% suffered weight loss (WL), respectively 9.2% WL of more than 10%. 39.1% of the residents gained weight (WG), respectively 7.1% WG of more than 10% (Table 30). Of the main parameters for malnutrition, only eating less on nutritionDay was significantly associated with weight loss during the outcome period. A higher BMI was more often related to weight loss in the follow up period compared to a BMI below 20kg/m^2. There was no significant difference in the development of weight loss whether the residents had eaten less in the near past (week before nDay) or lost weight in the previous year (Table 31). Weight loss of more than 10% varied between 6.3-11.5% of residents that were still in the NHs in the different regions/countries. Another 4.1-8.4% of the residents gained weight of at least 10% of their body weight (Table 32).

Weight changes during outcome period		
	n	
Outcome weight difference available	8 857	85%
Weight loss	4 105	46.3%
Weight loss >10%	819	9.2%
Weight gain	3 465	39.1%
Weight gain >10%	631	7.1%

Table 30: Weight changes after outcome period; total count; percentage

Do malnourished suffer more often from further weight loss during outcome period?		
	Chi^2-Test	
BMI<20 vs. BMI≥22	no, but normal nourished had more weight losses	p<0.0001
Lunch eaten on ND (less vs. normal)	yes	p<0.0001
Appetite in week before ND (less vs. normal)	no	n.s.
Lost weight before ND (yes vs. no)	no	n.s.

Table 31: Weight loss in malnourished versus normally nourished residents

Weight changes in the different countries/regions (n=8 854)				
	still in NH (n)	% weight loss >10%	% weight gain >10%	% missing data
Hungary	2 734	8.1	8.4	4.4
Austria	3 224	11.5	6.6	1.3
Germany	1 721	6.3	6.2	2.4
Nordic	389	6.9	6.4	13.9
Southern	280	10.7	6.4	1.8
Western	271	8.9	4.1	7.7
CCEE	231	7.4	6.9	10.4

Table 32: Weight changes during six month outcome period in different countries/regions

3.4. Further analyses

3.4.1. Data exclusion

In the previous chapter, the data described participants from different nursing homes all over Europe during the years 2007-2010. For further statistical analyses, quality measures were implemented. The percentage frequency of outcome evaluation was one quality criteria. Altogether, 54.4% residents' outcome data were received. The big group of Hungarian participants provided very low outcome evaluations (31.9%). At the same time, this group differed a lot from others (see Table 33). Basic data like age, gender distribution or duration of stay in the nursing home showed large differences compared to the population data of the other countries. Therefore, Hungarian data (n=9 221) were excluded for the ongoing statistical analyses.

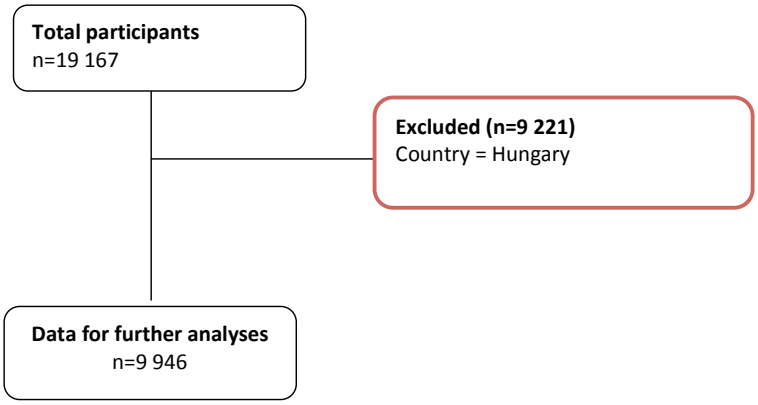


Figure 58: Flow diagram - further analyses

Differences t-test	**Hungary (n=9 221) versus all others (n=9 946)**			
	mean Hungary vs. others	**p value**	**95% CI (Lower)**	**95% CI (Upper)**
age of residents (years)	67.80 vs. 85.09	<0.001	-17.705	-16.873
duration in NH (months)	117.87 vs. 39.95	<0.001	72.7118	83.1252
beds staffed (n)	107.84 vs. 37.33	<0.001	-73.625	-67.406
chi-square test	**number Hungary vs. others**			
gender female (n)*	5788 vs. 7790	<0.001		

Table 33: Differences in basic data between residents in Hungary and other countries; CI= contingence interval

The residents included in the step-wise multivariate analysis are described shorthly in the following table. The residents were older, were more often women, had a lower mean BMI and showed a lower mean duration in the NH than the original population. The units had more beds staffed.

N	9 946
Mean age (min;max); median in years	85.09±9.89; 87
Age below 65 years (n;%)	386; 3.88
Gender female %	78.3
Mean BMI (min;max); median in kg/m^2	24.67±5.37; 24.13
N units (center)	342 (159)
N outcome (%)	7 477 (75.2)
N outcome weight difference (%)	6 131 (61.6)
Mean staffed beds (min;max); median	37.33±27.9 (5;372); 33
Mean duration in NH (min;max); median in months	39.95±82.94 (0;3624); 24

Table 34: Characteristics of population for final statistical analyses

3.4.2. First research question: What influences weight loss of more than 10% or death within six months of residents in European nursing homes?

For the method of analysis, binary logistic regression was chosen. The outcome variable was defined according to the list below. The combined outcome of "weight loss of more than 10%" and "death" within six months was defined as "bad outcome".

outcome variable characteristic, combinations	death (yes=1/no=0/missing)	10% weight loss (yes=1/no=0/missing)	**bad outcome** (combined outcome) (yes=1/no=0/missing)
	0	0	0
	1	1	1
	0	1	1
	1	0	1
	1	missing	1
	missing	1	1
	0	missing	missing
	missing	0	missing
	missing	missing	missing

Table 35: Definition of outcome variable; 1=yes,0=no

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	weight stable or gained / 0	5 387	54.2	76.2	76.2
	dead or weight loss ≥10% / 1	1 683	16.9	23.8	100.0
	Total	7 070	71.1	100.0	
Missing	System	2 876	28.9		
Total		9 946	100.0		

Table 36: Outcome variable statistics

3.4.2.1. Univariate analyses: Analyses for "Risk factors for weight loss of at least 10% or death within six months" (first research question)

For the univariate analyses (UVA), several exposure factors of the residents and the risk of dying in the nursing home or losing weight of at least 10% within 180 days were related. Table 37 shows the variables entered and the results of the analysis with the random factor "unit". The clustering of residents within nursing homes has been accounted for with the method of general estimation equations (GEE) with exchangeable covariance structure. As residents in the same NH were supplied by the same source, management and nutritional care, NH units were taken as clusters. The variables were grouped into the following categories: structure, demography, autonomy, disease relation and nutritional status. The variable "level of care" was first introduced in 2008. Therefore, this single variable is based on 2008-2010 data only. Model effects for the statistical model were checked. If the model effect was not given in the univariate analysis, the variable was not highlighted and not entered into further analyses. Factors that showed significant results in the analysis are highlighted.

Table 37

Results of univariate analysis, GEE, binary logistic regression (n=9 946), "Risk factors for weight loss or death within 6 months", all model effects tested; outcome variable: Weight loss or death within 6 months (n=7070, missing=2876), Significant results highlighted yellow

Variable	OR (95% CI)	p-Value
Structural		
number of actual staffed beds in the unit (n=7070)	0.99 (0.99-1.00)	0.341
kind of operator		
communal (n=4006)	1.0	Reference
non-profite (n=1823)	0.79 (0.67-0.92)	0.003
private (n=1241)	0.78 (0.63-0.98)	0.033
availability of a nutrition care person (n=7070)	0.99 (0.85-1.14)	0.86
nutrition procedures according guidelines (n=7070)	1.06 (0.90-1.24)	0.523
fraction of residents that need help in unit		
>=70% need help (n=1628)	1.0	Reference
51-70% need help (n=2135)	1.02 (0.85-1.21)	0.851
30-50% need help (n=1996)	0.95 (0.79-1.14)	0.586
<30% need help (n=1220)	1.04 (0.83-1.29)	0.759
missing (n=91)	0.85 (0.53-1.34)	0.474
Demographic		
gender		
male (n=1365)	1.0	Reference
female (n=5689)	0.99 (0.87-1.15)	0.994
missing (n=16)	1.6 (0.65-3.92)	0.303
age[a] (n=7067)	1.28 (1.20-1.37)	<0.0001
Autonomy		
received visits		
several times/week (n=2230)	1.0	Reference
once/week (n=1816)	0.88 (0.77-1.02)	0.079
less than once/week (n=1133)	0.91 (0.76-1.08)	0.275
less than once/month (n=576)	0.88 (0.71-1.1)	0.26
rarely or never (n=598)	0.813 (0.66-1.0)	0.055
missing (n=717)	0.96 (0.78-1.19)	0.724
mobility		
ambulatory (n=2076)	1.0	Reference
partially mobile (n=2634)	1.61 (1.36-1.91)	<0.0001

Table 37 continued

Variable	OR (95% CI)	p-Value
immobile (n=2339)	2.49 (2.13-2.91)	<0.0001
missing (n=21)	1.59 (0.55-4.56)	0.391
Disease related		
number of different daily drugs (n=7034)	1.02 (1.0-1.04)	0.022
time since unit admission in months (n=7034)	0.99 (0.99-1.0)	0.032
number of hospital stays in previous year (n=5790)	1.04 (0.97-1.11)	0.238
exsiccation		
no (n=6255)	1.0	Reference
yes (n=646)	2.01 (1.66-2.43)	<0.0001
missing (n=169)	1.02 (0.74-1.42)	0.898
contractures		
none (n=5555)	1.0	Reference
one (n=627)	1.34 (1.12-1.61)	0.002
more than one (n=888)	1.43 (1.18-1.72)	<0.0001
pressure sores		
intact skin (n=913)	1.0	Reference
blister (n=201)	1.83 (1.31-2.54)	<0.0001
superficial ulcer (n=110)	2.44 (1.65-3.63)	<0.0001
deep ulcer (n=24)	2.97 (1.30-6.77)	0.01
missing or no pressure sore (n=5822)	0.78 (0.64-0.95)	0.012
cognitive status		
normal (n=1713)	1.0	Reference
light-moderate impaired (n=3137)	1.45 (1.23-1.71)	<0.0001
severe impaired (n=2172)	2.03 (1.71-2.4)	<0.0001
missing (n=48)	1.53 (0.69-3.4)	0.295
dysphagia		
yes (n=1081)	1.0	Reference
no (n=5897)	0.49 (0.43-0.56)	<0.0001
missing (n=92)	0.2 (0.11-0.36)	<0.0001
chewing problems		
yes (n=1534)	1.0	Reference
no (n=5444)	0.5 (0.44-0.57)	<0.0001
missing (n=92)	0.25 (0.13-0.47)	<0.0001
psychoactive substances (antidepressants)		

Table 37 continued

Variable	OR (95% CI)	p-Value
no (n=3690)	0.99 (0.89-1.11)	0.86
missing (n=65)	0.52 (0.26-1.06)	0.07
antibiotics		
yes (n=296)	1.0	Reference
no (n=6709)	0.56 (0.46-0.7)	<0.0001
missing (n=65)	0.3 (0.13-0.69)	0.005
opiates		
yes (n=869)	1.0	Reference
no (n=6113)	0.62 (0.52-0.73)	<0.0001
missing (n=88)	0.42 (0.22-0.83)	0.012
Nutritional status		
BMI in five categories		
22-29.99 kg/m^2 (n=3619)	1.0	Reference
<20 kg/m^2 (n=1283)	1.61 (1.35-1.91)	<0.0001
20-21.99 kg/m^2 (n=1010)	1.14 (0.96-1.34)	0.13
30-34.99 kg/m^2 (n=794)	0.8 (0.65-0.99)	0.039
>35 kg/m^2 (n=262)	0.88 (0.63-1.24)	0.475
missing (n=102)	1.53 (0.87-2.7)	0.144
malnutrition evaluation by staff		
no (n=5075)	1.0	Reference
at risk (n=1105)	1.65 (1.43-1.9)	<0.0001
yes (n=736)	2.28 (1.88-2.78)	<0.0001
missing (n=154)	0.84 (0.5-1.41)	0.51
diet		
normal (n=4486)	1.0	Reference
blenderized (n=1061)	2.19 (1.87-2.57)	<0.0001
fortified (n=477)	2.07 (1.68-2.56)	<0.0001
other special (n=832)	1.08 (0.87-1.34)	0.484
none (n=132)	2.16 (1.5-3.11)	<0.0001
missing (n=82)	1.64 (1.02-2.63)	0.041
weight loss in previous year		
yes (n=2448)	1.0	Reference
no (n=2070)	0.62 (0.54-0.71)	<0.0001
no, gained weight (n=1577)	0.5 (0.42-0.58)	<0.0001

Table 37 continued

Variable	OR (95% CI)	p-Value
missing (n=321)	0.93 (0.69-1.24)	0.601
amount eaten during last week		
as usual (n=5130)	1.0	Reference
a bit less than usual (n=1076)	1.97 (1.69-2.3)	<0.0001
less than half of usual (n=261)	3.04 (2.35-3.94)	<0.0001
less than a quarter to nearly nothing (n=94)	7.55 (4.83-11.8)	<0.0001
do not know (n=130)	2.41 (1.66-3.5)	<0.0001
missing (n=379)	1.76 (1.43-2.18)	<0.0001
fraction of meal eaten on nutritionDay		
all (n=4177)	1.0	Reference
half (n=1753)	1.92 (1.68-2.19)	<0.0001
quarter (n=554)	2.73 (2.23-3.35)	<0.0001
nothing (n=197)	4.64 (3.44-6.26)	<0.0001
do not know (n=39)	2.79 (1.54-5.05)	0.001
missing (n=350)	2.52 (2.0-3.18)	<0.0001
number of drinks at lunch on nutritionDay (n=6249)	1.48 (1.02-2.14)	0.039
*level of care**		
less than 45 min (n=669)	1.0	Reference
45-119 min (n=914)	1.64 (1.21-2.23)	0.001
120-239 min (n=1241)	2.0 (1.48-2.72)	<0.0001
more than 240 min (n=2860)	2.17 (1.62-2.91)	<0.0001
missing (n=51)	3.08 (1.59-5.98)	0.001

[a] OR for 10 years.
* level of care (n=7869, data 2008-2010, not to be entered in MVA)

Table 37: Results of univariate analyses, GEE, binary logistic regression (n=9,946), "Risk factors for weight loss or death within 6 months", all model effects tested; outcome variable: Weight loss or death within 6 months (n=7070, missing=2876), Significant results highlighted yellow

3.4.2.2. Multivariate model: Analysis for "Risk factors for weight loss of at least 10% or death within six months" (first research question)

All significant variables of the univariate analyses (highlighted yellow) were entered into a multivariate analysis (MVA). One factor was related to demography (age), nine factors analysed to diseases (occurrence of contractures, pressure sores, cognitive restrictions, dysphagia, chewing problems, number of months that the residents had already spent in nursing home before nutritionDay, number of drugs taken daily, receipt of antibiotics, receipt of opiates), one factor related to the ward (kind of operator), one factor concerned resident's autonomy (mobility), and seven indicators related to nutritional status (BMI in five categories, malnutrition evaluation by staff, kind of diet received, weight change in last year before nutritionDay, amount eaten during the last week, fraction of meal eaten on nutritionDay, number of drinks at lunch on nutritionDay). Model effects were tested. Significant results are highlighted yellow.

Table 38

Multivariate analysis, GEE, binary logistic regression (n=9,946), Risk factors for weight loss or death within 6 months, Outcome variable: Weight loss or death within 6 months (included: n=6192, excluded: n=3754)

Variable	HR (95% CI)	p-Value	
Structural			
kind of operator			
communal (n=3534)	1.0	Reference	
non-profite (n=1591)	0.96 (0.77-1.21)	0.741	
private (n=1067)	0.85 (0.7-1.03)	0.093	
Demographic			
age[a] (n=6192)	1.28 (1.18-1.38)	<0.0001	
Autonomy			
mobility			
ambulatory (n=1876)	1.0	Reference	
partially mobile (n=2359)	1.28 (1.06-1.53)	0.009	
immobile (n=1939)	1.39 (1.13-1.71)	0.002	
missing (n=18)	1.19 (0.35-4.06)	0.779	
Disease related			
number of different daily drugs (n=6192)	1.04 (1.02-1.06)	0.001	
time since unit admission in months (n=6192)	0.998 (0.996-0.999)	0.005	
exsiccation			
no (n=5512)	1.0	Reference	
yes (n=542)	1.1 (0.88-1.37)	0.412	
missing (n=138)	1.38 (0.97-1.96)	0.075	
contractures			
none (n=4961)	1.0	Reference	
one (n=526)	0.91 (0.72-1.14)	0.393	
more than one (n=705)	0.91 (0.72-1.17)	0.469	
pressure sores			
intact skin (n=775)	1.0	Reference	**Model effect!**
blister (n=165)	1.35 (0.92-1.99)	0.126	
superficial ulcer (n=88)	1.58 (0.99-2.53)	0.055	
deep ulcer (n=20)	1.33 (0.44-4.03)	0.611	
missing or no pressure sore (n=5144)	0.85 (0.67-1.07)	0.161	

Table 38 continued

Variable	HR (95% CI)	p-Value	
cognitive status			
normal (n=1525)	1.0	Reference	
light-moderate impaired (n=2819)	1.26 (1.06-1.5)	0.011	
severe impaired (n=1826)	1.43 (1.17-1.74)	<0.0001	
missing (n=22)	0.94 (0.27-3.31)	0.926	
dysphagia			
yes (n=802)	1.0	Reference	
no (n=5324)	0.81 (0.67-0.98)	0.033	**No model effect!**
missing (n=66)	0.36 (0.06-2.06)	0.252	
chewing problems			
yes (n=1223)	1.0	Reference	
no (n=4903)	0.88 (0.72-1.08)	0.211	
missing (n=66)	0.61 (0.13-2.91)	0.531	
antibiotics			
yes (n=246)	1.0	Reference	
no (n=5897)	0.72 (0.57-0.91)	0.006	
missing (n=49)	0.24 (0.08-0.78)	0.017	
opiates			
yes (n=721)	1.0	Reference	**No model effect!**
no (n=5403)	0.8 (0.65-0.97)	0.024	
missing (n=68)	0.8 (0.33-1.96)	0.625	
Nutritional status			
BMI in five categories			
22-29.99 kg/m^2 (n=3202)	1.0	Reference	**No model effect!**
<20 kg/m^2 (n=1082)	0.94 (0.76-1.17)	0.596	
20-21.99 kg/m^2 (n=869)	0.79 (0.66-0.95)	0.011	
30-34.99 kg/m^2 (n=716)	1.05 (0.82-1.35)	0.681	
>35 kg/m^2 (n=237)	1.33 (0.92-1.93)	0.129	
missing (n=86)	1.15 (0.59-2.23)	0.681	
malnutrition evaluation by staff			
no (n=4508)	1.0	Reference	
at risk (n=957)	1.11 (0.92-1.35)	0.279	
yes (n=599)	1.17 (0.9-1.52)	0.253	
missing (n=128)	0.95 (0.53-1.69)	0.859	

Table 38 continued

Variable	HR (95% CI)	p-Value
diet		
normal (n=4074)	1.0	Reference
blenderized (n=905)	1.32 (1.07-1.64)	0.011
fortified (n=413)	1.32 (1.01-1.71)	0.04
other special (n=738)	1.06 (0.83-1.34)	0.659
none (n=11)	0.38 (0.1-1.39)	0.143
missing (n=51)	1.52 (0.79-2.93)	0.212
weight loss in previous year		
yes (n=2172)	1.0	Reference
no (n=1833)	0.94 (0.8-1.11)	0.47
no, gained weight (n=1403)	0.84 (0.7-1.54)	0.062
do not know (n=591)	1.21 (0.95-1.54)	0.128
missing (n=193)	1.03 (0.71-1.49)	0.875
amount eaten during last week		
as usual (n=4690)	1.0	Reference
a bit less than usual (n=979)	1.39 (1.17-1.66)	<0.0001
less than half of usual (n=224)	1.56 (1.14-2.13)	0.005
less than a quarter to nearly nothing (n=68)	3.42 (1.84-6.34)	<0.0001
do not know (n=108)	1.56 (1.06-2.28)	0.023
missing (n=123)	0.94 (0.57-1.55)	0.809
fraction of meal eaten on nutritionDay		
all (n=3937)	1.0	Reference
half (n=1600)	1.65 (1.43-1.9)	<0.0001
quarter (n=476)	1.82 (1.43-1.9)	<0.0001
nothing (n=129)	2.9 (1.96-4.29)	<0.0001
do not know (n=13)	1.68 (0.53-5.36)	0.378
missing (n=37)	1.24 (0.54-2.88)	0.613
number of drinks at lunch on nutritionDay (n=6192)	0.98 (0.91-1.05)	0.521
2008-2010 (n=7869)		
level of care	**No data!**	

[a] HR for 10 years.

Table 38: Results of the multivariate analysis with outcome "Weight loss or death within 6 months", GEE, binary logistic regression (n=9,946), (included: n=6192, excluded: n=3754) variables highlighted yellow show significant results; [a] HR for 10 years.

The following (highlighted) predicting factors remained significant for the outcome variable "weight loss of at least 10% or death within six months" independent of any other factors:

- age
- mobility
- unit admission
- drug intake
- pressure sores (effect only for whole model)
- cognitive status
- antibiotics
- diet status
- appetite last week
- actual food intake

3.4.2.3. Sensitivity analyses for first research question

For all the above calculations, sensitivity analyses (SA) were performed with a restricted data set including only wards

- with at least 60% of residents participating on nutritionDay and
- at least 80% of outcomes recorded (=quality criteria)

For that analysis, 7 197 (72.4%) residents remained in the data set. MVA was performed and the results were compared with the results (model effects) of the basal population (Table 40).

Another sensitivity analysis was also performed

- after exclusion of 2007 data*

*2007 data were derived from the first run (pilot run). Some answer categories changed from 2007 on. For example, in 2007, there was no category "missing" for many answer possibilities, therefore "no" could have also meant "missing".

After the exclusion of 2007 data (n=2 077), data from 7 869 residents remained for the final multivariate analysis. Results of tested model effects are compared in Table 39.

Table 39

all data - no restrictions

Tests of model effects	Typ III Wald-Chi-Quadrat	df	Sig.
	37,987	1	0
age in years	34,985	1	0
mobility	10,553	3	0,014
exsiccation	3,512	2	0,173
operator	2,824	2	0,244
different drugs	11,697	1	0,001
unit admission (duration)	7,712	1	0,005
contractures	1,075	2	0,584
pressure sores	15,225	4	0,004
cognitive status	12,421	3	0,006
dysphagia	5,653	2	0,059
chewing problems	1,738	2	0,419
antibiotics	11,641	2	0,003
opiates	5,123	2	0,077
BMI grouped	10,527	5	0,062
malnutrition by staff	1,927	3	0,588
diet status	11,51	5	0,042
weight loss before nutritionDay	7,708	4	0,103
well eaten before nutritionDay	31,404	5	0
lunch eaten on nutritionDay	70,067	5	0
drinks at lunch	0,411	1	0,521
Depending variable: Bad outcome (weight loss and/or death)			

without 2007 data

Tests of model effects	Typ III Wald-Chi-Quadrat	df	Sig.
	34,103	1	0
age in years	35,542	1	0
mobility	6,574	3	0,087
exsiccation	3,501	2	0,174
operator	3,504	2	0,173
different drugs	8,709	1	0,003
unit admission (duration)	9,04	1	0,003
contractures	0,947	2	0,623
pressure sores	13,207	4	0,01
cognitive status	12,414	3	0,006
dysphagia	3,462	2	0,177
chewing problems	2,489	2	0,288
antibiotics	10,892	2	0,004
opiates	4,46	2	0,108
BMI grouped	9,722	5	0,084
malnutrition by staff	3,148	3	0,369
diet status	9,039	5	0,108
weight loss before nutritionDay	7,191	4	0,126
well eaten before nutritionDay	32,381	5	0
lunch eaten on nutritionDay	48,79	5	0
drinks at lunch	0,871	1	0,351
Depending variable: Bad outcome (weight loss and/or death)			

Quality criteria (participation 60% + outcome 80%)

Tests of model effects	Typ III Wald-Chi-Quadrat	df	Sig.
	32,087	1	0,000
age in years	31,366	1	0,000
mobility	9,976	3	0,018
exsiccation	3,798	2	0,065
operator	2,483	2	0,295
different drugs	8,403	1	0,001
unit admission (duration)	8,9	1	0,002
contractures	0,592	2	0,655
pressure sores	15,799	4	0,002
cognitive status	10,518	3	0,007
dysphagia	5,743	2	0,072
chewing problems	1,485	2	0,644
antibiotics	11,584	2	0,003
opiates	5,642	2	0,060
BMI grouped	11,85	5	0,056
malnutrition by staff	2,157	3	0,610
diet status	9,1	5	0,165
weight loss before nutritionDay	8,692	4	0,171
well eaten before nutritionDay	29,895	5	0,000
lunch eaten on nutritionDay	70,703	5	0,000
drinks at lunch	0,266	1	0,297
Depending variable: Bad outcome (weight loss and/or death)			

Table 39: Results of the sensitivity analyses: First box (beige) including all data, without restrictions; second box (blue) data without results from 2007; third box (red) data of units with at least 60% participation + 80% outcome, significant results are highlighted

The differences in model effects of the sensitivity analyses are shown in Table 39.

The first box shows the test of model effects for the multivariate analysis without any sensitivity analysis restrictions. The factors with significant results are highlighted in beige. In comparison, the “blue“ box includes the results without 2007 data. As can be seen, differences are found with regard to “mobility“ and “diet status“. These two variables were not significant once 2007 data were excluded. Other factors did not change. The “red“ box shows the results of the MVA when the quality criteria “at least 60% participation and 80% outcome data available“ were applied. The results stayed more or less the same with the exception of the risk factor “diet status“ (i.e. diet used - blenderized, fortified, etc.), which was not a significant risk factor any more.

In the next step, the outcome variable "*weight loss of more than 10% or death within six months"* was split into the two outcome variables *"death within six months"* and *"weight loss of at least 10% within six months"*. Again, UVA, MVA and SA were performed in order to receive detailed information about risk factors that are rather attributed to the one or the other "bad" outcome.

3.4.3. Second research question: What influences death of residents within six months in European nursing homes?

Outcome variable

death (yes=1/no=0/missing)
0
1
missing

3.4.3.1. Univariate analysis for "Risk factors for death within six months"

Table 40
Univariate analysis for "risk of death within 6 months" GEE, binary logistic regression (n=9 946), all model effects tested; Outcome variable: Death within 6 months (n=7 477, missing=2 469)

Variable	OR (95% CI)	p-Value
Structural		
number of actual staffed beds in the unit (n=7477)	1.00 (0.996-1.003)	0.836
kind of operator		
communal (n=4267)	1.0	Reference
non-profite (n=1300)	0.69 (0.55-0.87)	0.002
private (n=1908)	0.78 (0.66-0.92)	0.003
availability of a nutrition care person (n=7477)		
no or missing(n=3954)	1.0	Reference
yes (n=3523)	0.98 (0.85-1.13)	0.788
nutrition procedures according guidelines (n=7477)		
no or missing (n=1340)	1.0	Reference
yes (n=6137)	0.999 (0.82-1.22)	0.995
fraction of residents that need help in unit		
>=70% need help (n=1731)	1.0	Reference
51-70% need help (n=2240)	1.02 (0.84-1.23)	0.835
30-50% need help (n=2094)	0.93 (0.76-1.14)	0.508
<30% need help (n=1321)	0.98 (0.79-1.22)	0.881
missing (n=91)	0.65 (0.30-1.39)	0.265

Table 40 continued

Variable	OR (95% CI)	p-Value
Demographic		
gender		
male (n=1460)	1.0	Reference
female (n=6001)	0.89 (0.76-1.04)	0.136
missing (n=16)	2.57 (1.06-6.23)	0.036
age[a] (n=7474)	1.48 (1.37-1.61)	<0.0001
Autonomy		
received visits		
several times/week (n=2364)	1.0	Reference
once/week (n=1907)	0.82 (0.69-0.98)	0.024
less than once/week (n=1203)	0.95 (0.78-1.15)	0.575
less than once/month (n=599)	0.99 (0.77-1.26)	0.920
rarely or never (n=631)	0.77 (0.59-0.99)	0.039
missing (n=773)	1.07 (0.83-1.39)	0.599
mobility		
ambulatory (n=2205)	1.0	Reference
partially mobile (n=2775)	1.83 (1.48-2.27)	<0.0001
immobile (n=2472)	3.12 (2.58-3.77)	<0.0001
missing (n=25)	1.12 (0.31-3.98)	0.864
Disease related		
number of different daily drugs (n=7437)	1.01 (0.99-1.03)	0.241
time since unit admission in months (n=7438)	0.999 (0.997-1.0)	0.166
number of hospital stays in previous year (n=6177)	1.06 (0.98-1.14)	0.140
exsiccation		
no (n=6608)	1.0	Reference
yes (n=678)	2.38 (1.93-2.93)	<0.0001
missing (n=191)	0.85 (0.50-1.42)	0.526
contractures		
none (n=5880)	1.0	Reference
one (n=649)	1.52 (1.24-1.87)	<0.0001
more than one (n=948)	1.50 (1.24-1.80)	<0.0001
pressure sores		
intact skin (n=945)	1.0	Reference
blister (n=212)	1.91 (1.32-2.75)	0.001
superficial ulcer (n=119)	2.48 (1.65-3.74)	<0.0001
deep ulcer (n=27)	2.91 (1.23-6.86)	0.015
missing or no pressure sore (n=6174)	0.71 (0.58-0.88)	0.002
cognitive status		
normal (n=1855)	1.0	Reference
light-moderate impaired (n=3274)	1.45 (1.18-1.77)	<0.0001
severe impaired (n=2294)	2.10 (1.72-2.56)	<0.0001
missing (n=54)	1.13 (0.47-2.71)	0.786

Table 40 continued

Variable	OR (95% CI)	p-Value
dysphagia		
yes (n=1135)	1.0	Reference
no (n=6247)	0.43 (0.37-0.50)	<0.0001
missing (n=95)	0.14 (0.06-0.34)	<0.0001
chewing problems		
yes (n=1617)	1.0	Reference
no (n=5765)	0.46 (0.40-0.53)	<0.0001
missing (n=95)	0.17 (0.07-0.37)	<0.0001
psychoactive substances (antidepressants)		
yes (n=3486)	1.0	Reference
no (n=3917)	1.14 (0.99-1.31)	0.068
missing (n=74)	0.61 (0.25-1.45)	0.261
antibiotics		
yes (n=315)	1.0	Reference
no (n=7094)	0.56 (0.44-0.72)	<0.0001
missing (n=68)	0.42 (0.16-1.12)	0.082
opiates		
yes (n=922)	1.0	Reference
no (n=6464)	0.58 (0.48-0.69)	<0.0001
missing (n=91)	0.47 (0.23-0.96)	0.039
Nutritional status		
BMI in five categories		
22-29.99 kg/m^2 (n=3799)	1.0	Reference
<20 kg/m^2 (n=1333)	2.37 (1.99-2.83)	<0.0001
20-21.99 kg/m^2 (n=1049)	1.38 (1.13-1.67)	0.001
30-34.99 kg/m^2 (n=834)	0.69 (0.53-0.90)	0.006
>35 kg/m^2 (n=269)	0.55 (0.35-0.89)	0.012
missing (n=193)	1.05 (0.65-1.69)	0.837
malnutrition evaluation by staff		
no (n=5381)	1.0	Reference
at risk (n=1153)	2.18 (1.87-2.55)	<0.0001
yes (n=769)	3.20 (2.61-3.93)	<0.0001
missing (n=174)	0.88 (0.52-1.49)	0.642
diet		
normal (n=4764)	1.0	Reference
blenderized (n=1121)	2.52 (2.15-2.95)	<0.0001
fortified (n=485)	2.55 (2.04-3.18)	<0.0001
other special (n=883)	1.25 (0.99-1.59)	0.066
none (n=138)	2.46 (1.65-3.66)	<0.0001
missing (n=86)	2.20 (1.29-3.78)	0.004

Table 40 continued

Variable	OR (95% CI)	p-Value
weight loss in previous year		
yes (n=2574)	1.0	Reference
no (n=2184)	0.56 (0.48-0.66)	<0.0001
no, gained weight (n=1639)	0.48 (0.39-0.59)	<0.0001
do not know (n=730)	0.76 (0.62-0.93)	0.008
missing (n=350)	1.00 (0.72-1.40)	0.982
amount eaten during last week		
as usual (n=5403)	1.0	Reference
a bit less than usual (n=1145)	1.88 (1.57-2.26)	<0.0001
less than half of usual (n=279)	3.26 (2.46-4.32)	<0.0001
less than a quarter to nearly nothing (n=97)	8.40 (5.60-12.59)	<0.0001
do not know (n=138)	2.42 (1.71-3.43)	<0.0001
missing (n=415)	2.03 (1.58-2.61)	<0.0001
fraction of meal eaten on nutritionDay		
all (n=4427)	1.0	Reference
half (n=1843)	1.99 (1.72-2.31)	<0.0001
quarter (n=580)	2.72 (2.22-3.32)	<0.0001
nothing (n=208)	5.31 (3.96-7.10)	<0.0001
do not know (n=39)	3.21 (1.59-6.45)	0.001
missing (n=380)	2.91 (2.26-3.76)	<0.0001
number of drinks at lunch on nutritionDay (n=6590)	0.91 (0.78-1.06)	0.241
2008-2010 (n=6064)		
level of care		
less than 45 min (n=724)	1.0	Reference
45-119 min (n=974)	1.69 (1.16-2.46)	0.006
120-239 min (n=1334)	1.98 (1.40-2.81)	<0.0001
more than 240 min (n=2972)	2.29 (1.65-3.18)	<0.0001
missing (n=60)	3.10 (1.59-6.04)	0.001

[a] OR for 10 years.

Table 40: Univariate analysis for "risk of death within 6 months" GEE, binary logistic regression (n=9 946), all model effects tested; Outcome variable: Death within 6 months (n=7 477, missing=2 469)

3.4.3.2. Multivariate analysis for “Risk factors for death within six months“

Table 41
Results of the MVA on "death within six months", GEE, binary logistic regression (n=7 474), Outcome variable: Death within 6 months, significant results highlighted yellow

Variable	OR (95% CI)	p-Value	
Structural			
kind of operator			
communal (n=4266)	1.0	Reference	
non-profite (n=1908)	0.87 (0.72-1.06)	0.159	
private (n=1300)	0.85 (0.68-1.08)	0.188	
Demographic			
gender			
male (n=1459)	1.0	Reference	
female (n=5999)	0.62 (0.52-0.75)	<0.0001	
missing (n=16)	2.18 (0.77-6.14)	0.141	
age[a] (n=7474)	1.43 (1.31-1.56)	<0.0001	
Autonomy			
mobility			
ambulatory (n=2204)	1.0	Reference	
partially mobile (n=2774)	1.52 (1.22-1.90)	<0.0001	
immobile (n=2471)	1.78 (1.42-2.25)	<0.0001	
missing (n=25)	1.17 (0.29-4.67)	0.829	
Disease related			
exsiccation			
no (n=6605)	1.0	Reference	
yes (n=678)	1.13 (0.91-1.40)	0.284	
missing (n=191)	1.05 (0.65-1.70)	0.848	
contractures			
none (n=5879)	1.0	Reference	
one (n=648)	0.91 (0.73-1.15)	0.435	
more than one (n=947)	0.77 (0.62-0.97)	0.024	**No model effect!**
pressure sores			
intact skin (n=943)	1.0	Reference	
blister (n=212)	1.20 (0.81-1.77)	0.372	
superficial ulcer (n=119)	1.45 (0.93-2.26)	0.099	**Model effect!**
deep ulcer (n=27)	1.66 (0.6-4.59)	0.33	
missing or no pressure sore (n=6173)	0.79 (0.62-0.99)	0.039	
cognitive status			
normal (n=1855)	1.0	Reference	
light-moderate impaired (n=3273)	1.15 (0.93-1.42)	0.202	
severe impaired (n=2292)	1.21 (0.97-1.50)	0.096	
missing (n=54)	0.92 (0.33-2.57)	0.869	

Table 41 continued

Variable	OR (95% CI)	p-Value	
dysphagia			
yes (n=1135)	1.0	Reference	
no (n=6244)	0.80 (0.66-0.99)	0.036	**No model effect!**
missing (n=95)	0.53 (0.08-3.65)	0.518	
chewing problems			
yes (n=1617)	1.0	Reference	
no (n=5762)	0.97 (0.80-1.17)	0.745	
missing (n=95)	0.45 (0.07-2.70)	0.381	
antibiotics			
yes (n=315)	1.0	Reference	
no (n=7091)	0.66 (0.51-0.85)	0.002	
missing (n=68)	0.43 (0.13-1.43)	0.169	
opiates			
yes (n=922)	1.0	Reference	
no (n=6461)	0.78 (0.63-0.96)	0.019	**No model effect!**
missing (n=91)	0.84 (0.34-2.08)	0.701	
Nutritional status			
BMI in five categories			
22-29.99 kg/m^2 (n=3799)	1.0	Reference	
<20 kg/m^2 (n=1331)	1.3 (1.05-1.60)	0.014	**No model effect!**
20-21.99 kg/m^2 (n=1048)	0.96 (0.79-1.18)	0.716	
30-34.99 kg/m^2 (n=834)	0.96 (0.72-1.28)	0.774	
>35 kg/m^2 (n=269)	0.92 (0.58-1.45)	0.704	
missing (n=193)	0.97 (0.62-1.52)	0.899	
malnutrition evaluation by staff			
no (n=5381)	1.0	Reference	
at risk (n=1151)	1.27 (1.05-1.52)	0.012	
yes (n=768)	1.31 (1.02-1.68)	0.034	
missing (n=174)	0.85 (0.47-1.53)	0.581	
diet			
normal (n=4763)	1.0	Reference	
blenderized (n=1120)	1.39 (1.13-1.70)	0.002	
fortified (n=485)	1.29 (1.01-1.65)	0.041	
other special (n=882)	1.22 (0.95-1.57)	0.124	
none (n=138)	1.04 (0.62-1.74)	0.881	
missing (n=86)	1.71 (0.89-3.27)	0.109	
weight loss in previous year			
yes (n=2571)	1.0	Reference	
no (n=2184)	0.96 (0.80-1.15)	0.628	
no, gained weight (n=1639)	0.93 (0.74-1.17)	0.552	
do not know (n=730)	1.06 (0.83-1.34)	0.643	
missing (n=350)	1.35 (0.93-1.96)	0.11	

Table 41 continued

Variable	OR (95% CI)	p-Value
amount eaten during last week		
as usual (n=5400)	1.0	Reference
a bit less than usual (n=1145)	1.31 (1.06-1.61)	0.011
less than half of usual (n=279)	1.63 (1.19-2.24)	0.002
less than a quarter to nearly nothing (n=97)	2.86 (1.8-4.54)	<0.0001
do not know (n=138)	1.36 (0.95-1.93)	0.089
missing (n=415)	0.93 (0.59-1.45)	0.735
fraction of meal eaten on nutritionDay		
all (n=4425)	1.0	Reference
half (n=1842)	1.56 (1.33-1.83)	<0.0001
quarter (n=580)	1.71 (1.36-2.16)	<0.0001
nothing (n=208)	2.58 (1.89-3.53)	<0.0001
do not know (n=39)	1.77 (0.8-3.95)	0.158
missing (n=380)	2.42 (1.66-3.52)	<0.0001

[a] OR for 10 years.

Table 41: Results of the MVA on "death within six months", GEE, binary logistic regression (n=7 474), Outcome variable: Death within 6 months

The following factors influenced the outcome variable “death within six months“ significantly, independent of any other factors:

- gender
- age
- mobility
- pressure sores
- antibiotics
- malnutrition according staff
- diet
- appetite in week before
- lunch on nutritionDay

All results stayed the same when the data from 2007 were excluded for the sensitivity analyses. In consideration of the quality criteria (60% participation and 80% outcome), the factors “malnutrition evaluated by staff“ as well as “diet status“ fell out of the significant range (Table 42).

3.4.3.3. Sensitivity analyses for second research question

Table 42

All data - no restrictions

Tests of model effects	Typ III Wald-Chi-Quadrat	df	Sig.
(Intercept)	63,508	1	0
operator	3,094	2	0,213
sex	30,403	2	0
age in years	62,298	1	0
mobility	25,214	3	0
exsiccation	1,148	2	0,563
contractures	5,173	2	0,075
pressure sores	17,209	4	0,002
cognitive status	2,883	3	0,41
dysphagia	4,46	2	0,108
chewing problems	0,819	2	0,664
antibiotics	11,204	2	0,004
opiates	5,496	2	0,064
BMI grouped	8,255	5	0,143
malnutrition by staff	8,32	3	0,04
diet status	13,171	5	0,022
weight loss before nutritionDay	4,024	4	0,403
well eaten before nutritionDay	35,199	5	0
lunch eaten on nutritionDay	57,997	5	0
Dependent variable: death yes/no or missing			

without 2007 data

Tests of model effects	Typ III Wald-Chi-Quadrat	df	Sig.
(Intercept)	64,811	1	0
operator	3,743	2	0,154
sex	20,275	2	0
age in years	70,112	1	0
mobility	18,416	3	0
exsiccation	0,198	2	0,906
contractures	5,012	2	0,082
pressure sores	14,74	4	0,005
cognitive status	4,007	3	0,261
dysphagia	3,122	2	0,21
chewing problems	0,901	2	0,637
antibiotics	11,199	2	0,004
opiates	5,474	2	0,065
BMI grouped	9,185	5	0,102
malnutrition by staff	9,709	3	0,021
diet status	12,44	5	0,029
weight loss before nutritionDay	5,676	4	0,225
well eaten before nutritionDay	31,938	5	0
lunch eaten on nutritionDay	44,598	5	0

Quality criteria (participation 60% + outcome 80%)

Tests of model effects			
	Typ III Wald-Chi-Quadrat	df	Sig.
(Intercept)	52,03	1	0
operator	2,157	2	0,34
sex	24,796	2	0
age in years	53,997	1	0
mobility	26,053	3	0
exsiccation	1,403	3	0,496
contractures	4,051	2	0,132
pressure sores	20,372	4	0
cognitive status	2,111	3	0,55
dysphagia	4,166	2	0,125
chewing problems	0,635	2	0,728
antibiotics	12,241	2	0,002
opiates	5,696	2	0,058
BMI grouped	9,255	5	0,099
malnutrition by staff	7,652	3	0,054
diet status	9,477	5	0,091
weight loss before nutritionDay	3,842	4	0,428
well eaten before nutritionDay	39,541	5	0
lunch eaten on nutritionDay	56,997	5	0
Dependent variable: death yes/no or missing			

Table 42: Sensitivity analyses for outcome "Risk of death within 6 months": First box (beige) including all data, without restrictions; second box (blue) data without results from 2007; third box (red) data of units with at least 60% participation + 80% outcome; significant results are highlighted

3.4.4. Third research question: What influences weight loss of 10% of residents within six months in European nursing homes?

outcome variable

weight loss (yes=1/no=0/missing)
0
1
missing, because of death
missing

3.4.4.1. Univariate analysis for "Risk factors for weight loss of at least 10% within six months"

Table 43
UVA for "risk of weight loss of at least 10% in six months", GEE, binary logistic regression (n=9 946), all model effects tested, Outcome variable: Weight loss of at least 10% within 6 months (n=6132, missing=3814)

Variable	OR (95% CI)	p-Value
Structural		
number of actual staffed beds in the unit (n=6132)	0.99 (0.995-1.002)	0.488
kind of operator		
communal (n=3408)	1.0	Reference
non-profite (n=1602)	1.18 (0.93-1.50)	0.164
private (n=1122)	1.08 (0.76-1.55)	0.664
availability of a nutrition care person (n=6132)		
no or missing(n=3228)	1.0	Reference
yes (n=2904)	0.99 (0.77-1.24)	0.919
nutrition procedures according guidelines		
no or missing (n=1051)	1.0	Reference
yes (n=5081)	1.31 (0.97-1.76)	0.078
fraction of residents that need help in unit		
>=70% need help (n=1420)	1.0	Reference
51-70% need help (n=1890)	0.99 (0.75-1.34)	0.993
30-50% need help (n=1708)	1.08 (0.77-1.50)	0.666
<30% need help (n=1029)	1.11 (0.79-1.58)	0.543
missing (n=85)	0.95 (0.55-1.67)	0.867
Demographic		
gender		
male (n=1174)	1.0	Reference
female (n=4947)	1.29 (1.02-1.64)	0.036
age[a] (n=6129)	1.05 (0.95-1.15)	0.342

Table 43 continued

Variable	OR (95% CI)	p-Value
Autonomy		
received visits		
several times/week (n=1907)	1.0	Reference
once/week (n=1604)	1.02 (0.81-1.30)	0.848
less than once/week (n=980)	0.84 (0.63-1.13)	0.254
less than once/month (n=497)	0.78 (0.55-1.10)	0.149
rarely or never (n=534)	0.91 (0.65-1.27)	0.561
missing (n=610)	0.69 (0.48-1.01)	0.053
mobility		
ambulatory (n=1944)	1.0	Reference
partially mobile (n=2313)	1.35 (1.11-1.64)	0.003
immobile (n=1856)	1.59 (1.26-2.01)	<0.001
missing (n=19)	1.72 (0.43-6.86)	0.442
Disease related		
number of different daily drugs (n=6102)	1.04 (1.01-1.06)	0.009
time since unit admission in months (n=6103)	0.999 (0.997-1.0)	0.129
number of hospital stays in previous year (n=4994)	0.98 (0.92-1.04)	0.443
exsiccation		
no (n=5493)	1.0	Reference
yes (n=477)	1.25 (0.93-1.68)	0.136
missing (n=162)	1.06 (0.62-1.80)	0.836
contractures		
none (n=4883)	1.0	Reference
one (n=514)	1.09 (0.79-1.50)	0.603
more than one (n=735)	1.17 (0.87-1.58)	0.302
pressure sores		
intact skin (n=754)	1.0	Reference
blister (n=141)	1.43 (0.80-2.57)	0.233
superficial ulcer (n=72)	1.54 (0.75-3.18)	0.242
deep ulcer (n=14)	1.43 (0.31-6.73)	0.648
missing or no pressure sore (n=5151)	0.87 (0.65-1.17)	0.365
cognitive status		
normal (n=1562)	1.0	Reference
light-moderate impaired (n=2750)	1.48 (1.16-1.88)	0.001
severe impaired (n=1778)	1.72 (1.32-2.24)	<0.001
missing (n=42)	1.91 (0.74-4.92)	0.180
dysphagia		
yes (n=828)	1.0	Reference
no (n=5212)	0.75 (0.60-0.93)	0.009
missing (n=92)	0.36 (0.15-0.84)	0.018
chewing problems		
yes (n=1206)	1.0	Reference
no (n=4835)	0.68 (0.55-0.84)	<0.001
missing (n=91)	0.43 (0.19-0.98)	0.045

Table 43 continued

Variable	OR (95% CI)	p-Value
psychoactive substances (antidepressants)		
yes (n=2894)	1.0	Reference
no (n=3176)	0.77 (0.65-0.91)	0.002
missing (n=62)	0.37 (0.13-1.05)	0.061
antibiotics		
yes (n=231)	1.0	Reference
no (n=5842)	0.63 (0.44-0.90)	0.011
missing (n=59)	0.17 (0.05-0.61)	0.006
opiates		
yes (n=691)	1.0	Reference
no (n=5351)	0.75 (0.59-0.96)	0.021
missing (n=80)	0.44 (0.18-1.05)	0.065
Nutritional status		
BMI in five categories		
22-29.99 kg/m^2 (n=3225)	1.0	Reference
<20 kg/m^2 (n=975)	0.67 (0.50-0.91)	0.010
20-21.99 kg/m^2 (n=869)	0.84 (0.65-1.10)	0.204
30-34.99 kg/m^2 (n=733)	0.96 (0.73-1.27)	0.793
>35 kg/m^2 (n=251)	1.29 (0.88-1.90)	0.189
missing (n=79)	0.55 (0.25-1.22)	0.141
malnutrition evaluation by staff		
no (n=4552)	1.0	Reference
at risk (n=911)	0.66 (0.26-1.68)	0.38
yes (n=531)	1.03 (0.77-1.38)	0.834
missing (n=138)	0.90 (0.69-1.18)	0.451
diet		
normal (n=4028)	1.0	Reference
blenderized (n=815)	1.45 (1.09-1.94)	0.011
fortified (n=382)	1.39 (0.95-1.89)	0.098
other special (n=737)	0.82 (0.60-1.11)	0.194
none (n=104)	1.48 (0.88-2.53)	0.151
missing (n=66)	0.099 (0.09-0.11)	0.462
weight loss in previous year		
yes (n=2017)	1.0	Reference
no (n=1850)	0.76 (0.61-0.95)	0.016
no, gained weight (n=1451)	0.61 (0.49-0.76)	<0.001
do not know (n=548)	0.99 (0.71-1.37)	0.935
missing (n=266)	0.67 (0.42-1.06)	0.089
amount eaten during last week		
as usual (n=4633)	1.0	Reference
a bit less than usual (n=874)	1.85 (1.50-2.28)	<0.001
less than half of usual (n=181)	2.21 (1.51-3.24)	<0.001
less than a quarter to nearly nothing (n=45)	3.25 (1.56-6.77)	0.002
do not know (n=98)	2.02 (1.20-3.39)	0.008
missing (n=301)	1.10 (0.77-1.55)	0.609

Table 43 continued

Variable	OR (95% CI)	p-Value
fraction of meal eaten on nutritionDay		
all (n=3825)	1.0	Reference
half (n=1461)	1.65 (1.36-2.02)	<0.001
quarter (n=426)	2.38 (1.72-3.31)	<0.001
nothing (n=121)	2.5 (1.47-4.25)	0.001
do not know (n=31)	1.95 (0.85-4.47)	0.114
missing (n=268)	1.51 (1.04-2.19)	0.03
number of drinks at lunch on nutritionDay (n=5491)	0.83 (0.72-0.95)	0.009
2008-2010 (n=4965)		
level of care		
less than 45 min (n=635)	1.0	Reference
45-119 min (n=808)	1.56 (1.04-2.35)	0.031
120-239 min (n=1069)	1.89 (1.32-2.71)	<0.001
more than 240 min (n=2415)	1.997 (1.42-2.82)	<0.001
missing (n=38)	2.06 (0.71-6.01)	0.186

[a] OR for 10 years.

Table 43: UVA for "risk of weight loss of at least 10% in six months", GEE, binary logistic regression (n=9 946), all model effects tested, Outcome variable: Weight loss of at least 10% within 6 months (n=6132, missing=3814)

3.4.4.2. Multivariate analyses for “Risk factors for weight loss of at least 10% within six months“

Table 44
MVA for "risk of weight loss of at least 10% in six months", GEE, binary logistic regression (n=9 946), Outcome variable: Weight loss of at least 10% within 6 months; model effects tested

Variable	OR (95% CI)	p-Value
Demographic		
gender		
male (n=1034)	1.0	Reference
female (n=4421)	1.23 (0.94-1.61)	0.135
Autonomy		
mobility		
ambulatory (n=1766)	1.0	Reference
partially mobile (n=2092)	1.18 (0.96-1.46)	0.114
immobile (n=1580)	1.15 (0.87-1.52)	0.322
missing (n=17)	2.05 (0.49-8.61)	0.325
Disease related		
number of different daily drugs (n=5455)	1.03 (0.995-1.06)	0.107

Table 44 continued

Variable	OR (95% CI)	p-Value	
cognitive status			
normal (n=1404)	1.0	Reference	
light-moderate impaired (n=2492)	1.42 (1.09-1.83)	0.008	
severe impaired (n=1527)	1.62 (1.17-2.25)	0.003	
missing (n=32)	1.65 (0.53-5.17)	0.391	
dysphagia			
yes (n=623)	1.0	Reference	
no (n=4752)	0.92 (0.65-1.31)	0.654	
missing (n=80)	0.32 (0.08-1.20)	0.091	
chewing problems			
yes (n=980)	1.0	Reference	
no (n=4396)	0.93 (0.68-1.26)	0.631	
missing (n=79)	1.41 (0.35-5.61)	0.627	
psychoactive substances (antidepressants)			
yes (n=2608)	1.0	Reference	
no (n=2799)	0.84 (0.68-1.03)	0.092	
missing (n=48)	1.26 (0.26-6.18)	0.774	
antibiotics			
yes (n=202)	1.0	Reference	
no (n=5205)	0.75 (0.51-1.10)	0.753	
missing (n=48)	0.26 (0.04-1.64)	0.151	
opiates			
yes (n=588)	1.0	Reference	
no (n=4802)	0.77 (0.59-1.01)	0.056	
missing (n=65)	0.74 (0.34-1.60)	0.439	
Nutritional status			
BMI in five categories			
22-29.99 kg/m^2 (n=2892)	1.0	Reference	
<20 kg/m^2 (n=836)	0.45 (0.32-0.63)	<0.001	
20-21.99 kg/m^2 (n=764)	0.64 (0.47-0.86)	0.003	
30-34.99 kg/m^2 (n=666)	1.19 (0.86-1.63)	0.289	
>35 kg/m^2 (n=228)	1.86 (1.21-2.85)	0.004	
missing (n=69)	0.38 (0.12-1.21)	0.1	
diet			
normal (n=3685)	1.0	Reference	
blenderized (n=720)	1.26 (0.88-1.79)	0.205	
fortified (n=336)	1.39 (0.95-2.04)	0.089	**Model effect!**
other special (n=661)	0.78 (0.57-1.08)	0.132	
missing (n=53)	0.39 (0.11-1.44)	0.159	
weight loss in previous year			
yes (n=1822)	1.0	Reference	
no (n=1654)	0.85 (0.66-1.09)	0.193	
no, gained weight (n=1302)	0.68 (0.53-0.88)	0.003	
do not know (n=502)	1.34 (0.95-1.88)	0.098	
missing (n=175)	0.89 (0.51-1.57)	0.691	

Table 44 continued

Variable	OR (95% CI)	p-Value
amount eaten during last week		
as usual (n=4273)	1.0	Reference
a bit less than usual (n=801)	1.40 (1.09-1.78)	0.007
less than half of usual (n=161)	1.51 (0.92-2.5)	0.105
less than a quarter to nearly nothing (n=33)	2.55 (0.98-6.66)	0.055
do not know (n=82)	1.52 (0.88-2.61)	0.131
missing (n=105)	0.64 (0.26-1.54)	0.315
fraction of meal eaten on nutritionDay		
all (n=3615)	1.0	Reference
half (n=1340)	1.65 (1.33-2.04)	<0.001
quarter (n=373)	2.07 (1.39-3.08)	<0.001
nothing (n=79)	2.51 (1.28-4.93)	0.008
missing (n=48)	1.01 (0.39-2.62)	0.979

[a] OR for 10 years.

Table 44: MVA for "risk of weight loss of at least 10% in six months", GEE, binary logistic regression (n=9 946), Outcome variable: Weight loss of at least 10% within 6 months; model effects tested

3.4.4.3. Sensitivity analyses for third research question

Table 45

All data - no restrictions

Tests of model effects	Typ III Wald-Chi-Quadrat	df	Sig.
(Intercept)	16,98	1	0
sex	2,23	1	0,135
mobility	3,546	3	0,315
different drugs	2,594	1	0,107
cognitive status	10,062	3	0,018
dysphagia	2,999	2	0,223
chewing problems	0,647	2	0,724
psychoactive substances	3,073	2	0,215
antibiotics	3,502	2	0,174
opiates	3,702	2	0,157
BMI grouped	37,634	5	0
diet status	9,662	4	0,047
weight loss before nutritionDay	16,704	4	0,002
well eaten before nutritionDay	12,258	5	0,031
lunch eaten on nutritionDay	28,776	4	0
number of drinks at lunch	4,566	1	0,033
Dependent variable: weight loss of at least 10% or missing			

Without 2007 data

Tests of model effects	Typ III Wald-Chi-Quadrat	df	Sig.
(Intercept)	14,767	1	0
sex	0,551	1	0,458
mobility	3,657	3	0,301
different drugs	1,765	1	0,184
cognitive status	10,021	3	0,018
dysphagia	2,92	2	0,232
chewing problems	0,932	2	0,628
psychoactive substances	1,866	2	0,393
antibiotics	3,002	2	0,223
opiates	2,648	2	0,266
BMI grouped	32,176	5	0
diet status	7,994	4	0,092
weight loss before nutritionDay	11,684	4	0,02
well eaten before nutritionDay	13,347	5	0,02
lunch eaten on nutritionDay	19,567	4	0,001
number of drinks at lunch	4,214	1	0,04
Dependent variable: weight loss of at least 10% or missing			

Quality criteria (participation 60% + outcome 80%)

Tests of model effects	Typ III Wald-Chi-	df	Sig.
(Intercept)	14,611	1	0
sex	2,075	1	0,15
mobility	1,057	3	0,787
different drugs	2,489	1	0,115
cognitive status	11,268	3	0,01
dysphagia	2,706	2	0,258
chewing problems	0,444	2	0,801
psychoactive substances	2,494	2	0,287
antibiotics	2,789	2	0,248
opiates	3,904	2	0,142
BMI grouped	28,663	5	0
diet status	7,843	4	0,097
weight loss before nutritionDay	10,079	4	0,039
well eaten before nutritionDay	13,317	5	0,021
lunch eaten on nutritionDay	27,724	4	0
number of drinks at lunch	2,39	1	0,122
Dependent variable: weight loss of at least 10% or missing			

Table 45: Sensitivity analyses for "risk of weight loss of at least 10% in six months":First box (beige) including all data, without restrictions; second box (blue) data without results from 2007; third box (red) data of units with at least 60% participation + 80% outcome; significant results are highlighted

Significant results in the multivariate analysis finally arose from the following predictor variables

- cognitive status
- BMI groups
- diet status
- weight loss in previous year
- appetite last week
- actual food intake
- drinks

After the sensitivity analyses and exclusion of 2007 data, the factor “diet status“ became insignificant. When the quality criteria were applied, moreover, the predictor variable “drinks“ was not a significant predictor variable anymore.

3.4.5. OVERVIEW: Significant results of three different multivariate analyses

In the overview below, all results of the different MVAs are compared. The two variables "well eaten before" and "lunch eaten" are continuously independent, significant risk factors for diverse outcomes.

What are the risk factors for ... within six months

...weight loss and death	...death	... weight loss
cognitive status		BMI weight loss before cognitive status
well eaten before lunch eaten	well eaten before lunch eaten	well eaten before lunch eaten
age mobility pressure sores antibiotics drugs recent unit admission	age mobility pressure sores antibiotics sex	

Table 46: Comparison of the results of three different multivariate analyses, quality criteria fullfilled

All variables of the main multivariable analysis with the outcome "weight loss or death within six months" were checked for correlations. In this analysis, only two variables, "eating last week" and "lunch eaten", showed a significant Pearson correlation coefficient of 0.511. Detailed results can be found in the appendix.

Finally, it was of interest whether the country of origin influenced the results. Therefore, the variable "country code" was additionally considered, firstly in the univariate analysis and later in the MVA with outcome "death or weight loss within six months". In the main univariate analysis, with the repeated subject code "unit code" and predictor variable "country code",the people in Germany and Portugal, in comparison to Austria, had a significantly lower risk of dying or losing weight in the nursing home (Germany OR=0.643; CI= 0.537-0.771, $p<0.0001$; Portugal OR=0.608; CI=0.555-0.667, $p<0.0001$). In the

multivariable analysis, the country of origin was not a significant predictor variable anymore.

When the “country of origin“ in addition to the “unit of origin“ in the MVA/GEE as a repeated factor in the binary logistic regression was considered, the results stayed the same.

4. Discussion

„Food and eating bring shape to a day and facilitate social interaction, as well as providing essential energy and nutrients“. Among the factors older people associate with good personal care, they ranked food and nutrition as the most important aspect. (206) In light of this, nutritionDay addresses an important theme by trying to raise awareness on nutrition and malnutrition in nursing homes. Within the last ten years, its concept has succeeded. nutritionDay has gained many participants all around the world. One aim of this thesis is to investigate nutrition-related factors that may predict bad outcomes, such as weight loss or mortality in people living in nursing homes. The overarching goal of this study is to raise awareness of simple risk factors that, if detected early enough and corrected, this could not only contribute to a better quality of life for people in residential facilities but might also help avoid serious nutrition-related outcomes such as diseases associated with malnutrition.

4.1. Risk factors for poor outcome in elderly in nursing homes

The participants in this study were not equally distributed in the different regions or countries. The largest groups of residents were from Austria, Germany and Hungary. Therefore, it is difficult to compare the results; nevertheless, tendencies can be pointed out. It was shown that the Hungarian data were different from the rest. The residents were younger, less care dependent and showed better nutritional status and outcomes after six months. Different care facility structures may be responsible for this; for example, chronic hospital beds in Hungary belong to long-term nursing care, which were not part of the evaluation. Therefore, people in Hungarian nursing homes might show a better overall health status. For Hungarian data also six months outcome data were missing. As a consequence, it was decided to exclude the data of Hungarian participants for the main analyses, which are discussed in the following paragraphs.

A "bad outcome" was defined as "weight loss of at least 10% or death within 6 months." Risk factors for a bad outcome for residents in nursing homes were impaired cognitive function, reduced nutritional intake in the previous week and on the same day, higher age, reduced mobility, severe pressure sores, use of antibiotics and multimedication, and a short

time period since unit admission. All these factors were significant and independent predictors for a bad outcome in the multivariable analysis (see table 48).

In addition, a multivariable analysis (MA) was performed for the single outcome "weight loss of at least 10% during six months". Thereby, two other factors, body mass index and weight loss during the past year, became significant predictor variables as well. When considered in detail, a low BMI showed reduced weight loss risk, while a BMI above 35kg/m^2 increased the odds for losing weight. On the other hand, past weight loss indicated a higher risk for losing more weight in the future compared to weight gain in the past. Furthermore, impaired cognitive function and reduced nutritional intake in the previous week as well as on the same day influenced the outcome "weight loss of at least 10% during six months".

When the MVA with the single outcome "death within six months" was performed, in addition to the risk factors of reduced nutritional intake in the previous week and on the same day, higher age, reduced mobility, severe pressure sores and use of antibiotics, the variable of gender became relevant. Women showed an OR of 0.62 (95% CI: 0.52-0.75, $p<0.0001$) for the risk of dying within six months.

Apart from gender and age, which can hardly be influenced, further risk factors should be avoided in order to be able to maintain body weight and to live a longer life in a European nursing home. These risk factors are now part of the further discussion.

Reduced nutritional intake in the previous week and on the same day were the only strong predictors for each outcome variable among all residents in European nursing homes. The less the resident ate of a food portion, the higher was his/her risk of losing weight of at least 10% or dying within the following six months. Recently, Streicher et al. showed the same relation among the malnourished elderly residents in the nutritionDay nursing home population. (245) Results of a Danish follow-up study that was carried out among 441 nursing home residents in eleven nursing homes showed that eating dependency, **uneaten food** as well as chewing and swallowing problems were associated risk factors for weight loss and death. (241) According to a systematic review of the relevant literature, poor oral intake was associated with an increased likelihood of weight loss in different studies. (88) Among the contributing factors to malnutrition and related to one-year mortality were

further: age, female sex, baseline weight, total MNA-SF score, weight loss, **decreased food intake**, BMI, and recent stress. (242) Similar to results of this thesis, food intake was also significantly associated with death after three months. (205) A review from Labossiere et al., which aimed to emphasise the importance of malnutrition, came to the conclusion that the monitoring of weight and nutritional intake should be a part of the institutional routine, allowing for the recognition of differences between the prescribed diet and actual intake. (246) Moreover, Blaum et al. reported that, among other factors, poor oral intake contributed to weight loss. (247)

Of course, it was of interest why the residents ate less than recommended. The reasons for eating less were that the portions were too big and the residents were not hungry. A third reason mentioned was that the residents did not like the smell or taste of the food. Reduced appetite, of course, is an attribute of age. At a younger age, a compromised appetite can be improved more easily. Nevertheless, with appetite stimulants, there is a good chance for increasing appetite and gaining weight. (227) Nurses need to promote food intake. Eating in company as well as in a surrounding where the residents feel comfortable can enhance appetite. (56) Small portions of high nutrient dense food would meet the residents' expectations. The often portrayed, especially in media, bad food in nursing homes (248) (249) could not be proved true in the present data. To conclude, simple and short questions on food intake in the last week and the present need to be implemented regularly at nutritional status assessments.

Among other factors for a "bad outcome", an impaired cognitive status was a strong predictor. The variable "cognitive status" fell out of the significant range in the multivariable analysis for the single outcome "death". It´s presumed that the reason for this lies in the fact that "cognitive status" was slightly correlated with "mobility" and was also confounded with "pressure sores", which were both risk factors for "death" (see "correlations" in the appendix). As already shown in other studies, weight loss or eating problems are predictors of death in dementia patients, and dementia itself is a risk factor for mortality. (112, 250-252) Generally, dementia is on the rise, i.e. the proportion of demented residents has increased, as shown, for example, in a UK population where "dementia care" rose from 14% in 2001 to 23% in 2010. (253) In the present study population, light to severe impaired cognitive status was the most often occurring disturbance, with up to 77% per unit being affected. In comparison, Hoffmann et al.

reported that more than half of the residents in German nursing homes suffered from dementia. (107) Due to constant movement from pacing or agitation, demented residents have higher energy needs that can contribute to weight loss. Residents that are not able to sit long enough should be offered a variety of finger foods. (254) Special attention needs to be paid to demented residents with regard to weight loss and malnutrition risk.

It is obvious that the risk of death rises the older a person becomes. In the current study population, the independent risk of dying or losing weight within six months was 28% (18-38%) more for every ten years of higher age. The risk for the single outcome death was 43% (31-56%) higher for every ten years. The outcome "weight loss" alone is not independently related to the predicting variable "age" in this thesis´ population, presuming that weight loss is not necessarily an attribute of age. This is a contradiction to other studies which state that involuntary or unintentional weight loss is a common phenomenon among elderly. (255) The results show that with decreasing food intake at lunch, the odds ratio (OR) for mortality rises. This is shown in table 43. The OR to die within six months for those who ate only half of the portion was 1.56 compared to those who ate all. Furthermore, those who ate only a quarter of the portion had a OR to die of 1.71. And finally, those who ate nothing at lunch had the highest risk to die within six months (OR=2.58). A clear association between the amount of food intake and risk to die with in half a year was seen.

"Immobility" was a further independent predictive factor for the combined risk "lose weight or die", respectively to "die" within six months. Nevertheless, impaired mobility was not a risk factor for "weight loss" alone in the multivariable analysis. Restricted mobility was very common in the population of the thesis (52,9%). Associations between mobility and nutrition are well known. Immobility, for example, was related to a low BMI in a review on malnutrition. (88) A moderate positive correlation between MNA (results were grouped 0 [normal] to 2 [malnourished]) and immobility ($r=0.63$; $p<0.001$) was presented in a study conducted in Prague. (90) Severe functional impairment was more present in residents at nutritional risk who had lower nutritional screening scores (MNA), low BMI, weight loss and low food intake. (89) Physical training and nutritional and social support intervention was feasible and could help tackle malnutrition and frailty in older people living at home. (256)

Therefore, it seems certain that exercise for and mobilisation of the elderly residents in nursing homes is also very important.

In this thesis, the odds of dying rose with the increasing degree of pressure ulcers (OR=1.20-1.66 compared to intact skin). The association of "pressure sores or decubiti" and a bad outcome has been shown in several studies. (257) (100, 101) (240)

Antibiotics are often prescribed in nursing homes even when treatment is not necessary. 47-79% of the residents in nursing homes receive antibiotics at least once a year. This can lead to antibiotic resistance, which is quite common in long-term care facilities (258). In this study, 2.8% of the residents received antibiotics on a single day. The fact that antibiotics are related to death is explained by the state of illnesses or infections the patients have. The use of antibiotics was not related to the single outcome "weight loss" in this population.

The more different drugs were taken, the higher were the odds of achieving the combined outcome “weight loss or death”. Toffanello et al. proved that elderly people in hospitals are gustatorily impaired in comparison to free-living elderly. This may reduce the appetite of a person and lead to inadequate intake. The reason for it may lie in illnesses and polypharmacy. As compensation, flavor-enhanced foods should be strongly encouraged in long-term care settings. (259) This data showed that people in NHs take 6.4±3.7 different types of drugs per day on average, mainly psychoactive substances. Ruggiero et al. confirmed that the most frequent inappropriate prescriptions concern neuroleptics and long-term benzodiazepines in nursing homes. In Europe as well as in the US and Canada, the prevalence of inappropriate drug prescription was very high in nursing homes. Ruggiero et al.’s own Italian data showed inappropriate drug prescriptions of at least one medication in 28% of the residents. In their view, this highlights the urgent need for intervention trials that test strategies to decrease the burden of inappropriate drug prescription. (260)

Another very interesting result shows the variable "time since unit admission". The longer someone was in the nursing home, the lower was his/her risk (OR=0.998, p=0.005) of losing weight or dying during the outcome period. This probably means that as soon as the residents have tackled the first difficult period after admission, they have better chances to survive. The first time in the new surrounding is often characterised by major changeovers,

illnesses, functional impairment, social isolation, etc. A subanalysis shows a similar relation, in which residents who were in the nursing home for a maximum of twelve months, during the past five years, show a weight loss of -2.97% of body weight while the "long-staying" residents only lost -0.39%. The median duration of residents´ time since admission to the nursing home in this nutritionDay population was 36 months. A study from the UK showed a median period of 15 months from admission to death in nursing homes. Therein, people had a 55% chance of living for the first year after admission and a nearly 70% chance for the second year before having lower chances of surviving in the subsequent years. (261). In the LPZ study of the Netherlands, no association between time since admission and malnutrition was observed in the multivariable analysis. (262). It is of course also important to address a selection bias here: the obviously ill die fast, whereas the more robust (less ill) survive (survival of the fitter). As a consequence of finding in this thesis, residents in their first year of unit admission probably in particular need special attention with regard to nutritional risk factors. Further studies should investigate whether special care is needed during the first year or the observed effect is only related to a selection process of the fittest.

Apart from some other risk factors influencing "weight loss and death", "sex" was the only variable that predicted the outcome "death" alone. In the present study, women showed an OR of 0.62 (95% CI: 0.52-0.75, $p<0.0001$) for the risk of death within six months. The relationship between gender and death with age have been shown in other studies. For example, men showed a 23.4 times higher risk of dying within one year compared to women, especially when they had a weight loss of 5%. These patients suffered from idiopathic Parkinson´s disease. The gender difference was striking. (263) Another study showed that men had a shorter survival period after nursing home admission in its multivariate analysis (HR = 1.895, 95% CI: 1.651-2.175) (264). On the contrary, in a comparable study from the Netherlands (n=19 876), malnutrition was more related to the female gender (265). Men showed significantly better scores for food intake decline, weight loss, mobility and neuropsychological problems than women in another study. (237)
Residents in care establishments are mainly female. An important factor for the greater presence of women in communal establishments is the gender difference regarding marital status. Women are more likely than men to be without a spouse who could potentially care for them. Another reason is the higher level of disability in women than men at older ages.

Nevertheless, the gender gap has declined over the past years. For example, in the UK in 2001, there were 3.3 women for each man aged 65+ compared to only 2.8 women in 2011. (261) Individual reference values for nutritional intake could be considered. Currently, reference values for men and women in communal catering are averaged. It needs to be taken into account that women have their own special nutritional needs and characteristics of malnutrition, e.g. the high occurrence of osteoporosis. (9, 266) For economic and organisational reasons, it is rarely possible to provide separate menus for men and women in institutions. Still, further research in that field would be of interest.

As pointed out at the beginning of the discussion, residents with a body mass index (BMI) below 22kg/m^2 showed a reduced weight loss risk in the follow-up period, while those with a BMI above 35kg/m^2 had increased odds of losing weight. The BMI remains a topic that raises issues. Its relation to the outcome "death" can only be seen in a univariable analysis (UVA). Residents with a BMI lower than 22 kg/m^2, resp. 20 kg/m^2, had a higher risk of dying compared to people with a “normal” BMI between 22-29.99 kg/m^2 (OR=1.38 [1.13-1.67], p=0.001; OR=2.37 [1.99-2.83], p<0.0001). A BMI above 35 kg/m^2, on the other hand, decreased the odds of dying within six months (OR=0.55 [0.35-0.89], p=0.012). Many other studies have shown a similar relationship of BMI to mortality. (65, 235, 239, 267) Also, another study of the nutritionDay group shows a high impact of a BMI <20kg/m^2 on 6-months’ mortality (OR=1.7). (268) In their systematic review on obesity and mortality in the elderly, Donini et al. presented the relationship between BMI and mortality. In most studies, a U-shaped curve relationship occurs between BMI and mortality, showing high mortality for persons with a very low BMI (under 18.5 kg/m^2) and also for persons with a high BMI. Generally, the nadir of the curve lies higher with increased age, but the exact points differ from study to study. Donini et al. concluded that a BMI of 20-25 kg/m^2 for women and 25-30 kg/m^2 for men was protective against mortality. A low BMI could be more protective for women than men. (269) Other studies conclude that a low fat-free mass and skeletal muscle mass are far better predictors for 1-year mortality than BMI. (270) Why the BMI is a poor predictor of death in this whole population in the multivariate analyses cannot be explained. Further investigation into the validity of the body mass index as a predictor of malnutrition and mortality is needed.

These results also indicate that weight loss in the last year leads to further weight loss in the future. Residents who had lost weight immediately before nutritionDay had a significant and independent risk to lose (more) weight in the six-month period afterwards. On the contrary, those who had gained weight before nutritionDay had a 32% lower risk of losing weight. It is therefore very important to screen residents for weight loss at an early stage, at nursing home admission, for example, and also to ask for weight loss in the immediate past. Older studies already assumed weight loss led to increased mortality, morbidity and decreased quality of life (182, 183, 230, 271). Furthermore, in this study, those who had the highest risk for losing more weight in the future were those who didn't know whether they had lost weight in the past. The study of Izawa et al. showed a similar result, demonstrating that the lack of weight data was associated with a higher 2-year mortality (HR:1.54, 95% CI:1.09-1.79) and hospitalisation (HR:1.34, 95% CI:1.01-1.79). (272) So, it is especially important to care for people who do not know their weight and to be aware of the risks.

It was conspicuous that no predictor variable that was related to the structure of the unit, the nutritional management or the origin of the unit significantly influenced the outcome. All variables that played a significant role were resident-related. The influence of residents' characteristics on malnutrition prevalence was also shown by Van Nie-Visser et al. (265).

4.2. Further considerations

The data for this thesis are derived from 470 units in 234 nursing homes in 14 European countries. As far as known, no other similar data evaluation has been carried out on nutrition in nursing homes on such a large scale in the past years. Other releases of the nutritionDay data on the nursing home group have already shown the risk factors of mortality in malnourished residents (245) and a BMI <20 kg/m^2 and weight loss >5 kg in one year as 6-month mortality risks. (268) Partly comparable data can be derived from the annual Dutch surveys of the LPZ group which are also cross-sectional, multi-centred and use standardised multilevel instruments to gather data about the prevalence of malnutrition. (262, 265, 273) Today, the nutritionDay evaluation is the fastest growing, widespread audit worldwide.

As far as the main question on the risk factors for losing weight or dying within six months in NHs is concerned, the country of origin influenced the outcome only in the univariable analysis. With the repeated code "unitcode" and predictor variable "country code", the people in Germany and Portugal, in comparison to Austria, had a significantly lower risk of dying or losing weight in nursing homes (Germany OR=0.643; CI= 0.537-0.771, p<0.0001; Portugal OR=0.608; CI=0.555-0.667, p<0.0001). Nevertheless, in the multivariable analysis, the country of origin was not a significant predictor variable anymore. When the "country of origin" in addition to the "unitcode" as a repeated factor in the MVA/GEE in the binary logistic regression was considered, the results didn´t change either. The unit code may have already included the fact or information that this unit belongs to a specific country. It was striking that Germany showed the lowest number of people that lost >10% of weight during outcome period and that in Austria and Germany a very high adherence to local or national nutritional protocols (standards) was noticeable. Also, clinical nutrition support was highest among "non-eaters" in Austria (48%), Western European countries (46%) and Germany (40%). However, a relationship between "bad outcome" and the number of residents per unit couldn´t be found, although this had an important impact in other studies, e.g. Strathmann et al. (274). Nordic countries showed the lowest numbers of beds in one unit (14 beds/unit) while Southern countries showed the largest (51 beds/unit). In contrast to these numbers, US NH units are far bigger (with about 100 beds) (275). The variations in the number and FTE of staff were high between the regions/countries, but data completeness was also poor. In the study of Harrington et al., they too complained about lacking staff data (275). nutritionDay has the possibility to contribute these important data by specially pointing out their significance. Generally, this data show high variations between and within countries, respectively between units, as was shown in an earlier analysis. (276)

This results showed that Austrian´s NHs had the highest number of qualified nursing staff. As a possible consequence, this staff identified the highest percentage (46.1%) of people with a BMI below 20kg/m^2 according to their "clinical view", followed by the staff in Germany (40.3%). It was striking that up to 80% of the residents with a BMI below 20 kg/m^2 were not identified as malnourished in other regions/countries. In the review by Bostick et al. 2006, they showed the importance of highly qualified staff, which was associated with improved care processes and resident outcomes for functional ability, pressure ulcers, and

weight loss (277). A summary of US studies demonstrated that higher standards in nursing homes led to higher qualified staff levels and these resulted in lower resident mortality, fewer deficiencies and quality improvements (275). Regarding nutritional knowledge of the staff, an Australian study demonstrated low levels in residential facilities. There existed, for example, a lack of knowledge regarding higher energy and protein intake needs in residents with pressure ulcers. Barriers for the promotion of optimal nutrition were: insufficient time to observe the residents (56%), not being aware of the feeding issues of the residents, poor knowledge on nutritional assessment, and unappetising food appearance (57%) (143). Noticeably, lack of time was hardly ever specified as a reason for not helping the residents with eating and drinking in the present study, at least hardly anybody commented on that. The higher educated staff in Austria's NHs can also be responsible for the higher use of nutritional support. Austria showed the highest supply of oral nutritional supplements (ONS). Streicher et al. demonstrated that the availability of a nutritional expert in a unit as well as the performance of nutritional assessments increased the use of ONS. (278) This data also show that half of the non-eaters did not receive any nutritional support. Therefore, a high potential for nutritional support in the treatment and prevention of malnutrition exists.

4.3. Study limitations and future prospects

The nutritionDay study is an observational study on a large scale. Apart from its many participants, it may have also been affected by selection bias. NH units participated voluntarily. Often, these units were well-organised, already had a high interest in and knowledge about nutritional care and also had more time to carry out such surveys. Those units with little experience and interest in participation may be underrepresented. nutritionDay counters this by providing the simplest questionnaires and easy conditions, like the availability of the questionnaires in several languages and participation free of charge.

The number of participants differed a lot between the European regions/countries. Some small countries had an overproportionately high number of participants, some large countries showed very low involvement. The samples are therefore not representative of the European regions or countries. Still, regional tendencies can be seen. Furthermore, for

the main analyses, the "country of origin" was included as a predictor variable in the multivariable analysis, showing no influence on the outcomes. For further runs and analyses, area-wide surveys in a whole nation will be of interest, as already shown in a nutritionDay evaluation in Styria. (279)

The specification for this study was to include each registered resident of a unit. However, some units involved just a selection. For the main research question, therefore sensitivity analyses with data quality criteria were conducted. One of these quality criteria was a minimum participation of at least 60% of a unit´s residents.

Systematically missing values in one or several parameters may also bias estimates. A "missing data" category for all predictive variables evaluated was included in order to reduce any possible hidden impact due to missing data. This missing category was found to be very informative and probably associated with a category of residents that cannot communicate well, either due to the impact of disease, concomitant neurological or psychological conditions or their high level of dependency. However, we cannot exclude that other factors contributed to the missing category (e.g. refusal to answer after inclusion, having no time to answer questions due to investigations, etc.).(280)

The outcome data availability was quite low and needs to be enhanced in further implementations. It is important to keep the questioning as simple as possible and to encourage the people in NHs by pointing out the advantages of participation. The nutritionDay data can be analysed in much more detail and research in this field should be boosted. The WHO report of 2003 states that besides physical environment, nutrition has largely been neglected in past research regarding disabilities. (135) The large data collection allows for a lot of further research in the field of nutritional care in institutions.

Participation in the nutritionDay audit is meaningful, especially repeatedly, when the evaluation can be used as a kind of benchmark tool for quality assurance. Regular audits and feedback have decreasing effects on malnutrition prevalence rates (281).

5. Conclusions

This study identified risk factors associated with 6-months weight loss and mortality in NH residents. It clearly shows that the better the resident´s actual intake or intake in the last week was, the smaller the risk was to lose weight or die. Therefore, simple regular questions on actual food intake (with the help of plate symbols), regular weighing and inquiries about appetite should be routinely included in the residents' charts in NHs. Also, a detailed history at NH admission is important in order to get to know further risk factors like bad cognitive status, immobility, pressure sores, number of drugs used, weight loss data of the past as well as gender and age. As long as these factors are well-known and recognised, it is possible to counteract malnutrition through special nutritional observations and interventions.

The results not only show heterogenous data between countries but also between single institutions within countries. However, structural variables had less influence on a bad outcome compared to individual resident´s disease and nutrition-related factors.

Malnutrition data in this study population are similar to national and international data, finding a high prevalence of malnutrition among elderly persons in NHs. Main efforts by NHs should lie on offering high quality meal content, adequate portion sizes of nutrient-dense meals as well as helping with eating and drinking. Food for residents should be available throughout the day and night and the presentation of it should be most attractive, appealing to all senses. Residents should actively and regularly be motivated to drink and eat. Special attention should be paid to the increasing share of demented residents. But also obese elderly, who are on the rise, may be malnourished and need to be addressed carefully. Nutritional support was underrepresented in this population, showing a high potential for further interventions. For example, half of the non-eaters did not receive any nutritional support. Staff's estimation of residents´ malnutrition was poor, as 80% of the residents with a BMI<20kg/m^2 were not identified as malnourished. Regular participation in nutritionDay may help to improve the awareness of malnutrition and facilitate nutritional status assessment. Regular assessment of nutritional risk factors cannot be stressed enough.

6. Abstract

Rationale

In the near future, the demand for residential facilities such as nursing homes (NHs) will enormously increase, due to the drastic rise in old, dependent people. Accordingly, the demands for quality of nursing, including nutritional care influencing the well-being and health of the elderly, become increasingly important. This thesis, therefore, focuses on nutritional management in European nursing homes and the nutritional status of their residents in order to identify nutrition-related factors that may predict outcomes such as weight loss or mortality.

Methods

The data for this thesis are derived from the survey "nutritionDay in nursing homes" 2007-2010, which is a voluntarily, annually repeated one-day cross-sectional audit with an outcome evaluation after six months. Data were collected with the help of questionnaires, requesting unit characteristics, residents´ general characteristics, residents´ actual nutritional intake and outcome. In the first section of this thesis, data from 470 units in 234 nursing homes in 14 European countries were quantitatively described and summarised (descriptive analysis). For the analyses in the second section, Hungarian units were excluded due to missing outcome data. Univariate generalised estimating equations were performed with binary logistic regression to describe the relationship of each baseline independent variable to the outcomes "weight loss of at least 10% or death", respectively "weight loss of at least 10%" and "death". Significant predictor variables ($P<.05$) were included in multivariable regression models.

Results

19 167 residents with a mean age of 76.8±16.8 years, 71% female, took part in the survey. One third of the population had a BMI below 22 kg/m^2, showing a potential risk for malnutrition. 31% of the residents had lost weight and 19% had gained weight in the previous year. On the day of evaluation, 62% of the residents ate everything at lunch, 27% ate half a portion, 6% a quarter of the meal and 2% ate nothing. Only half of the "non-eaters" received nutritional support. After six months, the outcomes of 54.4% of the

residents were collected. Of these, 85% were still in the NH, 1.1% had been transferred, 1.2% had been discharged home and 12.1% had died.

For the outcome analyses, data from 9 946 residents, aged 85.1±9.9 years and 78% female, were included. The main finding was that higher age, immobility, a short time since unit admission, high drug intake, pressure sores, impaired cognitive status, antibiotics use, and reduced food intake before and on nutritionDay ($p<0.0001$-0.018) were independent predictors for the outcome "weight loss of at least 10% or death within 6 months". Furthermore, a high BMI, weight loss before, impaired cognitive status, and reduced food intake before and on nutritionDay were significant influencing factors for the outcome "weight loss of at least 10% within 6 months". Lastly, reduced food intake before and on nutritionDay, higher age, immobility, pressure sores, antibiotics use, and male gender were independent risk factors for "death within 6 months". Thereby, food intake before and at lunch on nutritionDay were the only independent influencing variables on all three outcome categories.

Conclusion

This analyses revealed that very simple individual resident and nutrition related data, like past and actual nutritional intake, showed the highest significance for predicting a bad outcome. Therefore, besides detailed anamnesis for risk factors, simple regular questions on actual intake (with the help of plate symbols), regular weighing and inquiring about appetite should be included routinely in the residents' charts in NHs.

7. Zusammenfassung

In naher Zukunft wird der Bedarf an Wohneinrichtungen, insbesondere Pflegeheimen aufgrund der drastischen Zunahme an alten, abhängigen Menschen, enorm ansteigen. Gleichzeitig wird der Bedarf an Qualität in der Pflege, inklusive Wohlbefinden und Gesundheit der Älteren, immer wichtiger werden. Daher fokussiert diese These auf das Ernährungsmanagement in europäischen Pflegeheimen und den Ernährungsstatus ihrer BewohnerInnen mit dem Ziel ernährungsbezogene Faktoren zu identifizieren, die das Outcome vorhersagen, wie etwa Gewichtsverlust oder Mortalität.

Methoden

Die Daten dieser Doktorarbeit stammen vom Projekt "nutritionDay in Pflegeheimen" 2007-2010, eine freiwillige, jährlich wiederholte eintägige Querschnittsstudie mit Outcome Evaluierung nach sechs Monaten. Die Daten wurden mit Hilfe von Fragebögen gesammelt. Diese erfragten Charakteristika der Abteilung, der BewohnerInnen allgemein, sowie die aktuelle Nahrungsaufnahme der BewohnerInnen und das Outcome. Im ersten Abschnitt der Arbeit wurden Daten von 470 Abteilungen aus 234 Pflegeheimen in 14 europäischen Ländern quantitativ beschrieben und zusammengefasst (deskriptive Analyse). Für die Analysen im zweiten Abschnitt, wurden die Daten der ungarischen Pflegeheime aufgrund fehlender Outcomedaten herausgenommen. Eindimensionale verallgemeinerte Schätzungsgleichungen (GEE) wurden mit binärer logistischer Regression durchgeführt um damit die Beziehung jeder unabhängigen Basisvariablen zum den Outcomes "Gewichtsverlust von mindestens 10% oder Tod", bzw. " Gewichtsverlust von mindestens 10%" und "Tod" innerhalb von sechs Monaten zu beschreiben. Signifikante Prädiktorvariable ($p<.05$) wurden in mulitvariate Regressionsmodelle eingeschlossen.

Ergebnisse

19 167 BewohnerInnen mit einem mittleren Alter von 76,8±16.8 Jahren, 71% weiblich, nahmen an der Erhebung teil. Ein Drittel der Population hatte einen BMI unter 22 kg/m^2, was ein potentielles Risiko für Mangelernährung darstellt. 31% der BewohnerInnen hatten im vergangenen Jahr Gewicht verloren und 19% an Gewicht zugelegt. Am Tag der Erhebung haben zu Mittag 62% alles zu Mittag gegessen, 27% die halbe Portion, 6% ein Viertel der Portion und 2% haben nichts gegessen. Nur die Hälfte derer, die nichts gegessen haben

erhielten Ernährungssupport. Nach sechs Monaten wurde das Outcome von 54,4% der BewohnerInnen erhoben. Von diesen waren 85% noch im Pflegeheim, 1,1% kamen auf eine andere Station bzw. in ein anderes Pflegeheim, 1,2% wurden nach Hause entlassen und 12,1% waren verstorben.
In die Outcome-Analyse wurden Daten von 9 946 BewohnerInnen, im Alter von 85.1±9.9 Jahren, 78% weiblich inkludiert. Das wichtigste Ergebnis war, dass höheres Alter, Immobilität, kurze Zeit im Pflegeheim, hoher Medikamentekonsum, Dekubiti, eingeschränkter kognitiver Status, Antibiotikaverwendung und verringerte Nahrungsaufnahme sowohl vor als auch am nutritionDay ($p<0,0001$-$0,018$) unabhängige prädiktive Fakoren für das Outcome "Gewichtsverlust von mindestens 10% oder Tod" innerhalb von sechs Monaten waren. Ausserdem waren ein hoher BMI, Gewichtsverlust vor dem nutritionDay, eingeschränkte kognitive Fähigkeiten sowie verminderte Nahrungszufuhr vor und am nutritionDay signifikante Einflussfaktoren für das Outcome "Gewichtsverlust von mindestens 10% innerhalb 6 Monaten". Schliesslich sind eine verminderte Nahrungszufuhr vor und am nutritionDay, höheres Alter, Immobilität, Dekubiti, Verwendung von Antibiotika und männliches Geschlecht unabhängige Risikofaktoren für den "Tod während 6 Monaten" gewesen. Nahrungszufuhr vor und am nutritionDay waren die einzigen Faktoren, die in allen drei Outcomekategorien einen signifikanten Einfluss zeigten.

Konklusion

Unsere Analysen zeigten, dass sehr simple individuelle Bewohner- und Ernährungsbezogene Daten, wie die vergangene und aktuelle Nahrungszufuhr, höchste Bedeutung haben, ein schlechtes Outcome vorauszusagen. Daher sollten neben einer detaillierten Anamnese nach Risikofaktoren, einfache regelmäßige Fragen zur aktuellen Nahrungszufuhr (mithilfe von Tellersymbolen), regelmäßiges Wiegen und die Frage nach dem Appetit standardmäßig in die Bewohnerakte aufgenommen werden.

8. Appendices

A) Questionnaires in English language (Sheets 1,2,3a,3b,4, resident list) and explanations

B) Announcement of nutritionDay for the unit

C) Approvals of the ethical committee of the Medical University in Vienna

D) Modifications of the questionnaires 2007-2010

E) Complete list of terms and items in the database

F) Correlation results of the predictor variables

A)

nutritionDay WORLDWIDE

SHEET I

Date ☐☐ ☐☐ ☐☐☐☐

Centre Code[1] ☐☐☐☐

Unit Code[2] ☐☐☐☐

Actual N° of beds in the unit that are staffed[3]			☐☐ beds
Maximum number of beds in the unit[4]			☐☐ beds
Operator of the nursing home[5]	☐ communal	☐ private	☐ charity organisation

People working at your unit (excluding persons cleaning only)[6]**:**

professional groups[6a]	number[6b]	Time spent in the unit per week (full time equivalent)[6c]
permanent physicians	☐☐ / ○ none	
external physicians	☐☐ / ○ none	
director of nurses	☐☐ / ○ none	
nurses	☐☐ / ○ none	
staff assistants	☐☐ / ○ none	
dieticians, dietetic assistants	☐☐ / ○ none	
physiotherapists / ergotherapists / speech therapists	☐☐ / ○ none	
musictherapists/ animators	☐☐ / ○ none	
community service	☐☐ / ○ none	
others (please describe):_____	☐☐ / ○ none	

Is there a person at your unit mandated to nutritional care?	☐ YES	☐ NO
Do you routinely use written procedures for nutritional care?[7]	☐ YES	☐ NO
If YES, which one ...		
local standards	☐ YES	☐ NO
national guidelines	☐ YES	☐ NO
individual resident nutritional care plans only	☐ YES	☐ NO

Do you regularly screen your residents for malnutrition/ risk of malnutrition? (single choice only)

☐ only at admission	☐ approx. 4 - 6 times a year	☐ never
☐ approx. once a month	☐ approx. 1 - 2 times a year	

Evaluation of malnutrition / risk of malnutrition of all residents by use of[8]**:**

☐ weight	☐ biochemical parameter
☐ screening for undernutrition (MNA, MUST,...)	☐ others
☐ weight course	☐ not known
☐ clinical view	

How many percent of your residents need help with nutrition[9]**?**

- ☐ more than 70% of residents
- ☐ between 51 and 70% of residents
- ☐ between 30 and 50% of residents
- ☐ less than 30% of residents

How often do you weigh you residents routinely[10]**? (single choice only)**

☐ only at admission	☐ approx. 4 - 6 times a year	☐ never
☐ approx. once a month	☐ approx. 1 - 2 times a year	

SHEET II Sheet-N°[1] ☐☐ Centre Code[2] ☐☐☐☐ Unit Code[3] ☐☐☐☐ Date ☐☐ ☐☐ ☐☐☐☐

"Unit - all residents"

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initials	resident [4] ☐☐☐☐ (4 initials)	resident-number [5]	consent [6]	year of birth (YYYY) [7]	gender [8]	WEIGHT [9] measured (m) or estimated (e) [kg and fill in "m" or "e"]		HEIGHT [10] measured (m) or estimated (e) [cm and fill in "m" or "e"]		level of care [11]	malnutrition [12]	duration since nursing home admission [13]	number of hospitals stays in the year 2011 [14]	exsiccation [15]	contractures [16]	pressure scores [17] (max. degree)	dysphagia [18]	chewing problems [19]	cognitive status [20]	mobility [21]	How many different drugs/day [22]	antidepressants [23]	antibiotics [24]	opiates [25]	diet [26]	artificial nutrition (1,2,3...) & energy intake [27] (A,B,C,D)	lines & tubes [28]		duration since placement of line or tube [29]	care-causing diagnosis [30]
	N°	C	YYYY	f/m	kg	m /e	cm	m /e	1,2, 3,..	N/R /J	months	0,1,2,..	Y/N	0,1,2	degree	Y/N	Y/N	1,2,3	1,2,3	number	Y/N	Y/N	Y/N	1,2,..	1,2,3,..+ A,B,C,D	lines & tubes		months	1,2,3,...

CONSENT (C):
E = written consent
N = oral consent
C = consent rejected

LINES & TUBES
O= none
CV= central venous
PV= peripheral venous
NG= nasogastric
PEG= percutaneous endosc./surgical gastrostomy
PEJ= percutaneous endosc./surgical jejunostomy
X= others

ARTIFICIAL NUTRITION (1,2,3,..) AND ENERGY INTAKE BY ARTIFICIAL NUTRITION(A,B,...)

1= none
2= sip feeds
3= tube feeds
4= parenteral nutrition
8= subcutaneous nutrition
9= others (declare):_____

A= ≤ 499 kcal
B= 500-999 kcal
C= 1000-1499 kcal
D= ≥ 1500 kcal

MALNUTRITION:
N=No
R= at risk of malnutrition
J= malnutrition

COGNITIVE STATUS:
1= normal
2= light to moderate impairment
3= severe impairment

PRESSURES SORES (degree):
1= non blanchable erythema, intact skin
2= blister
3= superficial ulcer
4= deep ulcer

LEVEL OF CARE (time needed for basal care per day):
1= < 45 min/day
2= 45 - 119 min/day
3= 120 - 239 min/day
4= > 240 min/day

DIET:
1= normal diet
2= blenderized diet
3= fortified diet
4= other special diets
5= none

CONTRACTURES:
0= none
1= one
2= more than one

MOBILITY:
1= ambulatory
2= partially ambulatory
3= immobile

CARE-CAUSING DIAGNOSIS
1= brain, nerves: e.g. dementia, stroke, MS,Parkinson, ALS
2= cancer
3= skeleton/bone/muscle
4= heart, circulation, lung: e.g. myocardial infarction, cardiac insufficiency, COPD
5= endocrine system: e.g. diabetes I/II
6= digestive organs
7= Intoxication, injury: e.g. alcoholism, cerebral injury
8= others

nutritionDay worldwide - SHEET IIIa - resident general

Interview with the resident by staff or family members:
(If the resident is not able to answer the question him/herself, the questions should be answered by staff or family members)

Date ☐☐ ☐☐ ☐☐☐☐

Resident N°[1] ☐☐ Unit Code[3] ☐☐☐☐

Resident's Initials[4] First name ☐☐ Last name ☐☐

Do you regularly receive visits (from friends and family)?

- O several times a week
- O once a week
- O less than once a week
- O less than once a month
- O rarely or never

Your weight 5 years ago[5] ☐☐☐ kg O not known

Have you lost weight within the last year?

O YES O NO O No, I have gained weight O I do not know

If YES, how many kilograms did your weight decrease?

- O 1-5 kg
- O >5-15 kg
- O >15 kg
- O I´m not sure

How well have you eaten during the last week? (Please ignore this question, if the resident is mainly fed by tube or intravenously)

- O as usual
- O a bit less than usual
- O less than half of usual
- O less than a quarter to nearly nothing
- O I do not know

I ate less because (check more than one if necessary)

- O loss of appetite
- O swallowing- and/or chewing problems
- O tooth problems
- O meals are not adequately prepared
- O nausea
- O others

Each exponent corresponds to the numbers at the explanations.

SHEET IIIb

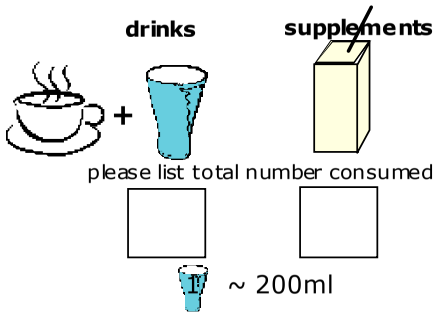
"the resident today"

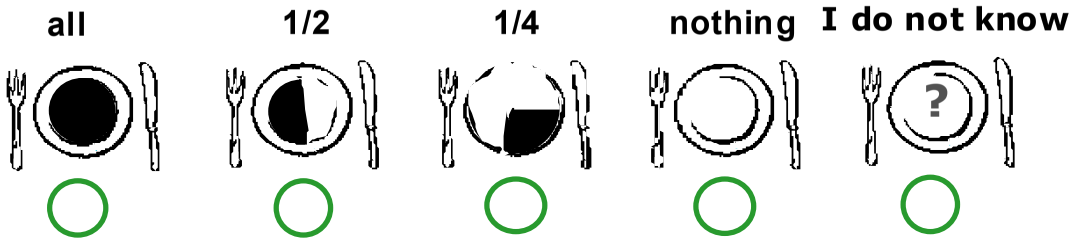
Resident N°[1] ☐☐ First name ☐☐ Last name ☐☐ I N I T I A L S [2] Unit Code[4] ☐☐☐☐

Interview with the resident by staff or family members: Date ☐☐ ☐☐ ☐☐☐☐

Please check a circle to indicate **how much** you ate (plates) and drank (glasses) for lunch today[5]

LUNCH (please check)





I did not eat everything because:

○ I can not eat without help	○ I did not like the smell/taste
○ I was not hungry	○ I had pain
○ I can not eat so much	○ meat/vegetables were too hard (to chew)
○ I had nausea/vomiting	○ I have swallowing problems

To be filled in by staff or family members:

Was the resident assisted with this meal?

- ○ no, because he/she does not need any help
- ○ no, because there was no time to do so
- ○ yes, he/she was assisted for:
  - ○ less than 10 min
  - ○ between 10 and 20 min
  - ○ more than 20 min

Each exponent corresponds to the numbers at the explanations.

Unit resident list and outcome (all residents in the audit)

PLEASE KEEP locally only!

Sheet-N°[1] □□

resident number[4] □□□

Codification
A = still in nursing home
B = transferred to another nursing home
C = discharge home
D = death
E = others

nutritionDay WORLDWIDE

Centre Code[1] □□□□

Unit Code[2] □□□□

Date of nutritionDay □□□□ □□□□

Date of outcome-evaluation □□□□ □□□□

				OUTCOME AFTER 6 MONTHS					
firstname lastname date of birth or resident sticker	unit room N° optional	sheet 2 N°	sheet 2 resident number	**habitation after 6 months**[3]	**date** of transfer to another unit, death,...[4] **dd/mm/yy**	**actual** WEIGHT (kg)[5] only if the resident is still in nursing home!	**hospital-stays during the last 6 months**[6] number	in days	**comments**
Example 	5	1	1	A		75,1 kg	2		
		1	1			_____ , ___			
		1	2			_____ , ___			
		1	3			_____ , ___			

NUTRITIONDAY worldwide | Nursing homes
Explanations and definitions

Sheet I „Unit Sheet“

1. Centre Code: Please insert the anonymous Code that you received from the Coordinating Center.

2. Unit Code: Please insert the anonymous Code that you received from the Study Committee.

3. Actual number of beds that are staffed: Please fill in the number of beds that presently are staffed.

4. Maximum number of beds in the unit: Please fill in the maximum number of beds in your unit.

5. Operator of the nursing home: Please specify the operator/owner of the nursing home.

- **communal:** Cities and municipalities are referred to as communal owner.
- **private:** private-industrial owners are private persons and companies
- **charity organisation (nonprofit organisation):** nonprofit organisations include clerical owners such as Caritas or Diakonie and owner welfare organisations like the Red Cross;

6. People working on the unit (excl. cleaning staff): Insert the total number of people working in your unit per week. Please exclude cleaning staff unless they are involved in food service.

6a) Professional groups:

Permanent physicians: Fill in the number of consultants, registrars and other doctors working at your unit
External physicians: Fill in the number of primary care physicians or external consultants, who take care of certain residents
Director of nurse: Fill in the number of professional nurses with additional training and function as director of nurses
Nurses: Fill in the number of nurses.
Staff assistant: Staff without professional education
Dieticians/dietetic assistants: Please insert the number of dieticians/dietetic assistants working at your unit
Physiotherapists / ergotherapists / speech therapists: Please insert the number of physiotherapists / ergotherapists / speech therapists working at your unit

Musictherapists / animators: Please insert the number of Musictherapists / animators working at your unit
Community service: Please insert the number of volunteers working at your unit
Others

6b) Number: number of representatives of the indicated professional groups
Please tick "none", if there is no professional of the indicated group working at your unit

6c) full-time equivalent: Mean hours spent in the unit per week or parts there of should be recorded as full-time equivalents. Example: 40 hours per week equal1 full-time equivalent. 10 hours equal 0.25 full-time equivalents.
Example 1: Two physicians spend 2 days each in the unit during the nutritionDay week. This equals 32 hours or 0.8 full-time equivalents provided the working day has 8 hours.
Example 2: A dietician/dietetic assistant spends 5 hours in the unit during the week of nutritionDay which equals 0.125 full-time equivalents.

7. Do you routinely use written procedures for nutritional care?
Please indicate how you how you proceed routinely. Please choose only one answer.

8. Evaluation of malnutrition / risk of malnutrition of all residents by use of:
Please indicate how you evaluate malnutrition/risk for malnutrition.

9. How many percent of your residents need help with nutrition:
"Help in nutrition" includes the range from monitoring nutrition, assistance in eating to feeding the residents: All taken actions from assistants in eating to artificial nutrition are included in the definition. Please tick the adequate percentage.

10. How often do you weigh your residents routinely? Please tick the correct answer.

Sheet IIa: („Unit all residents“)

1. Sheet number: Depending on the number of residents admitted to your unit, you will eventually need more than one of these sheets. Please indicate the number here.

2. Centre Code: Please insert the anonymous Code which you received from the Coordinating Center.

3. Unit Code: Please insert the anonymous Code which you received from the Study Committee.

4. Resident: Insert resident's initials by writing the two first letters of the first name and the two first letters of the last name into the boxes, e.g. Peter Smith: PE SM

5. Resident number: Please give each resident a number and **record this number in the resident-list**. That is important, because you need this information for the outcome documentation after six months. The same number it to be filled in the **respective resident information sheet and the two resident interview sheets (sheets 3a + 3b)**.

6. Consent: Please note if the resident her/himself or his/her nominated proxy has given a written consent for the investigation (**E = written consent**), if the consent was given orally (**N=oral consent**) or if the resident/nominated proxy rejected the participation (**C=consent rejected**). Please find the respective codification in the pink explanation box. If the resident/nominated proxy rejected the participation, then leave the respective line in the sheet empty and do not fill in the sheets 3a and 3b.

7. Year of birth: Please complete this way: 1970.

8. Gender: Please fill in the residents´ gender **(f = female, m = male)**

9. Weight (measured or estimated):
Weights should preferably be measured.
„m“: fill in "**m**", if weight was measured on a scale and insert weight in kg. The measured value must be not older than 3 weeks. Please insert the correct weight including one decimal number.
„e“: Measure weights older than 3 weeks also rate as estimated weights.

10. Height (measured or estimated):
Please insert height in cm and fill in "e", if height is estimated and "m" if height is measured.

„m“: Height can be classified as measured, when it was determined in an upright position on a wall or with a stadiometer (only in residents without spinal kyphosis/scoliosis) or calculated from knee-height (also in residents with spinal kyphosis/scoliosis).
„e“: all others methods of determination or estimation of body height including height noted in personal identifications, like passports.

11. Level of care: Please tick the time needed for basal care per resident and day and choose from the categories 1-4 in the box below. Basal care includes body hygiene, nutrition and mobility. Treatment care and other assistance (for instance, help for telephoning or contacting friends, accompaniment for outdoor walks) are not included.

12. Malnutrition:
Please fill in if – according to your opinion or as a result of a nutritional screening - the resident is well nourished (**N = no**), at risk for malnutrition (**R = risk**) or malnourished (**Y** = yes).

13. Duration since nursing home admission:
Please fill in the number of months since nursing home admission..

14. Number of hospital stays in the year 2011:
Please fill in how often the resident had to be admitted to a hospital ward during the year 2011. Write 0 if the resident had no hospital stay within the last year.

15. Exsiccation (dehydration):
Please fill in, if the resident is showing signs of exsiccation at the time of assessment **Y**(=**YES**)/ **N**(=**NO**).

16. Contractures:
Please fill in, if the resident shows one or more contractures at the time of assessment. Contractures are defined static muscle shortening due to tonic spasm or fibrosis **0 = none, 1=one, 2=more than one**.

17. Pressure sores (max. degree)
Please fill in the number and maximum grading of pressure sores. The grading classification is given in the yellow explanation box. Should the resident have more than one pressure sore, then please fill in the highest existing degree. Please write 0 if the resident has never had pressure sores.

18. Dysphagia
Please tick **Y (=YES)** or **N (=NO)** if the resident suffers from dysphagia.

19. Chewing problems:

Please tick Y (=YES) or N(=NO) if the resident has chewing problems.

20. Cognitive status:
Please fill in if the resident is showing signs of dementia. Ideally you may use the classification criteria according to the Mini Mental Status Test (MMST). If MMST has not been done for the resident, please classify subjectively according to your estimation.

21. Mobility:
Please fill in the residents' degree of mobility:
1: ambulatory: the resident is able to walk at least 50m without walking helps except walking sticks.
2: partially ambulatory: Locomotion is only possible with major walking helps (like walking frames) or without external help (independently) in a wheel-chair.
3: immobile: bed-ridden or locomotion is only possible in a wheel-chair with external support.

22. How many different drugs orally:
Please insert the total number of different drugs (substances) the resident is ordered to take per day. Please include all drugs given as tablets, liquid medication, infusions and plasters. Please do not fill in the number of pills. Write 0 if the resident is not ordered to take drugs.

23. Antidepressants:
Is the resident currently receiving antidepressants? Please answer by ticking **Y (=YES)** or **N (=NO)**.

24. Antibiotics:
Is the resident currently receiving antibiotics? Please answer by ticking **Y (=YES)** or **N (=NO)**.

25. Opiates:
Is the resident currently receiving opiates? Please answer by ticking **Y (=YES)** or **N (=NO)**.

26. Diet:
Please fill in the diet chosen for the resident. You find the respective codification in the light orange explanation box.
1 = normal diet: the resident receives the normal, standard kitchen diet.
2 = blenderized diet
3 = fortified diet: the resident receives meals fortified with protein and/or energy (calories)
4 = other special diets (p.e. diabetes diet, low purin diet, and so on....)

5 = none: the resident is mainly fed over tube or infusions (enteral or parenteral nutrition)

27. Artificial nutrition (1,2,3,..) and energy intake provided by artificial nutrition (ABCD):
The questions relate to types and calories in artificial nutrition. The amount of calories from normal nutrition is not included. Please find the codification for types and calories for artificial nutrition in the purple explanation box. Please fill in the correct number for the type of artificial nutrition as well as the correct letter for calorie/ day received through artificial nutrition. If the residents receives no artificial nutritional therapy (1 = none), than no letter for calorie intake is attributed.

28. Lines and Tubes:
The "Lines & Tubes"-Codes are given on the left lower part of the sheet. Please insert the letters corresponding with the code. Separate letters with a comma, if there is more than one code. Write "0" if the resident has no Lines or tubes.

29. Duration since placement of line or tube:
Please fill in the duration since placement in month for the lines and tubes which are listed in question 27. Write "0" if the resident has no Lines or tubes.

30. Care-causing diagnosis (1,2,3,...):
You can find a selective list of the care-causing diagnosis on the sheet in the orange explanation box. Please choose the most applicable cause of care.

General information about sheets IIb, IIIa and IIIb

Sheet 2b, 3a and 3b can be filled in by the staff or the residents' relatives. Health permitting, the resident should actively participate in the interview. If possible, sheet 3b should be filled in after lunch on the day of assessment.

Residents who should be included
Included should be all residents present at the unit during the week of investigation. Excluded are residents who did not give their consent for the interview. Residents who haven not given their consent are marked on sheet 2 with the letter C.

Explanation regarding the interview
There is no need to exclude any resident from the interview unless consent is not given. In case the interview is impossible or partly impossible because of physical or cognitive impairment of the resident, the staff or the residents' relatives can help completing the questionnaire. Many thanks.

Sheet IIb: Mini Nutritional Assessment - MNA®

Please ask the patient to answer the MNA questions A – F, using the codes below each question and filling in the white boxes at the right side. If the resident is unable to answer the question, ask the staff or the residents' relatives.

If BMI is not available, replace question F1 with question F2.

F2) Measuring Calf Circumference:

1. The subject should be sitting with the left leg hanging loosely or standing with their weight evenly distributed on both feet.
2. Ask the patient to roll up their trouser leg to uncover the calf.
3. Wrap the tape around the calf at the widest part and note the measurement.
4. Take additional measurements above and below the point to ensure that the first measurement was the largest.
5. An accurate measurement can only be obtained if the tape is at a right angle to the length of the calf.

Attention: to achieve correct results each box must be filled in (except at question F you can choose between F1 or F2)!

Sheet IIIa („the resident in general")

Interview with the resident by staff or family members - Part I:

(Tip! Fill in the codes for 2. and 3. before you copy the entire investigation)

1. Resident number: Please fill in the residents' number (see sheet 2)

2. Centre code: Please insert the anonymous Code which you received from the Coordinating Center.

3. Unit: Please insert the anonymous Code which you received from the Coordinating Center.

4. Residents' initials- first name □□ last name□□:
Please write the first two letters of the first name and the two first letters of last name of the resident into the boxes, e.g. Peter Smith => P E S M.

5. Your weight 5 years ago:
Please insert the former "usual" weight of the resident in kg or tick "not known".

Sheet IIIb („the resident today“)
Interview of the resident by staff – part II

(Tip! Fill in the codes for 3. and 4. before you copy the entire sheets for the investigation.)

1. Resident's number: Please fill in the resident's number (see sheet 2)

2. Residents' initials- first name □□ and last name□□: Please write the first two letters of the first name and the two first letters of last name of the resident into the boxes, e.g. Peter Smith => P E S M

3. Centre code: Please insert the anonymous Code which you received from the Coordinating Center.

4. Unit: Please insert the anonymous Code which you received from the Coordinating Center.

5. The staff or the residents' relatives can tick the boxes of the questionnaire themselves (for example after the meal, when the plates are removed) or ask the resident for answers.
Plate: The pictures of the plates are the symbol for a normal lunch which could consist of only one dish or include a soup, a main dish and a desert. Evaluate how much food was eaten. Choice of answers:
„all“: ¾ to all of the meal
„1/2“: half of the meal
„1/4“: ½ of the meal
„nothing“: nothing to nearly nothing
„I don´t know“: the resident does not know (and nobody else in the unit) how much the resident has eaten for lunch.

Glasses/cups: Please insert the number of drinks (glasses/cups) which were consumed for lunch. Drinks which were consumed up to 30 minutes after lunch can also be included. Drinks are all drinkable liquids including milk, tea and coffee. One cup contains approximately 200ml. Write „0“ if the resident did not drink anything at lunch.

Supplements: Supplements are all commercially available liquid foods which are used for oral nutritional support (sip feeds, oral nutritional supplements). Please tick the boxes whether supplements have been consumed for lunch including 30 min before and after the meal. Write "0" if the resident did not consume supplements.

Unit resident list and outcome (all participants)

This list remains in the unit. It serves to record all the residents who are attendant in the week of nutritionDay and to evaluate their outcome after 6 months.

1. Centre code: Please insert the anonymous Code which you received from the Coordinating Center.

2. Unit: Please insert the anonymous Code which you received from the Coordinating Center.

3. Habitation after 6 months: Choose a code from the box (A,B,C,…), depending on whether the resident is still in the nursing home, was discharged, died and so on.

4. Date of transfer to another unit, death,…: Fill in the date (dd/mm/yyyy), the outcome (see point 3) occurs.

5. Actual Weight (kg): If the resident is still in the nursing home, please fill in the actual weight including one decimal number.

6. Hospital stays during the last 6 months: Please insert the number of hospital stays and the total number of days the resident stayed in hospital if the resident is still in nursing home

B)

nutritionDay
WORLDWIDE

November 10th 2011

Dear residents,

We are currently participating in the „nutritionDay in nursing homes“ project.

This is a quality measure to investigate nutritional care in our unit. For the information of relatives and visitors, this means that your nutritional intake needs to be documented.

Dear visitors, you can help by assisting the resident to answer the questions on “nutritionDay” (after lunch).

Data collection simply involves a questionnaire and requires no additional blood samples or harm to your relatives.
In case you do not wish your relative to participate in this audit, please inform us. Your relatives will not be disadvantaged in any way if they choose not to participate!

C)

ETHICS-COMMITTEE
OF THE MEDICAL UNIVERSITY OF VIENNA
AND THE
VIENNA GENERAL HOSPITAL - AKH
Borschkegasse 8b/6 - A-1090 Vienna, Austria
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E-Mail: ethik-kom@meduniwien.ac.at
www.meduniwien.ac.at/ethik

406/11/2006) EK Nr. 407/2005

Univ.Prof.Dr. Michael Hiesmayr(1), Dr. Karin Schindler(2), Dr. Almuth Schöniger-Hekele(1)
Univ.Klin.f. Anästhesie u.Allg.Intensivmedizin, Klin.Abt. HTG(1), Univ.Klin.f. Innere Medizin III(2)
Nutrition Day in European Hospitals

Repetition of NutritionDay on January 25th, 2007

(Advice 16.11.2006)

The Ethics-Committee has approved the above mentioned application.

Univ.Prof.Dr. Ernst Singer
Chairperson

November 22nd, 2006

ETHICS-COMMITTEE
OF THE MEDICAL UNIVERSITY OF VIENNA
AND THE
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E-Mail: ethik-kom@meduniwien.ac.at
www.meduniwien.ac.at/ethik

601/10/2007) EK Nr. 407/2005 **Eudract-Nr:.**

Univ.Prof.Dr. Michael Hiesmayr(1), Dr. Karin Schindler(2),
Dr. Almuth Schöniger-Hekele(1)
Univ.Klin.f. Anästhesie u.Allg.Intensivmedizin, Klin.Abt. HTG(1), Univ.Klin.f. Innere Medizin III(2)
Nutrition Day in European Hospitals

Repetition of NutritionDay on January 31th, 2008

(Advice 29.10.2007)

The Ethics-Committee has approved the above mentioned application.

Univ.Prof.Dr. Ernst Singer
Chairperson

November 26th, 2007

ETHIK-KOMMISSION
DER MEDIZINISCHEN UNIVERSITÄT WIEN
UND DES
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342/09/2008) EK Nr. 407/2005 **Eudract-Nr:.**

Univ.Prof.Dr. Michael Hiesmayr(1), Dr. Karin Schindler(2), Dr. Almuth Schöniger-Hekele(1)
Univ.Klin.f. Anästhesie,Allg.Intens.,Schmerzth., Klin.Abt. HTG(1), Univ.Klin.f. Innere Medizin III(2)
Nutrition Day in European Hospitals

Repetition of NutritionDay on January 29th 2009

(Advice 29.09.2008)

The Ethics-Committee has approved the above mentioned application.

Univ.Prof.Dr. Ernst Singer
Chairperson

October 7th, 2008

ETHIK-KOMMISSION
DER MEDIZINISCHEN UNIVERSITÄT WIEN
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088/11/2009) EK Nr. 407/2005 **Eudract-Nr:.**

Univ.Prof.Dr. Michael Hiesmayr(1), Dr. Karin Schindler(2), Dr. Almuth Schöniger-Hekele(1)
Univ.Klin.f. Anästhesie,Allg.Intens.,Schmerzth., Klin.Abt. HTG(1), Univ.Klin.f. Innere Medizin III(2)
Nutrition Day in European Hospitals

Repetition of NutritionDay on January 21th, 2010

(Advice 16.09.2009)

The Ethics-Committee has approved the above mentioned application.

Univ.Prof.Dr. Ernst Singer
Vorsitzender der Kommission

November 16th, 2009

ETHIK-KOMMISSION
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AUSZUG AUS DEM PROTOKOLL DER AMENDMENTS U.DIV.MELDUNGEN DER ETHIK-KOMMISSION VOM JULI 2010

235/07/2010) EK Nr. 407/2005 **Eudract-Nr:.**

Univ.Prof.Dr. Michael Hiesmayr(1), Dr. Karin Schindler(2), Dr. Almuth Schöniger-Hekele(1)
Univ.Klin.f. Anästhesie,Allg.Intens.,Schmerzth., Klin.Abt. HTG(1), Univ.Klin.f. Innere Medizin III(2)
Nutrition Day in European Hospitals

Meldung über eine Wiederholung des NutritionDay und des Nutrition Day in worldwide nursing homes am 4. November 2010
Protokoll vom Juli 2010
Summary

(Meldung 29.07.2010)

Die Kommission nimmt diese Meldung ohne Einspruch zur Kenntnis.

Univ.Prof.Dr. Ernst Singer
Vorsitzender der Kommission

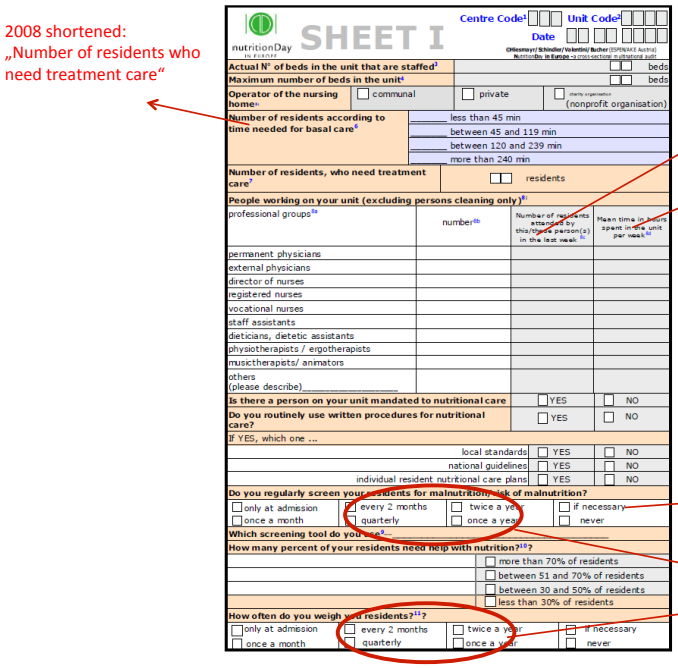
03. August 2010

1/1

D)

Modifications 2007 - 2008

2008 shortened:
„Number of residents who need treatment care“



2008 removed

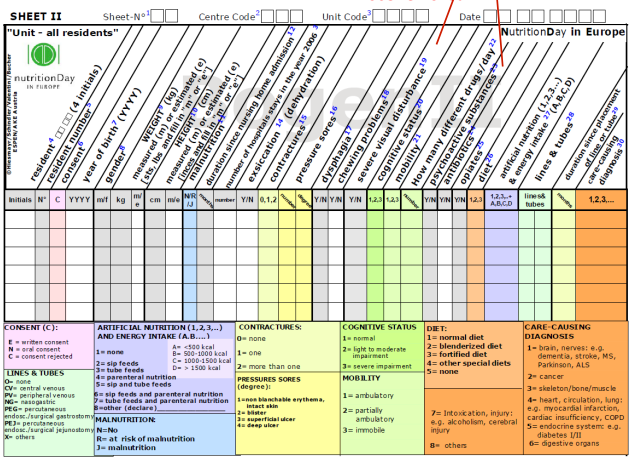
2008: replaced with „time spent in the unit per week“

removed

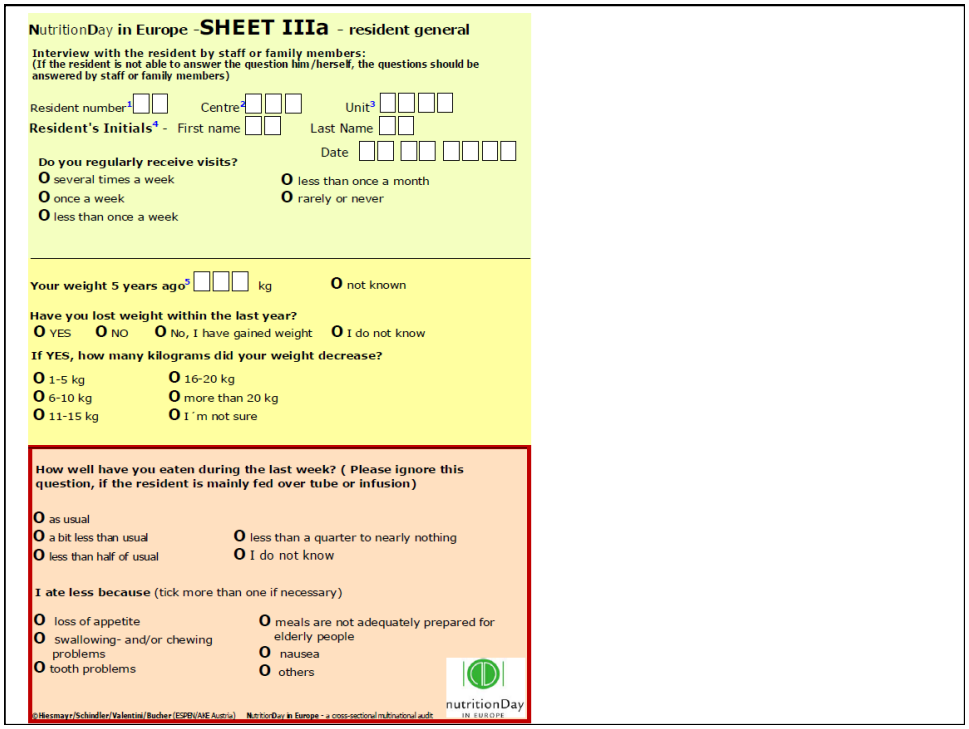
2008 replaced through:
app. 4-6 times a year
app. 1-2 times a year

Modifications 2007 - 2008

„severe visual disturbances“ and „psychoactive substances“ 2008 removed



2008: „level of care“
„antidepressants“ new



NutritionDay in Europe -SHEET IIIa - resident general

Interview with the resident by staff or family members:
(If the resident is not able to answer the question him/herself, the questions should be answered by staff or family members)

Resident number[1] ☐☐ Centre[2] ☐☐☐ Unit[3] ☐☐☐☐

Resident's Initials[4] - First name ☐☐ Last Name ☐☐

Date ☐☐ ☐☐ ☐☐☐☐

Do you regularly receive visits?

- O several times a week
- O once a week
- O less than once a week
- O less than once a month
- O rarely or never

Your weight 5 years ago[5] ☐☐☐ kg O not known

Have you lost weight within the last year?

O YES O NO O No, I have gained weight O I do not know

If YES, how many kilograms did your weight decrease?

- O 1-5 kg
- O 6-10 kg
- O 11-15 kg
- O 16-20 kg
- O more than 20 kg
- O I´m not sure

How well have you eaten during the last week? (Please ignore this question, if the resident is mainly fed over tube or infusion)

- O as usual
- O a bit less than usual
- O less than half of usual
- O less than a quarter to nearly nothing
- O I do not know

I ate less because (tick more than one if necessary)

- O loss of appetite
- O swallowing- and/or chewing problems
- O tooth problems
- O meals are not adequately prepared for elderly people
- O nausea
- O others

Modifications 2007 - 2008

2008: „date of transfer to another unit“ added

Unit resident list and outcome (all residents in the audit)

PLEASE KEEP locally only

Sheet N°. ☐☐

Codification
A = still in nursing home
B = transferred to another nursing home
C = discharge home
D = death
E = others

Centre Code ☐☐☐☐

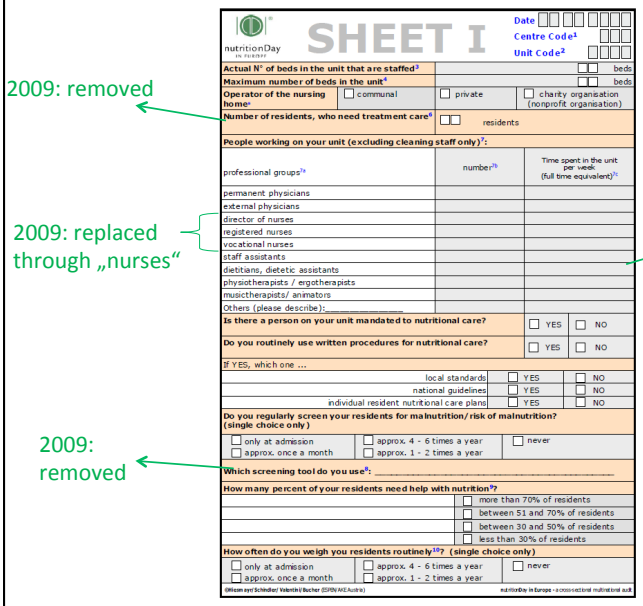
Unit Code ☐☐☐☐

Date of nutritionDay ☐☐☐☐ ☐☐☐☐ Date of outcome-evaluation ☐☐☐☐ ☐☐☐☐

Outcome after 6 months!

firstname lastname date of birth or resident sticker	unit room N° optional	sheet 2 N°	sheet 2 resident number	habitation after 6 months	WEIGHT (kg) only if the resident is still in nursing home!	number of hospital-stays during the last 6 months	Comments (date of transfer to another unit, death,...)
Example Max Muster W 10 01 1948 A 13101	5	1	1	A	75 kg	2	
		1	1				
		1	2				
		1	3				

Modifications 2008 - 2009



2009: removed

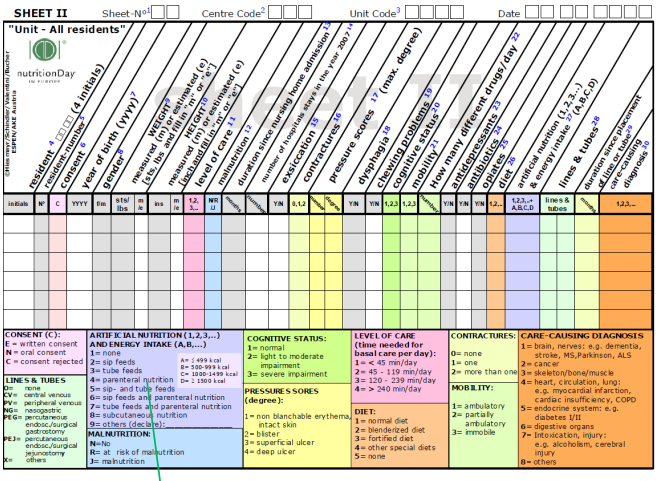
2009: replaced through „nurses“

2009: removed

2009: „community service“ added

2009: „Evaluation of malnutrition….“ new

Modifications 2008 - 2009



2009: answers 5-7 removed

Modifications 2008 - 2009

SHEET IIIb Resident N°[1] ☐☐ Resident´s initials[2] ☐☐ Last name ☐☐ Centre[3] ☐☐☐ Unit[4] ☐☐☐☐

"the resident today"

Date ☐☐ ☐☐ ☐☐☐☐

Interview with the resident by staff or family members:

Please tick a circle to indicate how much you ate and drank for lunch today[5]

LUNCH (please tick)

all | 1/2 | 1/4 | nothing | I do not know

drinks + supplements number

1 ~ 200ml

I did not eat everything because:

- ○ I can not eat without help
- ○ I was not hungry
- ○ I can not eat so much
- ○ I had nausea/vomiting
- ○ I did not like the smell/taste
- ○ I was tired
- ○ meat/vegetables were to hard
- ○ I have swallowing problems

2009: replaced with „I had pain“

To be filled in by staff or family members:

Was the resident helped with this meal?

2009: removed

- ○ no, because he/she does not need any help
- ○ no, because there was no time to do so
- ○ yes, the meal was cut into adequate pieces
- ○ yes, he/she was helped eating for:
  - ○ less than 10 min
  - ○ between 10 and 20 min
  - ○ more than 20 min

©Hiesmayr/Schindler/Valentini/Bucher (ESPEN, Austria)

Modifications 2008 - 2009

2009 new: „actual“ weight
„Hospital stays during 6 months in **number and days**“

Unit resident list and outcome (all residents in the audit)

PLEASE KEEP locally only

Sheet-N° [1] ☐☐

resident number [3] ☐☐☐ corner [4]

Codification
A = still in nursing home
B = transferred to another nursing home
C = discharge home
D = death
E = others

Date of nutritionDay ☐☐☐☐ ☐☐☐☐

nutritionDay IN EUROPE

Centre Code [1] ☐☐☐☐

Unit Code [2] ☐☐☐☐

Date of outcome-evaluation ☐☐☐☐ ☐☐☐☐

Outcome after 6 months

firstname lastname date of birth or resident sticker	unit room N° optional	sheet 2 N°	sheet 2 resident number	habitation after 6 months [3]	date of transfer to another unit, death,...[4]	WEIGHT (kg) [5] only if the resident is still in nursing home!	number of hospital-stays during the last 6 months [5]	Comments
Example Max Muster W 10 01 1948 A I3101	5	1	1	B	24.05.2007	75 kg	2	
		1	1					
		1	2					
		1	3					

	RELEVANT TERMS	YEAR	TYP	DEFINITION	VALID	INVALID	QUESTION/COMMENT
							differentiation for 2.ND in nov 2010
1	year_z	all	numeric	year of participation	2007-2010	other	in tab. ID
2	id	all	string	keyvariable	year(nov)_org (combination)	other	identification
3	country	all	string	country of origin	European	non-European	
4	center_code	all	string	anonymous code of center	1-9999	other	
5	unit_code	all	string	anonymous code of unit	1-9999	other	
6	actual_beds_z	all	numeric	actual staffed beds	5-400	<5, >400	
7	maximum_beds_z	all	numeric	maximal number of beds in unit	>= actual_beds_z, max. 500	< actual_beds_z, > 500	
8	OP_home	all	nominal	1= communal, 2=private, 3=non profit (operator)	1-3	0;>3	
							data from 2008 and younger derived
9	residents_number	all	numeric	residents < 45 min nursing time	<= actual beds	>actual beds	from residents sheet: care_code
							data from 2008 and younger derived
10	residents_number_I	all	numeric	residents 45 - 119 min nursing time	<= actual beds	>actual beds	from residents sheet: care_code
							data from 2008 and younger derived
11	residents_number_II	all	numeric	residents 120 - 239 min nursing time	<= actual beds	>actual beds	from residents sheet: care_code
							data from 2008 and younger derived
12	residents_number_III	all	numeric	residents >= 240 min nursing time	<= actual beds	>actual beds	from residents sheet: care_code
13	residents_number_missing	2008-2010	numeric	no care code in residents tab available /= missing	<= actual beds	>actual beds	
14	SUM residents number	2008-2010	numeric	number of participants	<= actual beds	>actual beds	
15	treatment_care_z	2007,2008	numeric	number of persons who need treatment care	<= actual beds	>actual beds	
16	permanent_physicians_I_z	all	numeric	number of permanent physicians (consultants, registrars,...)	<=10	> 10	
17	permanent_physicians_II_z	2007	numeric	n residents attended by this(these) person(s) in the last week	<= actual beds	>actual beds	
					2007: <= 80; 2008-2010: <=	2007: > 80; 2008-2010: >	
18	permanent_physicians_III_z	all	numeric	2007: average stay on unit / week in hours / person; 2008-2010: time in unit per week (full time equivalents)	permanent_physicians_I_z +10%	permanent_physicians_I_z	
19	external_physicians_I_z	all	numeric	number	<= 30	> 30	
20	external_physicians_II_z	2007	numeric	n residents attended by this(these) person(s) in the last week	<= actual beds	>actual beds	
					2007: <= 80; 2008-2010: <=	2007: > 80; 2008-2010: >	
21	external_physicians_III_z	all	numeric	2007: average stay on unit / week in hours / person; 2008-2010: time in unit per week (full time equivalents)	external_physicians_I_z + 10%	external_physicians_I_z	
22	director_nurses_I_z	all	numeric	number	<= 5	> 5	
23	director_nurses_II_z	2007	numeric	n residents attended by this(these) person(s) in the last week	<= actual beds	>actual beds	
					2007: <= 80; 2008-2010: <=	2007: > 80; 2008-2010:	
24	director_nurses_III_z	all	numeric	2007: average stay on unit / week in hours / person; 2008-2010: time in unit per week (full time equivalents)	director_nurses_I_z+10%	>director_nurses_I_z	
25	nurses_I_z	all	numeric	2007/08: number of registered nurses, 2009/10: number of nurses	<= 30	> 30	only use 2009 and 2010 data
				2007: average stay on unit / week in hours / person; 2008-2010: time in unit per week (full time equivalents),	2007: <= 80; 2008-2010: <=	2007: > 80; 2008-2010: >	
26	nurses_II_z	all	numeric	2007/08: number from "registered nurses" transfered	nurses_I_z+10%	nurses_I_z	only use 2009 and 2010 data
27	nursing_aides_I_z	all	numeric	number	<= 30	> 30	only use 2009 and 2010 data
					2007: <= 80; 2008-2010: <=	2007: > 80; 2008-2010: >	
28	nursing_aides_III_z	all	numeric	2007: average stay on unit / week in hours / person; 2008-2010: time in unit per week (full time equivalents)	nurses_aides_I_z +10%	nurses_aides_I_z	only use 2009 and 2010 data
29	dietetic_assistants_I_z	all	numeric	number	<= 5	> 5	
30	dietetic_assistants_II_z	2007	numeric	n residents attended by this(these) person(s) in the last week	<= actual beds	>actual beds	
					2007: <= 80; 2008-2010: <=	2007: > 80; 2008-2010: >	
31	dietetic_assistants_III_z	all	numeric	2007: average stay on unit / week in hours / person; 2008-2010: time in unit per week (full time equivalents)	dietetic_assistants_I_z+10%	dietetic_assistants_I_z	
32	physiotherapists_I_z	all	numeric	number of physiotherapists, ergotherapists, speech therapists	<= 10	> 10	
33	physiotherapists_II_z	2007	numeric	n residents attended by this(these) person(s) in the last week	<= actual beds	>actual beds	
					2007: <= 80; 2008-2010: <=	2007: > 80; 2008-2010: >	
34	physiotherapists_III_z	all	numeric	2007: average stay on unit / week in hours / person; 2008-2010: time in unit per week (full time equivalents)	physiotherapists_I_z+10%	physiotherapists_I_z	
35	musictherapists_I_z	all	numeric	number of musictherapists and animators	<= 5	> 5	

	RELEVANT TERMS	YEAR	TYP	DEFINITION	VALID	INVALID	QUESTION/COMMENT
36	musictherapists_II_z	2007	numeric	n residents attended by this(these) person(s) in the last week	<= actual beds	>actual beds	
37	musictherapists_III_z	all	numeric	2007: average stay on unit / week in hours / person; 2008-2010: time in unit per week (full time equivalents)	2007: <= 80; 2008-2010: <= musictherapists_I_z+10%	2007: > 80; 2008-2010: > musictherapists_I_z	
38	comm_service_I_z	2009,2010	numeric	number of volunteers	< = 30	> 30	
39	comm_service_II_z	2009,2011	numeric	full-time equivalent of volunteers	< = comm_service_I_z+10%	> comm_service_I_z	
40	people_working_comment	all	string	others: comment	all		
41	nutritional_care_person	all	nominal	person for nutrition care, 1=yes 2007: 0=no; 2008-2010: 2=no	0-2	> 2	
42	nutrition_procedures	all	nominal	routinely use of written procedures, 1=yes; 2007: 0=no; 2008-2010: 2=no;	0-2	> 2	
43	local_protocol	all	nominal	local procedures, 1=yes; 2007: 0=no; 2008-2010: 2=no;	0-2	> 2	
44	national_guidelines	all	nominal	national guidelines, 1=yes; 2007: 0=no; 2008-2010: 2=no;	0-2	> 2	
45	individual_care_plan	all	nominal	individual care plans, 1=yes; 2007: 0=no; 2008-2010: 2=no;	0-2	> 2	
46	NRS_tool	2007	nominal	screening tool used; yes=1/no(or not filled) =0 or .	0;1;"."	other	
47	MUST_tool	2007,2008	nominal	screening tool used; yes=1/no(or not filled) =0 or .	0;1;"."	other	
48	national_tool	2007	nominal	screening tool used; yes=1/no(or not filled) =0 or .	0;1;"."	other	
49	local_tool	2007	nominal	screening tool used; yes=1/no(or not filled) =0 or .	0;1;"."	other	
50	tool_comment	2007,2008	string	screening tool used	all		
51	eval_malnutrition 0	2009,2010	nominal	evaluation of malnutrition by use of...0 = answer, 1=no answer; 1= weight, 2=screening, 3=weight course, 4=clinical view, 5=biochemical parameter, 6=others, 7=not known	0;1;	other	
52	eval_malnutrition 1	2009,2010	nominal	evaluation of malnutrition by use of...0= not selected, 1= weight	0;1;	other	
53	eval_malnutrition 2	2009,2010	nominal	evaluation of malnutrition by use of...0= not selected, 1=screening	0;1;	other	
54	eval_malnutrition 3	2009,2010	nominal	evaluation of malnutrition by use of...0= not selected, 1= weight course	0;1;	other	
55	eval_malnutrition 4	2009,2010	nominal	evaluation of malnutrition by use of...0= not selected, 1= clinical view	0;1;	other	
56	eval_malnutrition 5	2009,2010	nominal	evaluation of malnutrition by use of...0= not selected, 1= biochemical parameter	0;1;	other	
57	eval_malnutrition 6	2009,2010	nominal	evaluation of malnutrition by use of...0= not selected, 1= others	0;1;	other	
58	eval_malnutrition 7	2009,2010	nominal	evaluation of malnutrition by use of...0= not selected, 1=not known	0;1;	other	
59	eval_malnutrition n	2009,2010	scale	total number of choices in eval_malnutrition 0-7	0-7	other	
60	residents_need_help	all	ordinal	percentage of residents needing help with nutrition: 1=>=70%, 2=51-70%, 3=30-50%, 4=<30%, 5="-", 0=please choose	0-5	other	
61	number_of_weigh	2008-2010	ordinal	weighing routine: 0=not filled, 1=at admission, 2=once a month, 3=approx.4-6/year, 4=approx.1-2/year, 5=never, 6="-"	0-6;"-"	other	
62	number_of_weigh 0	2007	nominal	weighing routine: 0=answer, 1=no answer	0;1;	other	
63	number_of_weigh 1	2007	nominal	weighing routine: 0=not filled, 1=at admission			
64	number_of_weigh 2	2007	nominal	weighing routine: 0=not filled, 1=every 2 mo			
65	number_of_weigh 3	2007	nominal	weighing routine: 0=not filled, 1=twice a year			
66	number_of_weigh 4	2007	nominal	weighing routine: 0=not filled, 1=if necessary			
67	number_of_weigh 5	2007	nominal	weighing routine: 0=not filled, 1=once a month			
68	number_of_weigh 6	2007	nominal	weighing routine: 0=not filled, 1=quarterly			
69	number_of_weigh 7	2007	nominal	weighing routine: 0=not filled, 1=once a year			
70	number_of_weigh 8	2007	nominal	weighing routine: 0=not filled, 1=never			
71	number_of_weigh n	2007	nominal	total number of choices in number_of_weigh 0-8	0-8	other	combined answers not reasonable
72	nutri_care_plan	2008-2010	ordinal	screening routine: 0=not filled, 1=at admission, 2=once a month, 3=approx.4-6/year, 4=approx.1-2/year, 5=never, 6="-"	0-6;"-"	other	
73	nutri_care_plan 0	2007	ordinal	screening routine: 0=answer, 1=no answer	0;1;	other	
74	nutri_care_plan 1	2007	ordinal	screening routine: 0=not filled, 1=at admission	0;1;	other	
75	nutri_care_plan 2	2007	ordinal	screening routine: 0=not filled, 1=every 2 mo	0;1;	other	
76	nutri_care_plan 3	2007	ordinal	screening routine: 0=not filled, 1=twice a year	0;1;	other	
77	nutri_care_plan 4	2007	ordinal	screening routine: 0=not filled, 1=if necessary	0;1;	other	
78	nutri_care_plan 5	2007	ordinal	screening routine: 0=not filled, 1=once a month	0;1;	other	
79	nutri_care_plan 6	2007	ordinal	screening routine: 0=not filled, 1=quarterly	0;1;	other	
80	nutri_care_plan 7	2007	ordinal	screening routine: 0=not filled, 1=once a year	0;1;	other	
81	nutri_care_plan 8	2007	ordinal	screening routine: 0=not filled, 1=never	0;1;	other	
82	nutri_care_plan n	2007	nominal	total number of choices in number_of_weigh 0-5	0-6	other	combined answers not reasonable
83	residents	all	numeric	number of residents in unit with filled residents sheets	<=170	>170	

	RELEVANT TERMS	YEAR	TYP/MEASURE	DEFINITION	VALID	INVALID	QUESTION/COMMENT
1	id	all	string	identification and key variable	year(nov)_org	other	
2	year_z	all	nominal	year of participation	2007-2010	other	differentiation for 2.ND in nov 2010 in tab. ID
3	country	all	string	country of origin	European	non-European	
4	center_code	all	string	anonymous code of center	1-9999	other	
5	unit_code	all	string	anonymous code of unit	1-9999	other	
6	S3a	all	string	sheet 3a available	ja, nein	other	
7	S3b	all	string	sheet 3b available	ja, nein	other	
8	code	all	nominal	consent to participation: 0=not chosen, 1=written consent, 2=oral consent, 3=consent rejected	0-2	3	
9	sex	all	nominal	gender: 1=female, 2= male, 3=? 0=missing	1-3	0	
10	birthyear_z	all	nominal	birthyear as number	<=year_z-50	>year_z-50	
11	age	all	scale	calculated	>=65, <=120	<65, >120	
12	weight_z	all	scale	weight in kg	>=15kg,<=250 kg	<15kg,> 250 kg	
13	weight_code	all	nominal	2007: weight estimated (2) or measured (1), ab 2008: weight estimated (1) or measured (2)	1;2;	other	
14	height_z	all	scale	height in cm	>=100cm,<=220cm	<100cm,>220cm	
15	height_code	all	nominal	2007: height estimated (2) or measured (1), ab 2008 height estimated (1) or measured (2)	1;2;	other	
16	BMI	all	scale	Body Mass Index, calculated	>=10, <=90	<10, >90	
17	malnutrition_code	all	nominal	malnutrition: 0= no answer, 1=No, 2=at risk, 3=yes, subjective assessment by staff	0-3	other	
18	how_many_different_drugs_z	all	scale	how many different drugs/day?	<=30, "."	>30	
19	duration_since_unit_admission_z	all	scale	time in months	<=1000	>1000	
20	duration_since_hospital_admission_z	all	scale	number of hospital stays in the last year	<=50	>50	
21	exsiccation	all	nominal	exsiccation 0=no answer, 1=yes, 2=no, 3=?	0-3	other	2007: only "yes" or "no", "no" can also mean "no answer"
22	contractures_code	all	ordinal	contractures 1=none, 2=one, 3=more than one	1-3	other	
23	pressure_sores_code	all	ordinal	max. degree pressure scores: 0=no answer, 1=intact skin, 2=blister, 3=superficial ulcer, 4=deep ulcer	0-4	other	
24	pressure_sores_number_z	2007,2008	scale	number of pressure scores, "."= no answer	<=10, "."	>10	
25	cognitive_status	all	nominal	cognitiver status: 0=no answer, 1=normal, 2=light-moderate, 3=severe, 4="-"	0-4	other	2007 no "_"
26	mobility	all	nominal	mobility: 0=no answer, 1=ambulatory, 2=partially mobile, 3=immobile, "-"	0-4	other	2008 no "_"
27	dysphagia	all	nominal	dysphagia 0=no answer, 1=yes, 2=no, 3=?	0-3	other	2007: only "yes" or "no"
28	chewing_problems	all	nominal	chewing_problems: 0=no answer, 1=yes, 2=no, 3=?	0-3	other	2007: only "yes" or "no"
29	severe_visual_disturbance	2007	nominal	severe visual disturbance: 1=yes	0;1;	other	
30	psychoactive_substances	all	nominal	psychoact. substances 0=no answer, 1=yes, 2=no, 3=?	0-3	other	2007: only "yes" or "no", ab 2008 "antidepressants"
31	antibiotics	all	nominal	antibiotics: 0=no answer, 1=yes, 2=no, 3=?	0-3	other	2007: only "yes" or "no"
32	opiates	all	nominal	opiates: 0=no answer, 1=yes, 2=no, 3=?	0-3	other	2007: only "yes" or "no"
33	diet_status	all	nominal	diet: 0=no answer, 1=normal, 2=blenderized, 3=fortified, 4=other special, 5=none	0-5	other	
34	nutrition_therapeutic_description	all	string	description of other form of artificial nutrition			

	RELEVANT TERMS	YEAR	TYP/MEASURE	DEFINITION	VALID	INVALID	QUESTION/COMMENT
35	nutrition_therapeutic_code0	all	nominal	0=answer, 1= no answer	0;1;	other	
36	nutrition_therapeutic_code1	all	nominal	0=not selected, 1=none	0;1;	other	
37	nutrition_therapeutic_code2	all	nominal	0=not selected, 1=sip feed	0;1;	other	
38	nutrition_therapeutic_code3	all	nominal	0=not selected, 1=tube feed	0;1;	other	
39	nutrition_therapeutic_code4	all	nominal	0=not selected, 1=parenteral nutrition	0;1;	other	
40	nutrition_therapeutic_code5	all	nominal	0=not selected, 2007/08: 1=sip and tube feed 2009/10: 1=subcutaneous	0;1;	other	
41	nutrition_therapeutic_code6	all	nominal	0=not selected, 2007/08: 1=sip and parent. feed 2009/10: 1=others	0;1;	other	
42	nutrition_therapeutic_code7	2007,2008	nominal	0=not selected, 2007/08: 1=tube and parent. nutrition	0;1;	other	
43	nutrition_therapeutic_code8	2007,2008	nominal	0=not selected, 2007/08: 1=others	0;1;	other	
44	nutrition_therapeutic_coden	all	scale	number of chosen answers;	<=5	<5	
45	caloric_intake_code	all	nominal	energy intake with artificial therapy: 0=no answer, 1=<500kcal, 2=500-1000kcal, 3=1000-1500kcal, 4=1500-2000kcal (2007/08) >=1500kcal (2009/10), 5=>=2000kcal (2007/08)	0-5	other	
46	lines_tubes_code1	all	nominal	lines and tubes: 0=no answer, 1=none, 2=CV, 3=PV, 5=NG, 6=PEG, 7=PEJ, 8=others	0-3;5-8	4, >8	4 no code
47	lines_tubes_code2	all	nominal	lines and tubes: 0=no answer, 1=none, 2=CV, 3=PV, 5=NG, 6=PEG, 7=PEJ, 8=others	0-3;5-8	4, >8	5 no code
48	lines_tubes_code3	2007,2008	nominal	lines and tubes: 0=no answer, 1=none, 2=CV, 3=PV, 5=NG, 6=PEG, 7=PEJ, 8=others	0-3;5-8	4, >8	6 no code
49	placement_of_line_tubes1_z	all	scale	duration of tube/line placement in months	<age	>=age	
50	placement_of_line_tubes2_z	all	scale	duration of tube/line placement in months	<age	>=age	
51	placement_of_line_tubes3_z	2007,2008	scale	duration of tube/line placement in months	<age	>=age	
52	affected_organs_code0	all	nominal	care-causing diagnosis: 0=answer available, 1=no answer	0;1;	other	
53	affected_organs_code1	all	nominal	care-causing diagnosis: 0=not selected, 1=brain,nerves	0;1;	other	
54	affected_organs_code2	all	nominal	care-causing diagnosis: 0=not selected, 1=tumor, cancer	0;1;	other	
55	affected_organs_code3	all	nominal	care-causing diagnosis: 0=not selected, 1=sceleton, bone, muscle	0;1;	other	
56	affected_organs_code4	all	nominal	care-causing diagnosis: 0=not selected, 1=heart, circulation	0;1;	other	
57	affected_organs_code5	all	nominal	care-causing diagnosis: 0=not selected, 1=endocrine sys.	0;1;	other	
58	affected_organs_code6	all	nominal	care-causing diagnosis: 0=not selected, 1=digestive	0;1;	other	
59	affected_organs_code7	all	nominal	care-causing diagnosis: 0=not selected, 1=inoxitation	0;1;	other	
60	affected_organs_code8	all	nominal	care-causing diagnosis: 0=not selected, 1=others	0;1;	other	
61	affected_organs_coden	all	scale	number of chosen answers;	<=8	>8	
62	outcome_code	all	nominal	outcome: 0=no answer, 1=in NH, 2=transferred other NH, 3=discharged home, 4=death, 5=others	0-5	other	
63	outcome_weight_z	all	scale	weight at outcome	15-250, "."	<15,>250kg	
64	outcome_number_hospital_stays_z	all	scale	number of hospital stays in last 6 months	0-20, "."	other	
65	outcome_number_days_hospital_stays _z	2009,2010	scale	number days of hospital stays in last 6 months	0-200, "."	other	
66	notweight	all	nominal	resident´s weight 5 years ago not known: 0=weight, 1=not known, "."=not filled	0;1;"."	other	
67	weightago_z	all	scale	weight 5 years ago	15-250	other	
68	lostweight	all	nominal	lost weight in last year? 0=no answer, 1=Yes, 2=no, 3=no, gained weight, 4=don´t know	0-4	other	
69	weightdecrease	all	nominal	if weight loss, how many? 0=no answer, 1=1-5kg, 2=>5-15kg, 3=>15kg, 4=not sure	0-4	other	

	RELEVANT TERMS	YEAR	TYP/MEASURE	DEFINITION	VALID	INVALID	QUESTION/COMMENT
70	welleaten	all	nominal	how well eaten during last week? (appetite): 0= no answer, 1=as usual, 2=a bit less than usual, 3=less than half of usual, 4=less than a quarter to nearly nothing, 5=I do not know	0-5	other	
71	lesseaten0	all	nominal	reasons for less eating: 0=answer, 1= no answer	0;1;"."	other	
72	lesseaten1	all	nominal	reasons for less eating: 0=no answer, 1=loss of appetite	0;1;"."	other	
73	lesseaten2	all	nominal	reasons for less eating: 0=no answer, 1=swallowing/chewing problems	0;1;"."	other	
74	lesseaten3	all	nominal	reasons for less eating: 0=no answer, 1=tooth problems	0;1;"."	other	
75	lesseaten4	all	nominal	reasons for less eating: 0=no answer, 1=meals not adequately prepared	0;1;"."	other	
76	lesseaten5	all	nominal	reasons for less eating: 0=no answer, 1=nausea	0;1;"."	other	
77	lesseaten6	all	nominal	reasons for less eating: 0=no answer, 1=others	0;1;"."	other	
78	lesseatenn	all	scale	number of answers chosen	0-6	other	
79	visits	all	nominal	regul. received visits: 0 or "."=no answer, 1=several times/week, 2=once/week, 3=<once/week, 4=<once/month, 5=rarly or never	0-5, "."	other	
80	lunch_eaten	all	nominal	amount of lunch eaten on nDay: 0 or "-"=no answer, 1=all, 2=half, 3=quarter, 4=nothing, 5=don´t know	0-5, ".","-"	other	
81	lunch_noteat0	all	nominal	reasons for not eating: 0=answer, 1= no answer	0;1;"."	other	
82	lunch_noteat1	all	nominal	reasons for not eating: 0=no answer, 1= cannot eat without help	0;1;"."	other	
83	lunch_noteat2	all	nominal	reasons for not eating: 0=no answer, 1= didn´t like smell/taste	0;1;"."	other	
84	lunch_noteat3	all	nominal	reasons for not eating: 0=no answer, 1= not hungry	0;1;"."	other	
85	lunch_noteat4	all	nominal	reasons for not eating: 0=no answer, 1= tired	0;1;"."	other	
86	lunch_noteat5	all	nominal	reasons for not eating: 0=no answer, 1= cannot eat so much	0;1;"."	other	
87	lunch_noteat6	all	nominal	reasons for not eating: 0=no answer, 1= too hard	0;1;"."	other	
88	lunch_noteat7	all	nominal	reasons for not eating: 0=no answer, 1= nausea/vomiting	0;1;"."	other	
89	lunch_noteat8	all	nominal	reasons for not eating: 0=no answer, 1= swallowing problems	0;1;"."	other	
90	lunch_noteatn	all	scale	number of answers chosen	0-8		
91	helped_meal0	all	nominal	was resident helped with this meal? 0=answer, 1=no answer	0;1;"."	other	
92	helped_meal1	all	nominal	was resident helped with this meal? 0=no answer, 1=no, does not need	0;1;"."	other	
93	helped_meal2	all	nominal	was resident helped with this meal? 0=no answer, 1=no, no time	0;1;"."	other	
94	helped_meal3	all	nominal	was resident helped with this meal? 0=no answer, 1=yes, cut into pieces	0;1;"."	other	
95	helped_meal4	all	nominal	was resident helped with this meal? 0=no answer, 1=yes, helped eating for	0;1;"."	other	
96	helped_mealn	all	scale	number of answers chosen	0-4	other	
97	helped_eating	all	nominal	time of help with this meal: 0 or "."=no answer, 1=<10min, 2=10-20 min, 3=>20min	0-3; "."	other	
98	lunch_drink1_z	all	scale	number of drinks (à 200 ml)	0-15	other	
99	lunch_drink2_z	all	scale	number of supplements (à 200 ml)	0-15	other	
100	patients_NotGiveConsent	all	nominal	1=resident does not give consent	0;1;	other	like "code"

Correlations

Important predictor variables of the multivariable analyses were checked for correlations. The results are shown in this table.

			cognitive status	lost weight in last year	BMI_grouped	number of drinks (à 200ml)	appetite in last week	amount of lunch eaten on nutrition Day	age divided by 10	mobility	pressure sore	antibiotics	diet status	different drugs/day	duration since unit admission in months	gender	malnutrition by staff
Kendall's tau_b	cognitive status	Correlation Coefficient	1	-,053**	-,171**	-,068**	,097**	,082**	,043**	,286**	-,032**	0,001	,193**	-,117**	,117**	,062**	,182**
		Sig. (2-tailed)	.	0	0	0	0	0	0	0	0	0,893	0	0	0	0	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	lost weight in last year	Correlation Coefficient	-,053**	1	,155**	0,007	-,059**	-,053**	-,044**	-,088**	,043**	0,017	-,051**	-,030**	-,082**	-,020*	-,120**
		Sig. (2-tailed)	0	.	0	0,446	0	0	0	0	0	0,062	0	0	0	0,029	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	BMI_grouped	Correlation Coefficient	-,171**	,155**	1	,109**	-,141**	-,157**	-,119**	-,158**	,080**	-0,014	-,137**	,110**	0,011	-0,014	-,447**
		Sig. (2-tailed)	0	0	.	0	0	0	0	0	0	0,142	0	0	0,159	0,132	0
		N	9647	9647	9647	8472	9647	9647	9632	9647	9647	9647	9647	9592	9510	9647	9647
	number of drinks (à 200ml)	Correlation Coefficient	-,068**	0,007	,109**	1	-,072**	-,127**	-,026**	-,065**	-0,014	-,027**	-,073**	,069**	-,031**	-,035**	-,091**
		Sig. (2-tailed)	0	0,446	0	.	0	0	0,002	0	0,14	0,007	0	0	0	0	0
		N	8713	8713	8472	8713	8713	8713	8691	8713	8713	8713	8713	8652	8580	8713	8713
	appetite in last week	Correlation Coefficient	,097**	-,059**	-,141**	-,072**	1	,371**	,027**	,126**	-,064**	-,024*	,127**	-0,003	-0,007	0,016	,161**
		Sig. (2-tailed)	0	0	0	0	.	0	0,001	0	0	0,013	0	0,676	0,389	0,101	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	amount of lunch eaten on nutritionDay	Correlation Coefficient	,082**	-,053**	-,157**	-,127**	,371**	1	,068**	,130**	-,048**	-,019*	,109**	-0,003	,019*	,053**	,142**
		Sig. (2-tailed)	0	0	0	0	0	.	0	0	0	0,04	0	0,748	0,016	0	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	age divided by 10	Correlation Coefficient	,043**	-,044**	-,119**	-,026**	,027**	,068**	1	,054**	,019*	,018*	-,044**	-,040**	,064**	,189**	,075**
		Sig. (2-tailed)	0	0	0	0,002	0,001	0	.	0	0,02	0,031	0	0	0	0	0
		N	9913	9913	9632	8691	9913	9913	9913	9913	9913	9913	9913	9850	9781	9913	9913
	mobility	Correlation Coefficient	,286**	-,088**	-,158**	-,065**	,126**	,130**	,054**	1	-,089**	-0,013	,262**	-0,004	,113**	,054**	,196**
		Sig. (2-tailed)	0	0	0	0	0	0	0	.	0	0,156	0	0,66	0	0	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	pressure sore	Correlation Coefficient	-,032**	,043**	,080**	-0,014	-,064**	-,048**	,019*	-,089**	1	,032**	-,053**	-,050**	,026**	,024*	-,056**
		Sig. (2-tailed)	0	0	0	0,14	0	0	0,02	0	.	0,001	0	0	0,001	0,013	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	antibiotics	Correlation Coefficient	0,001	0,017	-0,014	-,027**	-,024*	-,019*	,018*	-0,013	,032**	1	0,005	-,065**	,034**	0,012	,038**
		Sig. (2-tailed)	0,893	0,062	0,142	0,007	0,013	0,04	0,031	0,156	0,001	.	0,594	0	0	0,221	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	diet status	Correlation Coefficient	,193**	-,051**	-,137**	-,073**	,127**	,109**	-,044**	,262**	-,053**	0,005	1	-,037**	,093**	0,003	,215**
		Sig. (2-tailed)	0	0	0	0	0	0	0	0	0	0,594	.	0	0	0,746	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	different drugs/day	Correlation Coefficient	-,117**	-,030**	,110**	,069**	-0,003	-0,003	-,040**	-0,004	-,050**	-,065**	-,037**	1	-,076**	0,003	-,081**
		Sig. (2-tailed)	0	0	0	0	0,676	0,748	0	0,66	0	0	0	.	0	0,725	0
		N	9865	9865	9592	8652	9865	9865	9850	9865	9865	9865	9865	9865	9732	9865	9865
	duration since unit admission in months	Correlation Coefficient	,117**	-,082**	0,011	-,031**	-0,007	,019*	,064**	,113**	,026**	,034**	,093**	-,076**	1	,059**	,040**
		Sig. (2-tailed)	0	0	0,159	0	0,389	0,016	0	0	0,001	0	0	0	.	0	0
		N	9784	9784	9510	8580	9784	9784	9781	9784	9784	9784	9784	9732	9784	9784	9784
	gender	Correlation Coefficient	,062**	-,020*	-0,014	-,035**	0,016	,053**	,189**	,054**	,024*	0,012	0,003	0,003	,059**	1	,031**
		Sig. (2-tailed)	0	0,029	0,132	0	0,101	0	0	0	0,013	0,221	0,746	0,725	0	.	0,001
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	malnutrition by staff	Correlation Coefficient	,182**	-,120**	-,447**	-,091**	,161**	,142**	,075**	,196**	-,056**	,038**	,215**	-,081**	,040**	,031**	1
		Sig. (2-tailed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0,001	.
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
		Correlation															

"appetite in last week" = intake last week

Spearman's rho	cognitive status	Correlation Coefficient	1	-,062**	-,195**	-,077**	,107**	,092**	,054**	,319**	-,035**	0,001	,218**	-,145**	,150**	,066**	,201**
		Sig. (2-tailed)	.	0	0	0	0	0	0	0	0	0,89	0	0	0	0	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	lost weight in last year	Correlation Coefficient	-,062**	1	,183**	0,008	-,060**	-,059**	-,058**	-,102**	,048**	0,019	-,060**	-,038**	-,108**	-,022*	-,138**
		Sig. (2-tailed)	0	.	0	0,438	0	0	0	0	0	0,062	0	0	0	0,029	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	BMI_grouped	Correlation Coefficient	-,195**	,183**	1	,126**	-,160**	-,179**	-,154**	-,181**	,089**	-0,015	-,157**	,139**	0,014	-0,015	-,497**
		Sig. (2-tailed)	0	0	.	0	0	0	0	0	0	0,142	0	0	0,162	0,131	0
		N	9647	9647	9647	8472	9647	9647	9632	9647	9647	9647	9647	9592	9510	9647	9647
	number of drinks (à 200ml)	Correlation Coefficient	-,077**	0,008	,126**	1	-,080**	-,141**	-,034**	-,074**	-0,016	-,029**	-,084**	,086**	-,041**	-,038**	-,103**
		Sig. (2-tailed)	0	0,438	0	.	0	0	0,002	0	0,139	0,007	0	0	0	0	0
		N	8713	8713	8472	8713	8713	8713	8691	8713	8713	8713	8713	8652	8580	8713	8713
	appetite in last week	Correlation Coefficient	,107**	-,060**	-,160**	-,080**	1	,399**	,033**	,140**	-,068**	-,025*	,140**	-0,004	-0,009	0,016	,175**
		Sig. (2-tailed)	0	0	0	0	.	0	0,001	0	0	0,014	0	0,681	0,387	0,101	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	amount of lunch eaten on nutritionDay	Correlation Coefficient	,092**	-,059**	-,179**	-,141**	,399**	1	,086**	,145**	-,052**	-,021*	,122**	-0,003	,024*	,057**	,156**
		Sig. (2-tailed)	0	0	0	0	0	.	0	0	0	0,041	0	0,742	0,016	0	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	age divided by 10	Correlation Coefficient	,054**	-,058**	-,154**	-,034**	,033**	,086**	1	,069**	,023*	,022*	-,057**	-,056**	,091**	,228**	,093**
		Sig. (2-tailed)	0	0	0	0,002	0,001	0	.	0	0,021	0,031	0	0	0	0	0
		N	9913	9913	9632	8691	9913	9913	9913	9913	9913	9913	9913	9850	9781	9913	9913
	mobility	Correlation Coefficient	,319**	-,102**	-,181**	-,074**	,140**	,145**	,069**	1	-,096**	-0,014	,296**	-0,005	,146**	,058**	,216**
		Sig. (2-tailed)	0	0	0	0	0	0	0	.	0	0,158	0	0,635	0	0	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	pressure sore	Correlation Coefficient	-,035**	,048**	,089**	-0,016	-,068**	-,052**	,023*	-,096**	1	,033**	-,058**	-,060**	,033**	,025*	-,060**
		Sig. (2-tailed)	0	0	0	0,139	0	0	0,021	0	.	0,001	0	0	0,001	0,013	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	antibiotics	Correlation Coefficient	0,001	0,019	-0,015	-,029**	-,025*	-,021*	,022*	-0,014	,033**	1	0,005	-,077**	,042**	0,012	,040**
		Sig. (2-tailed)	0,89	0,062	0,142	0,007	0,014	0,041	0,031	0,158	0,001	.	0,59	0	0	0,221	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	diet status	Correlation Coefficient	,218**	-,060**	-,157**	-,084**	,140**	,122**	-,057**	,296**	-,058**	0,005	1	-,046**	,119**	0,003	,237**
		Sig. (2-tailed)	0	0	0	0	0	0	0	0	0	0,59	.	0	0	0,746	0
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	different drugs/day	Correlation Coefficient	-,145**	-,038**	,139**	,086**	-0,004	-0,003	-,056**	-0,005	-,060**	-,077**	-,046**	1	-,108**	0,004	-,099**
		Sig. (2-tailed)	0	0	0	0	0,681	0,742	0	0,635	0	0	0	.	0	0,725	0
		N	9865	9865	9592	8652	9865	9865	9850	9865	9865	9865	9865	9865	9732	9865	9865
	duration since unit admission in months	Correlation Coefficient	,150**	-,108**	0,014	-,041**	-0,009	,024*	,091**	,146**	,033**	,042**	,119**	-,108**	1	,072**	,050**
		Sig. (2-tailed)	0	0	0,162	0	0,387	0,016	0	0	0,001	0	0	0	.	0	0
		N	9784	9784	9510	8580	9784	9784	9781	9784	9784	9784	9784	9732	9784	9784	9784
	gender	Correlation Coefficient	,066**	-,022*	-0,015	-,038**	0,016	,057**	,228**	,058**	,025*	0,012	0,003	0,004	,072**	1	,032**
		Sig. (2-tailed)	0	0,029	0,131	0	0,101	0	0	0	0,013	0,221	0,746	0,725	0	.	0,001
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
	malnutrition by staff	Correlation Coefficient	,201**	-,138**	-,497**	-,103**	,175**	,156**	,093**	,216**	-,060**	,040**	,237**	-,099**	,050**	,032**	1
		Sig. (2-tailed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0,001	.
		N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Correlations

Pearson Correlation		cognitive status	lost weight in last year	BMI_grouped	number of drinks (à 200ml)	appetite in last week	amount of lunch eaten on nutrition Day	age divided by 10	mobility	pressure sore	antibiotics	diet status	different drugs/day	duration since unit admission in months	gender	malnutrition by staff
cognitive status	Pearson Correlation	1	-,040**	-,193**	-,053**	,111**	,116**	,061**	,322**	-,027**	0,01	,157**	-,144**	,106**	,066**	,196**
	Sig. (2-tailed)		0	0	0	0	0	0	0	0,007	0,338	0	0	0	0	0
	N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
lost weight in last year	Pearson Correlation	-,040**	1	,141**	-0,005	,185**	,081**	-,057**	-,083**	,027**	0,018	-0,002	-,035**	-,040**	-,030**	-,077**
	Sig. (2-tailed)	0		0	0,642	0	0	0	0	0,006	0,075	0,851	0	0	0,003	0
	N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
BMI_grouped	Pearson Correlation	-,193**	,141**	1	,079**	-,113**	-,127**	-,140**	-,181**	,077**	-0,014	-,091**	,139**	0,004	-0,016	-,449**
	Sig. (2-tailed)	0	0		0	0	0	0	0	0	0,172	0	0	0,708	0,111	0
	N	9647	9647	9647	8472	9647	9647	9632	9647	9647	9647	9647	9592	9510	9647	9647
number of drinks (à 200ml)	Pearson Correlation	-,053**	-0,005	,079**	1	-,060**	-,071**	-,024*	-,042**	-0,014	-0,019	-,041**	,060**	-0,018	-,039**	-,050**
	Sig. (2-tailed)	0	0,642	0		0	0	0,025	0	0,19	0,084	0	0	0,097	0	0
	N	8713	8713	8472	8713	8713	8713	8691	8713	8713	8713	8713	8652	8580	8713	8713
appetite in last week	Pearson Correlation	,111**	,185**	-,113**	-,060**	1	,511**	-,021*	,141**	-,054**	0,003	,204**	-,022*	-0,002	-0,003	,124**
	Sig. (2-tailed)	0	0	0	0		0	0,039	0	0	0,747	0	0,032	0,816	0,771	0
	N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
amount of lunch eaten on nutritionDay	Pearson Correlation	,116**	,081**	-,127**	-,071**	,511**	1	-0,01	,149**	-,047**	-0,003	,209**	-0,02	0,005	,034**	,111**
	Sig. (2-tailed)	0	0	0	0	0		0,329	0	0	0,788	0	0,05	0,636	0,001	0
	N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
age divided by 10	Pearson Correlation	,061**	-,057**	-,140**	-,024*	-,021*	-0,01	1	,050**	,054**	0,014	-,083**	-,047**	0,007	,243**	,072**
	Sig. (2-tailed)	0	0	0	0,025	0,039	0,329		0	0	0,161	0	0	0,495	0	0
	N	9913	9913	9632	8691	9913	9913	9913	9913	9913	9913	9913	9850	9781	9913	9913
mobility	Pearson Correlation	,322**	-,083**	-,181**	-,042**	,141**	,149**	,050**	1	-,072**	-0,006	,225**	0,004	,102**	,058**	,204**
	Sig. (2-tailed)	0	0	0	0	0	0	0		0	0,573	0	0,689	0	0	0
	N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
pressure sore	Pearson Correlation	-,027**	,027**	,077**	-0,014	-,054**	-,047**	,054**	-,072**	1	,024*	-,031**	-,058**	0,01	,023*	-,029**
	Sig. (2-tailed)	0,007	0,006	0	0,19	0	0	0	0		0,019	0,002	0	0,311	0,024	0,004
	N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
antibiotics	Pearson Correlation	0,01	0,018	-0,014	-0,019	0,003	-0,003	0,014	-0,006	,024*	1	,031**	-,078**	,125**	0,012	,073**
	Sig. (2-tailed)	0,338	0,075	0,172	0,084	0,747	0,788	0,161	0,573	0,019		0,002	0	0	0,229	0
	N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
diet status	Pearson Correlation	,157**	-0,002	-,091**	-,041**	,204**	,209**	-,083**	,225**	-,031**	,031**	1	-0,005	,070**	0,001	,167**
	Sig. (2-tailed)	0	0,851	0	0	0	0	0	0	0,002	0,002		0,631	0	0,884	0
	N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
different drugs/day	Pearson Correlation	-,144**	-,035**	,139**	,060**	-,022*	-0,02	-,047**	0,004	-,058**	-,078**	-0,005	1	-0,008	-0,002	-,082**
	Sig. (2-tailed)	0	0	0	0	0,032	0,05	0	0,689	0	0	0,631		0,448	0,865	0
	N	9865	9865	9592	8652	9865	9865	9850	9865	9865	9865	9865	9865	9732	9865	9865
duration since unit admission in months	Pearson Correlation	,106**	-,040**	0,004	-0,018	-0,002	0,005	0,007	,102**	0,01	,125**	,070**	-0,008	1	,021*	,110**
	Sig. (2-tailed)	0	0	0,708	0,097	0,816	0,636	0,495	0	0,311	0	0	0,448		0,039	0
	N	9784	9784	9510	8580	9784	9784	9781	9784	9784	9784	9784	9732	9784	9784	9784
gender	Pearson Correlation	,066**	-,030**	-0,016	-,039**	-0,003	,034**	,243**	,058**	,023*	0,012	0,001	-0,002	,021*	1	,034**
	Sig. (2-tailed)	0	0,003	0,111	0	0,771	0,001	0	0	0,024	0,229	0,884	0,865	0,039		0,001
	N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946
malnutrition by staff	Pearson Correlation	,196**	-,077**	-,449**	-,050**	,124**	,111**	,072**	,204**	-,029**	,073**	,167**	-,082**	,110**	,034**	1
	Sig. (2-tailed)	0	0	0	0	0	0	0	0	0,004	0	0	0	0	0,001	
	N	9946	9946	9647	8713	9946	9946	9913	9946	9946	9946	9946	9865	9784	9946	9946

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

"appetite in last week" = intake last week

9. References

1. European Social Network. Services for older people in Europe - Facts and figures about long term care services in Europe.2008. Internet: http://ec.europa.eu/health//sites/health/files/mental_health/docs/services_older.pdf (accessed 12th december 2016.).
2. Arvanitakis M, Beck A, Coppens P, De Man F, Elia M, Hebuterne X, Henry S, Kohl O, Lesourd B, Lochs H, et al. Nutrition in care homes and home care: how to implement adequate strategies (report of the Brussels Forum (22-23 November 2007)). Clinical nutrition 2008;27(4):481-8. doi: 10.1016/j.clnu.2008.04.011.
3. Eurostat and European Commission. Demography report 2010 - Older, more numerous and diverse Europeans.2011. Internet: http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KE-ET-10-001/EN/KE-ET-10-001-EN.PDF (accessed 1st april 2014.).
4. OECD iLibrary. Health at a Glance: Europe 2012. Internet: http://www.oecd-ilibrary.org/sites/9789264183896-en/01/01/index.html?itemId=/content/chapter/9789264183896-6-en (accessed 14th march 2014.).
5. European commission - Eurostat. Mortality and life expectancy statistics.2012. Internet: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Mortality_and_life_expectancy_statistics (accessed 14th march 2014.).
6. Eurostat. Population and population change statistics.2016. Internet: http://ec.europa.eu/eurostat/statistics-explained/index.php/Population_and_population_change_statistics (accessed 4th august 2016.).
7. Eurostat. Population structure and ageing.2016. Internet: http://ec.europa.eu/eurostat/statistics-explained/index.php/Population_structure_and_ageing (accessed 4th August 2016.).
8. Eurostat. Lebenserwartung bei der Geburt, nach Geschlecht.2014. Internet: http://epp.eurostat.ec.europa.eu/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tps00025&language=de (accessed 11st June 2014.).
9. World Health Organisation. Nutrition for older persons.2014. Internet: http://www.who.int/nutrition/topics/ageing/en/ (accessed 4th september 2014.).
10. European Communities. Long-term care in the European Union.2008. Internet: ec.europa.eu/social/BlobServlet?docId=2781&langId=en (accessed 13th december 2016.).
11. Eurostat. EU27 population is expected to peak by around 2040.2011. Internet: http://ec.europa.eu/eurostat (accessed 12th april 2014.).
12. Eurostat. Demographic outlook - National reports on the demographic developments in 2010.2012. Internet: http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-12-004/EN/KS-RA-12-004-EN.PDF (accessed 1st april 2014.).
13. Statistik Austria. Bevölkerung zu Jahresbeginn seit 2002 nach fünfjährigen Altersgruppen und Geschlecht.2016. Internet:

http://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/bevoelkerung/bevoelkerungsstruktur/bevoelkerung_nach_alter_geschlecht/023468.html (accessed 12th september 2016.).
14. Die Presse. Österreichs Bevölkerung wächst: 9,4 Millionen im Jahr 2050.2011. Internet: http://diepresse.com/home/panorama/oesterreich/694813/Osterreichs-Bevolkerung-waechst_94-Mio-im-Jahr-2050- (accessed 8th october 2016.).
15. Eurostat. Sustainable development - demographic changes.2016. Internet: http://ec.europa.eu/eurostat/statistics-explained/index.php/Sustainable_development_-_demographic_changes - Old-age_dependency (accessed 3rd August 2016.).
16. Eurostat. Old-age dependency ratio.2016. Internet: http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsdde510&plugin=1 (accessed 3rd august 2016.).
17. Marin B. Future ageing in the older age groups.2009. Internet: http://www.euro.centre.org/data/1253632585_29293.pdf (accessed 24th september 2014.).
18. World Health Organization. Home Care in Europe.2008. Internet: http://www.euro.who.int/__data/assets/pdf_file/0005/96467/E91884.pdf (accessed 12th december 2016.).
19. Bundesministerium für Soziales und Konsumentenschutz. Hochaltrige in Österreich: Eine Bestandsaufnahme. Hochaltrigkeit in Österreich Eine Bestandsaufnahme - BMSK 2008:502.
20. Masseria C, Mossialos, E. How much care for older people will be needed? What can policies do to avoid or reduce dependency and to ensure that adequate care will be available? The London school of economics and political science 2006.
21. European Commission. European economy - Long-term care: need, use and expenditure in the EU-27.2012. Internet: ec.europa.eu/economy_finance/publications (accessed 12th april 2014.).
22. British Geriatric Society. QUEST FOR QUALITY - British Geriatrics Society Joint Working Party Inquiry into the Quality of Healthcare Support for Older People in Care Homes: A Call for Leadership, Partnership and Quality Improvement. 2011.
23. European Commission. Demands for quality and quantity of long-term care bound to rise, says EU report.2008. Internet: http://europa.eu/rapid/press-release_IP-08-651_en.htm?locale=en (accessed 13th december 2016.).
24. OECD. Help Wanted? Providing and Paying for Long-Term Care.2011. Internet: http://www.oecd.org/health/health-systems/helpwantedprovidingandpayingforlong-termcare.htm (accessed 30th June 2014.).
25. Österreichischer Städtebund. Positionspapier "Sicherung der Altenpflege und -betreuung in Österreich". 2006.
26. World Health Organization. Long-Term Care Laws in Five Developed Countries: A Review 2000. Internet: http://apps.who.int/iris/bitstream/10665/66572/1/WHO_NMH_CCL_00.2.pdf (accessed 12th december 2012.).
27. Townsend P. The Last Refuge. London School of Economics and Political Science Department of Social Policy and Administration 1962.
28. Ebrahim S, Wallis, C., Brittis, S., Harwood, R., Graham, N. Long term care for elderly people. Quality in Health Care 1993;2:198-203.
29. Grundy E, Arie, T. Falling rate of provision of residential care for the elderly. British Medical Journal 1982;284:799-802.

30. Bundesministerium für soziale Sicherheit GuK. Ausbau der Dienste und Einrichtungen für pflegebedürftige Menschen in Österreich - Zwischenbilanz. 2004.
31. Coyte P, Goodwin, N., Laporte, A. World Health Organization. How can the settings used to provide care to older people be balanced? 2008.
32. World Health Organization. Key policy issues in long-term care.2003. Internet: http://apps.who.int/iris/bitstream/10665/42604/1/9241562250.pdf (accessed 12th december 2016.).
33. Statistik Austria. Bundespflegegeld.2016. Internet: http://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/soziales/sozialleistungen_auf_bundesebene/bundespflegegeld/index.html (accessed 28th november 2016.).
34. Bartels A, Jenrich, H. . Alt werden in Europa. Entwicklungen in der europäischen Altenhilfe. Mabuse-Verlag GmbH, Frankfurt 2004.
35. Bundesministerium für Gesundheit. Das österreichische Gesundheitssystem.2013. Internet: http://www.bmgf.gv.at/cms/home/attachments/3/4/4/CH1066/CMS1291414949078/gesundheitssystem-zahlen-daten-2013.pdf (accessed 28th november 2016.).
36. Statistik Austria. Jahrbuch der Gesundheitsstatistik 2009.2009. Internet: http://www.statistik.at/.
37. Bundesministerium für Arbeit SuK. 2010. Internet: http://www.bmsk.gv.at/, (accessed 2nd october 2010.).
38. Rudda J, Fürstl-Grasser, M., Rubisch, M. Neue Tendenzen der Pflegevorsorge in Österreich. 2008.
39. Österreichisches Bundesinstitut für Gesundheitswesen ÖBIG. Österreichischer Pflegebericht. 2006.
40. Fasching P. Der Heimarzt – Ein Modell zur Verbesserung der ärztlichen Betreuung in Pflegeheimen. Ethik in der Medizin - Springer 2007;19(4):313-9.
41. Kerschbaum M. Heimarzt - Beruf mit Zukunft. Laut gedacht (NÖ Patiente- und Pflegeanwaltschaft) 2009.
42. Statista. Pflege in Deutschland.2011. Internet: http://de.statista.com/themen/785/pflege-in-deutschland (accessed 18th march 2014.).
43. Medizinischer Dienst der Spitzenverbände der Krankenkassen eV. Pflegebericht des Medizinischen Dienstes 2003.2005. Internet: http://www.mds-ev.de/media/pdf/Pflegebericht_2003(1).pdf (accessed 2nd november 2009.).
44. Statistische Ämter des Bundes und der Länder. Demographischer Wandel in Deutschland. Auswirkungen auf Krankenhausbehandlungen und Pflegebedürftige im Bund und in den Ländern 2010;2.
45. Gesundheitsberichterstattung des Bundes - Deutschland. Pflegeheime und verfügbare Plätze in Pflegeheimen. Gliederungsmerkmale: Jahre, Region, Träger.2011. Internet: http://www.gbe-bund.de/oowa921-install/servlet/oowa/aw92/dboowasys921.xwdevkit/xwd_init?gbe.isgbetol/xs_start_neu/&p_aid=3&p_aid=97891688&nummer=570&p_sprache=D&p_indsp=99999999&p_aid=75033779 (accessed 18th march 2014.).
46. Statistisches Bundesamt. Pflegestatistik 2009 - Pflege im Rahmen der Pflegeversicherung Deutschlandergebnisse. 2011.
47. Statistisches Bundesamt Wiesbaden. Pflegestatistik 2011. 2013.
48. Arend S. Der Heimarzt bleibt bis auf weiteres Vision: Prognose aus Trägersicht Altenheim 2009;48:22-5.

49. Hungarian Central Statistical Office Census Department. 2011. Internet: http://www.ksh.hu (accessed 04th february 2011.).
50. Gaál P, Szigeti, S, Csere, M, Gaskins, M, Panteli, D. . Hungary: Health system review. Health Systems in Transition. 2011;13(5):1-266.
51. Hungarian Central Statistical Office Census Department. Yearbook of Welfare Statistics, 2009.
52. Statistik Austria. Bevölkerung.2014. Internet: http://www.statistik.at/web_de/statistiken/bevoelkerung/ (accessed 27th June 2014.).
53. Statista. Bevölkerung - Entwicklung der Einwohnerzahl von Deutschland von 1990 bis 2012 (in Millionen).2012. Internet: http://de.statista.com/statistik/daten/studie/2861/umfrage/entwicklung-der-gesamtbevoelkerung-deutschlands/ (accessed 27th June 2014.).
54. Hungarian Central Statistical Office Census Department. Population census 2011.2013. Internet: http://www.ksh.hu/nepszamlalas/?lang=en (accessed 29th June 2014.).
55. Czibere K. Long-term care in hungary. ENEPRI RESEARCH REPORT NO 79 2010:1-14.
56. Menebröcker C. Ernährung in der Altenpflege. Elsevier 2008(1):1-182.
57. Volkert D. Malnutrition in older adults - urgent need for action: a plea for improving the nutritional situation of older adults. Gerontology 2013;59(4):328-33. doi: 10.1159/000346142.
58. Donini LM, Poggiogalle E, Piredda M, Pinto A, Barbagallo M, Cucinotta D, Sergi G. Anorexia and eating patterns in the elderly. PloS one 2013;8(5):e63539. doi: 10.1371/journal.pone.0063539.
59. World Health Organisation. Active Ageing: A Policy Framework. 2002.
60. Eurostat. Causes of death in the EU28 in 2010. Circulatory diseases main cause of death for men and women aged 65 years and over.2013. Internet: http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/3-28112013-AP/EN/3-28112013-AP-EN.PDF (accessed 6th august 2014.).
61. Dugdale DC. Aging changes in the heart and blood vessels.2012. Internet: http://www.nlm.nih.gov/medlineplus/ency/article/004006.htm (accessed 6th august 2014.).
62. World Health Organisation. Obesity and overweight.2016. Internet: http://www.who.int/mediacentre/factsheets/fs311/en/ (accessed 9th october 2016.).
63. Parr EB, Coffey VG, Hawley JA. 'Sarcobesity': a metabolic conundrum. Maturitas 2013;74(2):109-13. doi: 10.1016/j.maturitas.2012.10.014.
64. Office for National Statistics. Health & social care: Obesity increased most among older people.2014. Internet: http://www.statistics.gov.uk/cci/nugget.asp?id=1268 (accessed 5th August 2014.).
65. Kaiser R, Winning K, Uter W, Volkert D, Lesser S, Stehle P, Kaiser MJ, Sieber CC, Bauer JM. Functionality and mortality in obese nursing home residents: an example of 'risk factor paradox'? Journal of the American Medical Directors Association 2010;11(6):428-35. doi: 10.1016/j.jamda.2009.10.004.
66. Zanandrea V, Barreto de Souto P, Cesari M, Vellas B, Rolland Y. Obesity and nursing home: a review and an update. Clinical nutrition 2013;32(5):679-85. doi: 10.1016/j.clnu.2013.05.008.
67. Villareal DT, Chode S, Parimi N, Sinacore DR, Hilton T, Armamento-Villareal R, Napoli N, Qualls C, Shah K. Weight loss, exercise, or both and physical function in

obese older adults. The New England journal of medicine 2011;364(13):1218-29. doi: 10.1056/NEJMoa1008234.
68. World Health Organisation. Diabetes.2016. Internet: http://www.who.int/mediacentre/factsheets/fs312/en/ (accessed 9th october 2016.).
69. Migdal A, Yarandi SS, Smiley D, Umpierrez GE. Update on diabetes in the elderly and in nursing home residents. Journal of the American Medical Directors Association 2011;12(9):627-32 e2. doi: 10.1016/j.jamda.2011.02.010.
70. Newton CA, Adeel S, Sadeghi-Yarandi S, Powell W, Migdal A, Smiley D, Olson D, Chambria R, Pinzon I, Toyoshima M, et al. Prevalence, quality of care, and complications in long term care residents with diabetes: a multicenter observational study. Journal of the American Medical Directors Association 2013;14(11):842-6. doi: 10.1016/j.jamda.2013.08.001.
71. Bundesministerium für Gesundheit. Wissenschaftliche Aufbereitung für Empfehlungen „Ernährung im Alter in verschiedenen Lebenssituationen“. 2013.
72. World Health Organisation. Cancer.2015. Internet: http://www.who.int/mediacentre/factsheets/fs297/en/ (accessed 9th october 2016.).
73. Yancik R, Ries LA. Cancer in older persons. Magnitude of the problem--how do we apply what we know? Cancer 1994;74(7 Suppl):1995-2003.
74. World Health Organisation. Gender, health and ageing.2003. Internet: http://whqlibdoc.who.int/gender/2003/a85586.pdf?ua=1 (accessed 11th august 2014.).
75. Incalzi RA, Scarlata S, Pennazza G, Santonico M, Pedone C. Chronic Obstructive Pulmonary Disease in the elderly. European journal of internal medicine 2014;25(4):320-8. doi: 10.1016/j.ejim.2013.10.001.
76. World Health Organisation. Chronic obstructive pulmonary disease (COPD).2015. Internet: http://www.who.int/mediacentre/factsheets/fs315/en/ (accessed 9th october 2016.).
77. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, Martin FC, Michel JP, Rolland Y, Schneider SM, et al. Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. Age and ageing 2010;39(4):412-23. doi: 10.1093/ageing/afq034.
78. Batsis JA, Mackenzie TA, Barre LK, Lopez-Jimenez F, Bartels SJ. Sarcopenia, sarcopenic obesity and mortality in older adults: results from the National Health and Nutrition Examination Survey III. European journal of clinical nutrition 2014. doi: 10.1038/ejcn.2014.117.
79. Evans WJ, Morley JE, Argiles J, Bales C, Baracos V, Guttridge D, Jatoi A, Kalantar-Zadeh K, Lochs H, Mantovani G, et al. Cachexia: a new definition. Clinical nutrition 2008;27(6):793-9. doi: 10.1016/j.clnu.2008.06.013.
80. Bauer JM, Wirth R, Volkert D, Werner H, Sieber CC, Teilnehmer des B-S. [Malnutrition, sarcopenia and cachexia in the elderly: from pathophysiology to treatment. Conclusions of an international meeting of experts, sponsored by the BANSS Foundation]. Deutsche medizinische Wochenschrift 2008;133(7):305-10. doi: 10.1055/s-2008-1046711.
81. Czerwinski E, Kumorek A, Milert A, Borowy P. Causes of falls in women in Krakow population. Ortopedia, traumatologia, rehabilitacja 2008;10(5):429-40.
82. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, Seeman T, Tracy R, Kop WJ, Burke G, et al. Frailty in older adults: evidence for a phenotype.

The journals of gerontology Series A, Biological sciences and medical sciences 2001;56(3):M146-56.
83. Kimyagarov S, Klid R, Fleissig Y, Kopel B, Arad M, Adunsky A. Skeletal muscle mass abnormalities are associated with survival rates of institutionalized elderly nursing home residents. The journal of nutrition, health & aging 2012;16(5):432-6.
84. Curtis JR, Safford MM. Management of osteoporosis among the elderly with other chronic medical conditions. Drugs & aging 2012;29(7):549-64. doi: 10.2165/11599620-000000000-00000.
85. Wade SW, Strader C, Fitzpatrick LA, Anthony MS, O'Malley CD. Estimating prevalence of osteoporosis: examples from industrialized countries. Archives of osteoporosis 2014;9(1):182. doi: 10.1007/s11657-014-0182-3.
86. Martinez-Reig M, Ahmad L, Duque G. The orthogeriatrics model of care: systematic review of predictors of institutionalization and mortality in post-hip fracture patients and evidence for interventions. Journal of the American Medical Directors Association 2012;13(9):770-7. doi: 10.1016/j.jamda.2012.07.011.
87. Walsh K, Roberts J, Bennett G. Mobility in old age. Gerodontology 1999;16(2):69-74.
88. Tamura BK, Bell CL, Masaki KH, Amella EJ. Factors associated with weight loss, low BMI, and malnutrition among nursing home patients: a systematic review of the literature. Journal of the American Medical Directors Association 2013;14(9):649-55. doi: 10.1016/j.jamda.2013.02.022.
89. Stange I, Poeschl K, Stehle P, Sieber CC, Volkert D. Screening for malnutrition in nursing home residents: comparison of different risk markers and their association to functional impairment. The journal of nutrition, health & aging 2013;17(4):357-63. doi: 10.1007/s12603-013-0021-z.
90. Rambouskova J, Slavikova M, Krskova A, Prochazka B, Andel M, Dlouhy P. Nutritional status assessment of institutionalized elderly in Prague, Czech Republic. Annals of nutrition & metabolism 2013;62(3):201-6. doi: 10.1159/000346038.
91. Meijers JM, Halfens RJ, Neyens JC, Luiking YC, Verlaan G, Schols JM. Predicting falls in elderly receiving home care: the role of malnutrition and impaired mobility. The journal of nutrition, health & aging 2012;16(7):654-8.
92. Milaneschi Y, Tanaka T, Ferrucci L. Nutritional determinants of mobility. Current opinion in clinical nutrition and metabolic care 2010;13(6):625-9. doi: 10.1097/MCO.0b013e32833e337d.
93. Bartali B, Frongillo EA, Bandinelli S, Lauretani F, Semba RD, Fried LP, Ferrucci L. Low nutrient intake is an essential component of frailty in older persons. The journals of gerontology Series A, Biological sciences and medical sciences 2006;61(6):589-93.
94. Daniels R, van Rossum E, de Witte L, Kempen GI, van den Heuvel W. Interventions to prevent disability in frail community-dwelling elderly: a systematic review. BMC health services research 2008;8:278. doi: 10.1186/1472-6963-8-278.
95. Bischoff-Ferrari HA, Dawson-Hughes B, Willett WC, Staehelin HB, Bazemore MG, Zee RY, Wong JB. Effect of Vitamin D on falls: a meta-analysis. JAMA : the journal of the American Medical Association 2004;291(16):1999-2006. doi: 10.1001/jama.291.16.1999.
96. Harris CL, Fraser C. Malnutrition in the institutionalized elderly: the effects on wound healing. Ostomy/wound management 2004;50(10):54-63.
97. IGAP - Institut für Innovationen im Gesundheitswesen und angewandte Pflegeforschung. Dekubitus - Pflegeratgeber. 2014.

98. Chow O, Barbul A. Immunonutrition: Role in Wound Healing and Tissue Regeneration. Advances in wound care 2014;3(1):46-53. doi: 10.1089/wound.2012.0415.
99. European Pressure Ulcer Advisory Panel and National Pressure Ulcer Advisory Panel. Prevention and treatment of pressure ulcers: quick reference guide. Washington DC: National Pressure Ulcer Advisory Panel 2009.
100. Thomas JM, Cooney LM, Jr., Fried TR. Systematic review: Health-related characteristics of elderly hospitalized adults and nursing home residents associated with short-term mortality. Journal of the American Geriatrics Society 2013;61(6):902-11. doi: 10.1111/jgs.12273.
101. Verbrugghe M, Beeckman D, Van Hecke A, Vanderwee K, Van Herck K, Clays E, Bocquaert I, Derycke H, Geurden B, Verhaeghe S. Malnutrition and associated factors in nursing home residents: a cross-sectional, multi-centre study. Clinical nutrition 2013;32(3):438-43. doi: 10.1016/j.clnu.2012.09.008.
102. Carrion S, Cabre M, Monteis R, Roca M, Palomera E, Serra-Prat M, Rofes L, Clave P. Oropharyngeal dysphagia is a prevalent risk factor for malnutrition in a cohort of older patients admitted with an acute disease to a general hospital. Clinical nutrition 2014. doi: 10.1016/j.clnu.2014.04.014.
103. Cichero JA, Steele C, Duivestein J, Clave P, Chen J, Kayashita J, Dantas R, Lecko C, Speyer R, Lam P, et al. The Need for International Terminology and Definitions for Texture-Modified Foods and Thickened Liquids Used in Dysphagia Management: Foundations of a Global Initiative. Current physical medicine and rehabilitation reports 2013;1:280-91. doi: 10.1007/s40141-013-0024-z.
104. Khan A, Carmona R, Traube M. Dysphagia in the elderly. Clinics in geriatric medicine 2014;30(1):43-53. doi: 10.1016/j.cger.2013.10.009.
105. McKhann G, Drachman D, Folstein M, Katzman R, Price D, Stadlan EM. Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. Neurology 1984;34(7):939-44.
106. Berr C, Wancata J, Ritchie K. Prevalence of dementia in the elderly in Europe. European neuropsychopharmacology : the journal of the European College of Neuropsychopharmacology 2005;15(4):463-71. doi: 10.1016/j.euroneuro.2005.04.003.
107. Hoffmann F, Kaduszkiewicz H, Glaeske G, van den Bussche H, Koller D. Prevalence of dementia in nursing home and community-dwelling older adults in Germany. Aging clinical and experimental research 2014. doi: 10.1007/s40520-014-0210-6.
108. Jonsson L, Wimo A. The cost of dementia in Europe: a review of the evidence, and methodological considerations. PharmacoEconomics 2009;27(5):391-403. doi: 10.2165/00019053-200927050-00004.
109. LeBlanc ES, Rizzo JH, Pedula KL, Yaffe K, Ensrud KE, Cauley J, Cawthon PM, Cummings S, Hillier TA, Study of Osteoporotic Fractures Research G. Weight Trajectory over 20 Years and Likelihood of Mild Cognitive Impairment or Dementia Among Older Women. Journal of the American Geriatrics Society 2016. doi: 10.1111/jgs.14552.
110. Allen V, Methven L, Gosney M. The influence of nutritional supplement drinks on providing adequate calorie and protein intake in older adults with dementia. The journal of nutrition, health & aging 2013;17(9):752-5. doi: 10.1007/s12603-013-0364-5.

111. Volkert D, Chourdakis M, Faxen-Irving G, Fruhwald T, Landi F, Suominen MH, Vandewoude M, Wirth R, Schneider SM. ESPEN guidelines on nutrition in dementia. Clinical nutrition 2015;34(6):1052-73. doi: 10.1016/j.clnu.2015.09.004.
112. Hanson LC, Ersek M, Lin FC, Carey TS. Outcomes of feeding problems in advanced dementia in a nursing home population. Journal of the American Geriatrics Society 2013;61(10):1692-7. doi: 10.1111/jgs.12448.
113. Meijers JM, Schols JM, Halfens RJ. Malnutrition in care home residents with dementia. The journal of nutrition, health & aging 2014;18(6):595-600. doi: 10.1007/s12603-014-0006-6.
114. White JV, Guenter P, Jensen G, Malone A, Schofield M. Consensus statement: Academy of Nutrition and Dietetics and American Society for Parenteral and Enteral Nutrition: characteristics recommended for the identification and documentation of adult malnutrition (undernutrition). JPEN Journal of parenteral and enteral nutrition 2012;36(3):275-83. doi: 10.1177/0148607112440285.
115. Stratton RS, Green, C.J., Elia M. Disease-related malnutrition: an evidence-based approach to treatment. CABI Publishing UK/USA 2003.
116. Lochs H, Allison SP, Meier R, Pirlich M, Kondrup J, Schneider S, van den Berghe G, Pichard C. Introductory to the ESPEN Guidelines on Enteral Nutrition: Terminology, definitions and general topics. Clinical nutrition 2006;25(2):180-6.
117. Soeters PB, Schols AM. Advances in understanding and assessing malnutrition. Current opinion in clinical nutrition and metabolic care 2009;12(5):487-94.
118. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z. Nutritional risk screening (NRS 2002): a new method based on an analysis of controlled clinical trials. Clinical nutrition 2003;22(3):321-36.
119. Pirlich M, A. Schwenk, M. J. Müller. DGEM-Leitlinie Enterale Ernährung: Ernährungsstatus. Aktuel Ernaehr Med 2003;28(Supplement 1):S10-S25.
120. Hiesmayr M, Schindler K, Pernicka E, Schuh C, Schoeniger-Hekele A, Bauer P, Laviano A, Lovell AD, Mouhieddine M, Schuetz T, et al. Decreased food intake is a risk factor for mortality in hospitalised patients: the NutritionDay survey 2006. Clinical nutrition 2009;28(5):484-91. doi: 10.1016/j.clnu.2009.05.013.
121. Valentini L, Schindler K, Schlaffer R, Bucher H, Mouhieddine M, Steininger K, Tripamer J, Handschuh M, Schuh C, Volkert D, et al. The first nutritionDay in nursing homes: participation may improve malnutrition awareness. Clinical nutrition 2009;28(2):109-16. doi: 10.1016/j.clnu.2009.01.021.
122. Yang Y, Brown CJ, Burgio KL, Kilgore ML, Ritchie CS, Roth DL, West DS, Locher JL. Undernutrition at baseline and health services utilization and mortality over a 1-year period in older adults receiving Medicare home health services. Journal of the American Medical Directors Association 2011;12(4):287-94. doi: 10.1016/j.jamda.2010.08.017.
123. American Society for Parenteral and Enteral Nutrition A.S.P.E.N., Commitee BoDaCP. Definition of Terms, Style, and Conventions Used in A.S.P.E.N. Board of Directors– Approved Documents. 2010.
124. Jensen GL, Mirtallo J, Compher C, Dhaliwal R, Forbes A, Grijalba RF, Hardy G, Kondrup J, Labadarios D, Nyulasi I, et al. Adult starvation and disease-related malnutrition: a proposal for etiology-based diagnosis in the clinical practice setting from the International Consensus Guideline Committee. JPEN Journal of parenteral and enteral nutrition 2010;34(2):156-9.
125. Jensen GL, Bistrian B, Roubenoff R, Heimburger DC. Malnutrition syndromes: a conundrum vs continuum. JPEN Journal of parenteral and enteral nutrition 2009;33(6):710-6. doi: 10.1177/0148607109344724.

126. Volkert D, Sieber, C.C. Mangelernährung in der Geriatrie. Aktuel Ernahrungsmed 2011;36:175–90.
127. Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T, Thomas DR, Anthony PS, Charlton KE, Maggio M, et al. Frequency of malnutrition in older adults: a multinational perspective using the mini nutritional assessment. Journal of the American Geriatrics Society 2010;58(9):1734-8.
128. Santomauro F, Olimpi N, Baggiani L, Comodo N, Mantero S, Bonaccorsi G. Bioelectrical Impedance Vector Analysis and Mini Nutritional Assessment in elderly nursing home residents. The journal of nutrition, health & aging 2011;15(3):163-7.
129. Kulnik D, Elmadfa, I. Assessment of the nutritional situation of elderly nursing home residents in Vienna. Annals of nutrition & metabolism 2008;52(Suppl 1):51-3.
130. Pauly L, Stehle P, Volkert D. Nutritional situation of elderly nursing home residents. Zeitschrift fur Gerontologie und Geriatrie 2007;40(1):3-12. doi: 10.1007/s00391-007-0430-x.
131. Crogan N, Pasvogel, A. The influence of protein-calorie malnutrition on quality of life in nursing homes. . J Gerontol A Biol Sci Med 2003;58:159-64.
132. Abbasi A, Rudman, D. . Undernutrition in the nursing home: prevalence, consequences, causes and prevention. . Nutr Rev 1994;52(4):113-22.
133. Mueller C, Compher C, Ellen DM. A.S.P.E.N. clinical guidelines: Nutrition screening, assessment, and intervention in adults. JPEN Journal of parenteral and enteral nutrition 2011;35(1):16-24.
134. Boggatz T, Dijkstra A, Lohrmann C, Dassen T. The meaning of care dependency as shared by care givers and care recipients: a concept analysis. Journal of advanced nursing 2007;60(5):561-9. doi: 10.1111/j.1365-2648.2007.04456.x.
135. Heikkinen E. What are the main risk factors for disability in old age and how can disability be prevented? WHO Regional Office for Europe, Copenhagen 2003.
136. Bundeskanzleramt Österreich. Höhe des Pflegegeldes.2014. Internet: https://www.help.gv.at/Portal.Node/hlpd/public/content/36/Seite.360516.html (accessed 6th october 2014.).
137. Nagi S. An epidemiology of disability among adults in the United States. Milbank Memorial Fund quarterly Health and society 1976;54:439-67.
138. Tannen A, Schuetz, T, Dassen, T,. Mangelernährung in deutschen Pflegeheimen und Krankenhäusern - Pflegebedarf und pflegerische Versorgung. Aktuel Ernaehr Med 2008;33(4):177-83.
139. Heseker H, Stehle,. Ernährung in stationären Einrichtungen für Senioren und Seniorinnen (ErnSTES). Ernährungsbericht 2008 der Deutschen Gesellschaft für Ernährung 2008.
140. Vetta F, Ronzoni, S, Taglieri, G, Bollea, MR. The impact of malnutrition on the quality of life in the elderly. Clinical nutrition 1999;18:259-67.
141. Elia M. Nutrition and health economic. Nutrition 2006;22:576-8.
142. Ljungqvist O, van Gossum A, Sanz ML, de Man F. The European fight against malnutrition. Clinical nutrition 2010;29(2):149-50. doi: 10.1016/j.clnu.2009.10.004.
143. Beattie E, O'Reilly M, Strange E, Franklin S, Isenring E. How much do residential aged care staff members know about the nutritional needs of residents? International journal of older people nursing 2014;9(1):54-64. doi: 10.1111/opn.12016.
144. Boaz M, Rychani L, Barami K, Houri Z, Yosef R, Siag A, Berlovitz Y, Leibovitz E. Nurses and nutrition: a survey of knowledge and attitudes regarding nutrition assessment and care of hospitalized elderly patients. Journal of continuing education in nursing 2013;44(8):357-64. doi: 10.3928/00220124-20130603-89.

145. Arvanitakis M, Coppens P, Doughan L, Van Gossum A. Nutrition in care homes and home care: recommendations - a summary based on the report approved by the Council of Europe. Clinical nutrition 2009;28(5):492-6. doi: 10.1016/j.clnu.2009.07.011.
146. Agarwal E, Miller M, Yaxley A, Isenring E. Malnutrition in the elderly: a narrative review. Maturitas 2013;76(4):296-302. doi: 10.1016/j.maturitas.2013.07.013.
147. Elmadfa I, Freisling, H, Nowak, V, Hofstädter, D, et al. Österreichischer Ernährungsbericht 2008. 2009(1).
148. Deutsche Gesellschaft für Ernährung, Österreichische Gesellschaft für Ernährung, Schweizerische Gesellschaft für Ernährungsforschung, Schweizerische Vereinigung für Ernährung. Referenzwerte für die Nährstoffzufuhr, 1., 5. corrected reprint, 2013.
149. Schlaffer R. Ernährungssituation geriatrischer Patienten - zwischen Theorie und Praxis. Diplomarbeit, 2005, AC04654126, Österreichische Dissertationsdatenbank.
150. Arbeitsgemeinschaft für klinische Ernährung. Ernährungsscreeningbogen für die geriatrische Langzeitpflege. Empfehlungen für die parenterale und enterale Ernährungstherapie des Erwachsenen 2004(3.):89.
151. Paker-Eichelkraut HS, Bai-Habelski JC, Overzier S, Strathmann S, Heseker H, Stehle P, Lesser S. Nutritional status and related factors in elderly nursing home residents: comparative cross-sectional study in migrants and native Germans. Journal of nutrition in gerontology and geriatrics 2013;32(4):330-42. doi: 10.1080/21551197.2013.842198.
152. Vikstedt T, Suominen MH, Joki A, Muurinen S, Soini H, Pitkala KH. Nutritional status, energy, protein, and micronutrient intake of older service house residents. Journal of the American Medical Directors Association 2011;12(4):302-7. doi: 10.1016/j.jamda.2010.12.098.
153. Sturtzel B, Elmadfa I, Ohrenberger G. The energy intake through regular nontherapeutic meals provision in long-term care: impact on nutritional status and related Geriatric Nutritional Risk Index. SpringerPlus 2016;5:136. doi: 10.1186/s40064-016-1763-y.
154. Mila R, Abellana R, Padro L, Basulto J, Farran A. High consumption foods and their influence on energy and protein intake in institutionalized older adults. The journal of nutrition, health & aging 2012;16(2):115-22.
155. Wlodarek D, Glabska D. Assessment of the quality of diet of Alzheimer's disease individuals living at homes and in nursing homes. Roczniki Panstwowego Zakladu Higieny 2013;64(3):217-23.
156. European Centre for Social Welfare Policy and Research. Measuring Progress: Indicators for care homes. PROGRESS 2010:1-92.
157. Murakami Y, Colombo, F. . A Good Life in Old Age?: Monitoring and Improving Quality in Long-term Care. Measuring quality in long-term care. OECD Publishing 2013:53–92. doi: DOI:10.1787/9789264194564-6-en.
158. Deutsches Netzwerk für Qualitätsentwicklung in der Pflege. Informationen.2016. Internet: https://www.dnqp.de/cn/ (accessed 21st january 2017.).
159. Quality network. Quality benchmark.2006. Internet: http://www.quality.co.uk/benchadv.htm (accessed 21st october 2011.).
160. Wübbenhorst K. Benchmarking. Gablers Wirtschaftslexikon 2014.
161. Agency for Healthcare Research and Quality R, MD. Outcomes Research. Fact Sheet. AHRQ Publication No 00-P011 2000.
162. Donabedian A. The effectiveness of quality assurance. Int J Qual Health Care 1996;8(4):401-7.

163. Hoffman F, Leichsenring, Kai. Quality management by result-oriented indicators: Towards benchmarking in residential care for older people. Policy Brief June 2011 - European centre 2011;1:15.
164. E-Qalin GmbH. E-Qalin.2010. Internet: http://www.e-qalin.net/index.php?id=2&L=1 (accessed 26th october 2011.).
165. Bundesministerium für Arbeit SuK. Nationales Qualitätszertifikat für Alten- und Pflegeheime in Österreich.2011. Internet: http://www.bmask.gv.at/cms/site/dokument.html?channel=CH0169&doc=CMS1218118631894 (accessed 22th september 2011.).
166. Österreichische Gesellschaft für Ernährung. ÖGE Gütezeichen.2016. Internet: http://www.oege.at/index.php/oege-zertifizierte-verpflegung (accessed 21st January 2017.).
167. Deutsche Gesellschaft für Ernährung. DGE-Qualitätsstandard für die Verpflegung in stationären Senioreneinrichtungen.2015. Internet: http://www.fitimalter-dge.de/service/medien.html?eID=dam_frontend_push&docID=1622 (accessed 21 january 2017.).
168. Institut für Pflegewissenschaft MUG. LPZ - Pflegequalitätserhebung 2.0.2017. Internet: https://at.lpz-um.eu/de (accessed 21 january 2017.).
169. Brandenburg H. Das Resident Assessment Instrument (RAI): Ausgewählte empirische Befunde und Konsequenzen für die pflegewissenschaftliche Diskussion in Deutschland. PfleGe 2002;7(3):95-102.
170. Morris JN, Murphy K, Nonemaker S. Long-term care facility resident assessment instrument (RAI) user´s manual. 1995.
171. Fries BE, Hawes C, Morris JN, Phillips CD, Mor V, Park PS. Effect of the National Resident Assessment Instrument on selected health conditions and problems. Journal of the American Geriatrics Society 1997;45(8):994-1001.
172. Rolland Y, Mathieu C, Piau C, Cayla F, Bouget C, Vellas B, de Souto Barreto P. Improving the Quality of Care of Long-Stay Nursing Home Residents in France. Journal of the American Geriatrics Society 2016;64(1):193-9. doi: 10.1111/jgs.13874.
173. Medizinischer Dienst der Spitzenverbände der Krankenkassen eV. MDK-Bericht: Pflegemissstände wegen Personalmangel.2008. Internet: http://www.altenheim.net/Infopool/Nachrichten/MDK-Bericht-Pflegemissstaende-wegen-Personalmangel (accessed 2nd october 2014.).
174. nutritionDay. nutritionDay worldwide.2017. Internet: http://www.nutritionday.org (accessed 21 january 2017.).
175. Elmadfa I, Leitzmann, C.,. Ernährung des Menschen. 5. ed: Ulmer, 2015.
176. Schindler K, Ludvik, B. Methodische und praktische Aspekte der Bestimmung der Körperzusammensetzung. Wien Med Wochenschr 2004;154(13-14):305-12.
177. Arbeitsgemeinschaft für Klinische Ernährung - AKE. Konsensus-Statement Geriatrie - Empfehlungen für die Ernährung des älteren Menschen in der Langzeitpflege. AKE 2010;1(1):76.
178. Günther P, Silkroski, M. Tube feeding: Practical guidelines and nursing protocols. Aspen publications 2001:19/20.
179. Volkert D. Der Body-Mass-Index (BMI) – ein wichtiger Parameter zur Beurteilung des Ernährungszustands. Aktuel Ernahrungsmed 2006;31:126-32.
180. Bamia C, Halkjaer J, Lagiou P, Trichopoulos D, Tjonneland A, Berentzen TL, Overvad K, Clavel-Chapelon F, Boutron-Ruault MC, Rohrmann S, et al. Weight change in later life and risk of death amongst the elderly: the European Prospective Investigation

into Cancer and Nutrition-Elderly Network on Ageing and Health study. Journal of internal medicine 2010;268(2):133-44. doi: 10.1111/j.1365-2796.2010.02219.x.
181. Lee CG, Boyko EJ, Nielson CM, Stefanick ML, Bauer DC, Hoffman AR, Dam TT, Lapidus JA, Cawthon PM, Ensrud KE, et al. Mortality risk in older men associated with changes in weight, lean mass, and fat mass. Journal of the American Geriatrics Society 2011;59(2):233-40. doi: 10.1111/j.1532-5415.2010.03245.x.
182. Dyck MJ, Schumacher JR. Evidence-based practices for the prevention of weight loss in nursing home residents. Journal of gerontological nursing 2011;37(3):22-33; quiz 4-5. doi: 10.3928/00989134-20110106-04.
183. Sullivan DH, Johnson LE, Bopp MM, Roberson PK. Prognostic significance of monthly weight fluctuations among older nursing home residents. The journals of gerontology Series A, Biological sciences and medical sciences 2004;59(6):M633-9.
184. Volkert D, Berner YN, Berry E, Cederholm T, Coti Bertrand P, Milne A, Palmblad J, Schneider S, Sobotka L, Stanga Z, et al. ESPEN Guidelines on Enteral Nutrition: Geriatrics. Clinical nutrition 2006;25(2):330-60.
185. Volkert D. Leitlinie der Deutschen Gesellschaft für Ernährungsmedizin (DGEM) in Zusammenarbeit mit der GESKES, der AKE und der DGG, Klinische Ernährung in der Geriatrie –Teil des laufenden S3-Leitlinienprojekts Klinische Ernährung. Aktuel Ernahrungsmed 2013;38:e1–e48.
186. Nattick M. Long Term Care Facility Resident Assessment Instrument (RAI) User's Manual. Eliot Press 1999.
187. Deutsche Gesellschaft für Ernährung e. V. D. DGE-Praxiswissen: Mangelernährung im Alter. 2012(2).
188. Roberts SB, Fuss P, Heyman MB, Evans WJ, Tsay R, Rasmussen H, Fiatarone M, Cortiella J, Dallal GE, Young VR. Control of food intake in older men. JAMA : the journal of the American Medical Association 1994;272(20):1601-6.
189. Hirani V, Mindell J. A comparison of measured height and demi-span equivalent height in the assessment of body mass index among people aged 65 years and over in England. Age and ageing 2008;37(3):311-7.
190. Chumlea WC, Guo SS, Wholihan K, Cockram D, Kuczmarski RJ, Johnson CL. Stature prediction equations for elderly non-Hispanic white, non-Hispanic black, and Mexican-American persons developed from NHANES III data. Journal of the American Dietetic Association 1998;98(2):137-42.
191. Sobotka L. Basis in clinical nutrition: Galen, 2004.
192. Hickson M, Frost G. A comparison of three methods for estimating height in the acutely ill elderly population. Journal of human nutrition and dietetics : the official journal of the British Dietetic Association 2003;16(1):13-20.
193. Roland S. Vom Umgang mit Zahlen und Daten. Eine praxisnahe Einführung in die Statistik und Ernährungsepidemiologie. Umschau 1997:320.
194. World Health Organization. BMI classification.2011. Internet: http://apps.who.int/bmi/index.jsp?introPage=intro_3.html (accessed 18th march 2012.).
195. National Research Council der USA - NRC. Diet and Health. Implications for Reducing Chronic Disease Risk. The National Academies Press, Washington DC 1989.
196. Kondrup J, Allison SP, Elia M, Vellas B, Plauth M. ESPEN guidelines for nutrition screening 2002. Clinical nutrition 2003;22(4):415-21.
197. Volkert D. Practical guideline for nutritional care in geriatric institutions. Zeitschrift fur Gerontologie und Geriatrie 2009;42(2):77-87.

198. Deutsches Netzwerk für Qualitätsentwicklung in der Pflege (DNQP). Instrument zur zweiphasigen Erfassung der Ernährungssituation in der stationären Langzeit-/ Altenpflege. 2009.
199. van Bokhorst-de van der Schueren MA, Guaitoli PR, Jansma EP, de Vet HC. A systematic review of malnutrition screening tools for the nursing home setting. Journal of the American Medical Directors Association 2014;15(3):171-84. doi: 10.1016/j.jamda.2013.10.006.
200. Vellas B, Villars H, Abellan G, Soto ME, Rolland Y, Guigoz Y, Morley JE, Chumlea W, Salva A, Rubenstein LZ, et al. Overview of the MNA--Its history and challenges. The journal of nutrition, health & aging 2006;10(6):456-63; discussion 63-5.
201. Kruizenga HM, de Vet HC, Van Marissing CM, Stassen EE, Strijk JE, Van Bokhorst-de Van der Schueren MA, Horman JC, Schols JM, Van Binsbergen JJ, Eliens A, et al. The SNAQ(RC), an easy traffic light system as a first step in the recognition of undernutrition in residential care. The journal of nutrition, health & aging 2010;14(2):83-9.
202. Ferguson M, Capra S, Bauer J, Banks M. Development of a valid and reliable malnutrition screening tool for adult acute hospital patients. Nutrition 1999;15(6):458-64.
203. British Association for Parenteral and Enteral Nutrition - BAPEN. Malnutrition Universal Screening Tool - MUST.2010. Internet: http://www.bapen.org.uk/screening-and-must/must/must-toolkit/the-must-itself/must-deutsch (accessed 9th september 2016.).
204. Posner BM, Jette AM, Smith KW, Miller DR. Nutrition and health risks in the elderly: the nutrition screening initiative. American journal of public health 1993;83(7):972-8.
205. Cereda E, Zagami A, Vanotti A, Piffer S, Pedrolli C. Geriatric Nutritional Risk Index and overall-cause mortality prediction in institutionalised elderly: a 3-year survival analysis. Clinical nutrition 2008;27(5):717-23. doi: 10.1016/j.clnu.2008.07.005.
206. The Caroline Walker Trust. Eating well for older people - Practical and nutritional guidelines for food in residential and nursing homes and for community meals. 2004(2).
207. U.S. Department of Health & Human Services - Administration on Aging. SERVING ELDERS AT RISK; The Older Americans Act Nutrition Programs - National Evaluation of the Elderly Nutrition Program, 1993-1995. Wall Street Journal 1994.
208. Medizinischer Dienst des Spitzenverbandes Bund der Krankenkassen eVM. Qualität in der ambulanten und stationären Pflege: 3. Bericht des MDS nach § 114a Abs. 6 SGB XI.2012. Internet: http://www.pflegenoten.de/media/dokumente/vereinbarungen/MDS_Dritter_Pflege_Qualitaetsbericht_04-2012_7101.pdf (accessed 2nd February 2015.).
209. Druml W. JK, Roth E. Empfehlungen für die enterale und parenterale Ernährung des Erwachsenen. Arbeitsgemeinschaft für Klinische Ernährung (AKE) 2004(3).
210. Layman DK. Dietary Guidelines should reflect new understandings about adult protein needs. Nutrition & metabolism 2009;6:12. doi: 10.1186/1743-7075-6-12.
211. Bauer J, Biolo G, Cederholm T, Cesari M, Cruz-Jentoft AJ, Morley JE, Phillips S, Sieber C, Stehle P, Teta D, et al. Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. Journal of the American Medical Directors Association 2013;14(8):542-59. doi: 10.1016/j.jamda.2013.05.021.

212. Paddon-Jones D, Leidy H. Dietary protein and muscle in older persons. Current opinion in clinical nutrition and metabolic care 2014;17(1):5-11. doi: 10.1097/MCO.0000000000000011.
213. Paddon-Jones D, Short KR, Campbell WW, Volpi E, Wolfe RR. Role of dietary protein in the sarcopenia of aging. The American journal of clinical nutrition 2008;87(5):1562S-6S.
214. Pedersen AN, Cederholm T. Health effects of protein intake in healthy elderly populations: a systematic literature review. Food & nutrition research 2014;58. doi: 10.3402/fnr.v58.23364.
215. Deutz NE, Bauer JM, Barazzoni R, Biolo G, Boirie Y, Bosy-Westphal A, Cederholm T, Cruz-Jentoft A, Krznaric Z, Nair KS, et al. Protein intake and exercise for optimal muscle function with aging: Recommendations from the ESPEN Expert Group. Clinical nutrition 2014. doi: 10.1016/j.clnu.2014.04.007.
216. Suominen MH, Hosia-Randell HM, Muurinen S, Peiponen A, Routasalo P, Soini H, Suur-Uski I, Pitkala KH. Vitamin D and calcium supplementation among aged residents in nursing homes. The journal of nutrition, health & aging 2007;11(5):433-7.
217. Rolland Y, de Souto Barreto P, Abellan Van Kan G, Annweiler C, Beauchet O, Bischoff-Ferrari H, Berrut G, Blain H, Bonnefoy M, Cesari M, et al. Vitamin D supplementation in older adults: searching for specific guidelines in nursing homes. The journal of nutrition, health & aging 2013;17(4):402-12. doi: 10.1007/s12603-013-0007-x.
218. Mithal A, Bonjour JP, Boonen S, Burckhardt P, Degens H, El Hajj Fuleihan G, Josse R, Lips P, Morales Torres J, Rizzoli R, et al. Impact of nutrition on muscle mass, strength, and performance in older adults. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2013;24(5):1555-66. doi: 10.1007/s00198-012-2236-y.
219. WHO/PAHO reg. WHO/PAHO regional expert group for cardiovascular disease prevention through population-wide dietary salt reduction.2011. Internet: http://www.paho.org/hq/index.php?option=com_docman&task=doc_view&gid=21491&Itemid= (accessed 2nd september 2014.).
220. Chidester JC, Spangler AA. Fluid intake in the institutionalized elderly. Journal of the American Dietetic Association 1997;97(1):23-8; quiz 9-30. doi: 10.1016/S0002-8223(97)00011-4.
221. Bundesministerium für Land- und Forstwirtschaft UuW. Lebensmittelbericht Österreich 2010. 2010.
222. Deutsche Gesellschaft für Ernährung. Umsetzung der D-A-CH-Referenzwerte in die Gemeinschaftsverpflegung. 2012.
223. Sozialreferat München - Amt für soziale Sicherung. Kostenstruktur in Pflegeheimen.2005. Internet: http://www.muenchnerpflegeboerse.de/downloads/beschluss061012_kostenstruktur_pflegeheime.pdf (accessed 9th october 2014.).
224. Eigendorf J. Unendliches Leid in deutschen Pflegeheimen.2012. Internet: http://investigativ.welt.de/2012/09/10/unendliches-leid-in-deutschen-pflegeheimen/ (accessed 9th october 2014.).
225. Council of Europe. Resolution ResAP(2003)3 on food and nutritional care in hospitals. 2003.

226. Dwyer JT, Coleman KA, Krall E, Yang GA, Scanlan M, Galper L, Winthrop E, Sullivan P. Changes in relative weight among institutionalized elderly adults. Journal of gerontology 1987;42(3):246-51.
227. Sullivan DH, Morley JE, Johnson LE, Barber A, Olson JS, Stevens MR, Yamashita BD, Reinhart SP, Trotter JP, Olave XE. The GAIN (Geriatric Anorexia Nutrition) registry: the impact of appetite and weight on mortality in a long-term care population. The journal of nutrition, health & aging 2002;6(4):275-81.
228. Woods JL, Iuliano-Burns S, Walker KZ. Weight loss in elderly women in low-level care and its association with transfer to high-level care and mortality. Clinical interventions in aging 2011;6:311-7. doi: 10.2147/CIA.S27334.
229. Newman AB, Yanez D, Harris T, Duxbury A, Enright PL, Fried LP, Cardiovascular Study Research G. Weight change in old age and its association with mortality. Journal of the American Geriatrics Society 2001;49(10):1309-18.
230. Nguyen ND, Center JR, Eisman JA, Nguyen TV. Bone loss, weight loss, and weight fluctuation predict mortality risk in elderly men and women. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 2007;22(8):1147-54. doi: 10.1359/jbmr.070412.
231. Yaari S, Goldbourt U. Voluntary and involuntary weight loss: associations with long term mortality in 9,228 middle-aged and elderly men. American journal of epidemiology 1998;148(6):546-55.
232. Shea MK, Houston DK, Nicklas BJ, Messier SP, Davis CC, Miller ME, Harris TB, Kitzman DW, Kennedy K, Kritchevsky SB. The effect of randomization to weight loss on total mortality in older overweight and obese adults: the ADAPT Study. The journals of gerontology Series A, Biological sciences and medical sciences 2010;65(5):519-25. doi: 10.1093/gerona/glp217.
233. Shea MK, Nicklas BJ, Houston DK, Miller ME, Davis CC, Kitzman DW, Espeland MA, Appel LJ, Kritchevsky SB. The effect of intentional weight loss on all-cause mortality in older adults: results of a randomized controlled weight-loss trial. The American journal of clinical nutrition 2011;94(3):839-46. doi: 10.3945/ajcn.110.006379.
234. Agarwal N, Acevedo F, Leighton LS, Cayten CG, Pitchumoni CS. Predictive ability of various nutritional variables for mortality in elderly people. The American journal of clinical nutrition 1988;48(5):1173-8.
235. Saletti A. Nutritional Status and a 3-Year Follow-Up in Elderly Receiving Support at Home. Gerontology 2005;51:192-8.
236. Kuikka LK, Salminen S, Ouwehand A, Gueimonde M, Strandberg TE, Finne-Soveri UH, Sintonen H, Pitkala KH. Inflammation markers and malnutrition as risk factors for infections and impaired health-related quality of life among older nursing home residents. Journal of the American Medical Directors Association 2009;10(5):348-53. doi: 10.1016/j.jamda.2009.02.007.
237. Serrano-Urrea R, Garcia-Meseguer MJ. Malnutrition in an elderly population without cognitive impairment living in nursing homes in Spain: study of prevalence using the Mini Nutritional Assessment test. Gerontology 2013;59(6):490-8. doi: 10.1159/000351763.
238. Baumeister SE, Fischer B, Doring A, Koenig W, Zierer A, John J, Heier M, Meisinger C. The Geriatric Nutritional Risk Index predicts increased healthcare costs and hospitalization in a cohort of community-dwelling older adults: results from the MONICA/KORA Augsburg cohort study, 1994-2005. Nutrition 2011;27(5):534-42. doi: 10.1016/j.nut.2010.06.005.

239. Chan M, Lim YP, Ernest A, Tan TL. Nutritional assessment in an Asian nursing home and its association with mortality. The journal of nutrition, health & aging 2010;14(1):23-8.
240. Shahin ES, Meijers JM, Schols JM, Tannen A, Halfens RJ, Dassen T. The relationship between malnutrition parameters and pressure ulcers in hospitals and nursing homes. Nutrition 2010.
241. Beck AM. Weight loss, mortality and associated potentially modifiable nutritional risk factors among nursing home residents--a Danish follow-up study. The journal of nutrition, health & aging 2015;19(1):96-101. doi: 10.1007/s12603-015-0439-6.
242. Lilamand M, Kelaiditi E, Demougeot L, Rolland Y, Vellas B, Cesari M. The Mini Nutritional Assessment-Short Form and mortality in nursing home residents--results from the INCUR study. The journal of nutrition, health & aging 2015;19(4):383-8. doi: 10.1007/s12603-014-0533-1.
243. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. Journal of psychiatric research 1975;12(3):189-98.
244. World Health Organisation. Comparative analysis of nutrition policies in the WHO European Region.2006. Internet: http://www.euro.who.int/__data/assets/pdf_file/0004/149782/instanbul_conf_20ebd02.pdf (accessed 12th december 2016.).
245. Streicher M, Themessl-Huber M, Schindler K, Sieber CC, Hiesmayr M, Volkert D. nutritionDay in Nursing Homes-The Association of Nutritional Intake and Nutritional Interventions With 6-Month Mortality in Malnourished Residents. Journal of the American Medical Directors Association 2016. doi: 10.1016/j.jamda.2016.08.021.
246. Labossiere R, Bernard MA. Nutritional considerations in institutionalized elders. Current opinion in clinical nutrition and metabolic care 2008;11(1):1-6. doi: 10.1097/MCO.0b013e3282f323e0.
247. Blaum CS, Fries BE, Fiatarone MA. Factors associated with low body mass index and weight loss in nursing home residents. The journals of gerontology Series A, Biological sciences and medical sciences 1995;50(3):M162-8.
248. Siemens A. Das Ekel-Essen des Jürgen E. .2015. Internet: http://www.spiegel.de/panorama/gesellschaft/nuernberg-der-rentner-und-das-ekel-essen-im-altenheim-a-1041637.html (accessed 30th october 2016.).
249. Dowideit A. Nichts zu lachen im Altersheim. WeltN24 2012. Internet: https://www.welt.de/print/wams/wirtschaft/article109106523/Nichts-zu-lachen-im-Altersheim.html (accessed 30th october 2016).
250. Mitchell SL, Teno JM, Kiely DK, Shaffer ML, Jones RN, Prigerson HG, Volicer L, Givens JL, Hamel MB. The clinical course of advanced dementia. The New England journal of medicine 2009;361(16):1529-38. doi: 10.1056/NEJMoa0902234.
251. Levine SK, Sachs GA, Jin L, Meltzer D. A prognostic model for 1-year mortality in older adults after hospital discharge. The American journal of medicine 2007;120(5):455-60. doi: 10.1016/j.amjmed.2006.09.021.
252. van Dijk PT, Mehr DR, Ooms ME, Madsen R, Petroski G, Frijters DH, Pot AM, Ribbe MW. Comorbidity and 1-year mortality risks in nursing home residents. Journal of the American Geriatrics Society 2005;53(4):660-5. doi: 10.1111/j.1532-5415.2005.53216.x.
253. Lievesley N, Crosby, G., Bowman, C. . The changing role of care homes.2011. Internet: http://www.cpa.org.uk/information/reviews/changingroleofcarehomes.pdf (accessed 2nd october 2014.).

254. University Hospitals Coventry and Warwickshire NT. Nutrition and Dietetics - Dementia care: A practical guide to eating and drinking. Patient Information 2014.
255. Stajkovic S. Unintentional weight loss in older adults. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne 2011;183(4):443-9.
256. Luger E, Dorner TE, Haider S, Kapan A, Lackinger C, Schindler K. Effects of a Home-Based and Volunteer-Administered Physical Training, Nutritional, and Social Support Program on Malnutrition and Frailty in Older Persons: A Randomized Controlled Trial. Journal of the American Medical Directors Association 2016;17(7):671 e9- e16. doi: 10.1016/j.jamda.2016.04.018.
257. Dhaussy G, Drame M, Jolly D, Mahmoudi R, Barbe C, Kanagaratnam L, Nazeyrollas P, Blanchard F, Novella JL, Group S. Is health-related quality of life an independent prognostic factor for 12-month mortality and nursing home placement among elderly patients hospitalized via the emergency department? Journal of the American Medical Directors Association 2012;13(5):453-8. doi: 10.1016/j.jamda.2011.10.002.
258. van Buul LW, van der Steen JT, Doncker SM, Achterberg WP, Schellevis FG, Veenhuizen RB, Hertogh CM. Factors influencing antibiotic prescribing in long-term care facilities: a qualitative in-depth study. BMC geriatrics 2014;14(1):136. doi: 10.1186/1471-2318-14-136.
259. Toffanello ED, Inelmen EM, Imoscopi A, Perissinotto E, Coin A, Miotto F, Donini LM, Cucinotta D, Barbagallo M, Manzato E, et al. Taste loss in hospitalized multimorbid elderly subjects. Clinical interventions in aging 2013;8:167-74. doi: 10.2147/CIA.S37477.
260. Ruggiero C, Lattanzio F, Dell'Aquila G, Gasperini B, Cherubini A. Inappropriate drug prescriptions among older nursing home residents: the Italian perspective. Drugs & aging 2009;26 Suppl 1:15-30. doi: 10.2165/11534630-000000000-00000.
261. Age UK. Later Life in the United Kingdom. 2014. Internet: http://www.ageuk.org.uk/Documents/EN-GB/Factsheets/Later_Life_UK_factsheet.pdf?dtrk=true (accessed 2nd october 2014).
262. Meijers JM, Schols JM, van Bokhorst-de van der Schueren MA, Dassen T, Janssen MA, Halfens RJ. Malnutrition prevalence in The Netherlands: results of the Annual Dutch National Prevalence Measurement of Care Problems. The British journal of nutrition 2008:1-7. doi: 10.1017/S0007114508998317.
263. Walker R, Davidson M, Gray W. Gender differences in 1-year survival rates after weight loss in people with idiopathic Parkinson's disease. International journal of palliative nursing 2012;18(1):35-9.
264. Lee JS, Chau PP, Hui E, Chan F, Woo J. Survival prediction in nursing home residents using the Minimum Data Set subscales: ADL Self-Performance Hierarchy, Cognitive Performance and the Changes in Health, End-stage disease and Symptoms and Signs scales. European journal of public health 2009;19(3):308-12. doi: 10.1093/eurpub/ckp006.
265. van Nie-Visser NC, Meijers J, Schols J, Lohrmann C, Bartholomeyczik S, Spreeuwenberg M, Halfens R. Which characteristics of nursing home residents influence differences in malnutrition prevalence? An international comparison of The Netherlands, Germany and Austria. The British journal of nutrition 2014;111(6):1129-36. doi: 10.1017/S0007114513003541.
266. National statistics. Focus on older people.2005. Internet: http://www.ons.gov.uk (accessed 11st June 2014.).

267. Miller MD, Thomas JM, Cameron ID, Chen JS, Sambrook PN, March LM, Cumming RG, Lord SR. BMI: a simple, rapid and clinically meaningful index of under-nutrition in the oldest old? The British journal of nutrition 2009;101(9):1300-5.
268. Wirth R, Streicher M, Smoliner C, Kolb C, Hiesmayr M, Thiem U, Sieber CC, Volkert D. The impact of weight loss and low BMI on mortality of nursing home residents - Results from the nutritionDay in nursing homes. Clinical nutrition 2016;35(4):900-6. doi: 10.1016/j.clnu.2015.06.003.
269. Donini LM, Savina C, Gennaro E, De Felice MR, Rosano A, Pandolfo MM, Del Balzo V, Cannella C, Ritz P, Chumlea WC. A systematic review of the literature concerning the relationship between obesity and mortality in the elderly. The journal of nutrition, health & aging 2012;16(1):89-98.
270. Kimyagarov S, Klid R, Levenkrohn S, Fleissig Y, Kopel B, Arad M, Adunsky A. Body mass index (BMI), body composition and mortality of nursing home elderly residents. Archives of gerontology and geriatrics 2010;51(2):227-30. doi: 10.1016/j.archger.2009.10.013.
271. Ryan C. Unintentional weight loss in long-term care: predictor of mortality in the elderly. South Med J 1995;88:721-4.
272. Izawa S, Enoki H, Hirakawa Y, Masuda Y, Iwata M, Hasegawa J, Iguchi A, Kuzuya M. Lack of body weight measurement is associated with mortality and hospitalization in community-dwelling frail elderly. Clinical nutrition 2007;26(6):764-70. doi: 10.1016/j.clnu.2007.08.007.
273. Bartholomeyczik S, Reuther S, Luft L, van Nie N, Meijers J, Schols J, Halfens R. [Prevalence of malnutrition, interventions and quality indicators in German nursing homes - first results of a nationwide pilot study]. Gesundheitswesen 2010;72(12):868-74.
274. Strathmann S, Lesser S, Bai-Habelski J, Overzier S, Paker-Eichelkraut HS, Stehle P, Heseker H. Institutional factors associated with the nutritional status of residents from 10 German nursing homes (ErnSTES study). The journal of nutrition, health & aging 2013;17(3):271-6. doi: 10.1007/s12603-012-0410-8.
275. Harrington C, Choiniere J, Goldmann M, Jacobsen FF, Lloyd L, McGregor M, Stamatopoulos V, Szebehely M. Nursing home staffing standards and staffing levels in six countries. Journal of nursing scholarship : an official publication of Sigma Theta Tau International Honor Society of Nursing / Sigma Theta Tau 2012;44(1):88-98. doi: 10.1111/j.1547-5069.2011.01430.x.
276. Schlaffer R, Schindler, K., Steininger, K., Mouhieddine, M., Tripamer, J., Handschuh, M, Schuh, Ch., Valentini, L., Hiesmayr, M. Qualitätsförderung in der Ernährungstherapie – Das europäische Benchmarking-Projekt „nutritionDay in Pflegeheimen“. Abstract am 4 Österreichisch-Deutschen Geriatriekongress, Wien 2009, 2009.
277. Bostick JE, Rantz MJ, Flesner MK, Riggs CJ. Systematic review of studies of staffing and quality in nursing homes. Journal of the American Medical Directors Association 2006;7(6):366-76. doi: 10.1016/j.jamda.2006.01.024.
278. Streicher M, Themessl-Huber M, Schindler K, Sieber CC, Hiesmayr M, Volkert D. Who receives oral nutritional supplements in nursing homes? Results from the nutritionDay project. Clinical nutrition 2016. doi: 10.1016/j.clnu.2016.09.005.
279. Diekmann R. LB022-MON nutritionDay in nursing homes 2012 – participation of the region Styria, Austria. Clinical nutrition 2013;Volume 32(Supplement 1):S240.
280. Pernicka E. Nutrition in Hospital and Outcome - Results on some Special Issues in the European Multicenter "nutritionDay" Study. Dissertation 2010.

281. Meijers JM, Candel MJ, Schols JM, van Bokhorst-de van der Schueren MA, Halfens RJ. Decreasing trends in malnutrition prevalence rates explained by regular audits and feedback. The Journal of nutrition 2009;139(7):1381-6. doi: 10.3945/jn.108.102608.