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Nutritional status of very old elderly living in private households in Germany – a cross-sectional study

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Nutritional status of very old elderly living in private households in Germany – a cross-sectional study

Aim: To evaluate of the nutritional status and the nutrient intake of high aged (85 years and older), healthy (i.e. independent in basic activities of daily living), free-living people in Germany. To analyse the risk for malnutrition and for dehydration in this population group and in subgroups, the necessity to recommend nutrient supplements, and the reliability of self-reports of body weight and height and of drinking fluids.

Methods: Two-tailed study (regional study part in Euskirchen near Bonn and nation-wide) from 1997-1998. Age-stratified random samples (64-74, 74-75 and ≥ 85 years) that originated from the registration office (regional) and an address-pool of a monthly contributed nation-wide survey (national), respectively. Inclusion criteria for both study parts were: minimum age 65 years, living in private household, independence in basic activities of daily living, and sufficient mental capacity to answer simple questions. Analyses are based on a standardised comprehensive questionnaire which covers socio-demographics, living situation, health and functional status, activities, smoking habits, and nutritional aspects as well as anthropometric measurements (body height and weight, arm-anthropometrics), and a dietary record over three consecutive days.

Results: Women outnumbered the men (68%), most of them widowed and single living. Orthopaedic problems, cardiac diseases and restrictions in short time memory were frequent. The functional status (ADL) was fairly good, a bit worse for women. Only few participants had merely occasionally a warm meal or missed social networks as regards doing the cooking or help in case of illness. About 80% knew the importance of a well balanced diet for health and well-being. A sedentary lifestyle was predominant. Mean BMI was 25 kg/m² for both sexes (regional: 27 kg/m² for men). Proportions of very low BMI values were rarely examined (0-4%), the prevalence of obesity (BMI ≥ 30 kg/m²) was about 9-14%. Swallow difficulties and appetite were associated with BMI for men, whereas for women self-perceived health status, self-perceived relative activity and financial problems showed statistically significant associations. Whereas body height was over-estimated, body weight (and thus resulting BMI) was slightly under-estimated. For energy and most nutrients the average intake of the high aged study participants (national study part) met the current recommendation for persons aged 65 years and older, whereas the intake of calcium, vitamin D, folate, and dietary fibre was too low. A low nutrient intake was positively associated with mental capacity (women), education and nutritional knowledge (males). Fluid intake remained adequate in half the free-living elderly, however, about one third drank less than 1 litre per day. Adequate fluid intake was examined to go along with rather rationally controlled and conscious attitudes towards drinking.

Discussion: The given anthropometric data are comparable to data of HNANES III (for people ≥ 80 years) which was suggested by the WHO for comparable proposes. Self-reports of weight can be used as reliable data source in high aged population groups on group level, the use of height and BMI by self-reports calls for a certain correction factor. There is no general risk for malnutrition, however, there is an obvious risk for osteoporosis (low intake of calcium and vitamin D) and probably for arteriosclerotic alterations (low intake of folic acid and dietary fibre, relatively high intake of fat), and for dehydration (especially for women). High-aged subjects should regularly expose themselves to ultraviolet sunlight, increase the consumption of nutrient dense foods, especially of milk products, whole-grain products, green (leafy) vegetables and fruits, and decrease the proportions of (fatty) meat and sausages. The necessity of a general supplementation of vitamin D, calcium and folic acid (and antioxidants) demands further nutritional research including biochemical parameters. When drinking amounts are only asked for as a whole instead of specifying all beverages usually drunken a considerable proportion of overestimation is possible.

Ernährungssituation hochbetagter, in Privathaushalten lebender Menschen in Deutschland (Original: Nutritional status of very old elderly living in private households in Germany – a cross-sectional study)

Ziel: Beschreibung der Ernährungssituation, des Ernährungszustandes und der Energie- und Nährstoffzufuhr ≥ 85-jähriger, gesunder, zu Hause lebender Senioren in Deutschland. Analyse des Risikos für Mangelernährung und Dehydrierung für die Gesamtgruppe bzw. mögliche Untergruppen, für die Notwendigkeit einer Nährstoffsupplementierung und der Verlässlichkeit von Selbstangaben von Körpergröße, -gewicht und Trinkmengen.

Methoden: Gesamtstudie (1997-1998) mit zwei Erhebungsteilen (regional in Euskirchen bei Bonn und bundesweit) mit jeweils nach drei Altersgruppen stratifizierter Stichprobe (65-74, 75-84 und ≥ 85 Jahre); die Stichprobenziehung erfolgte regional durch das Einwohnermeldeamt, national aus einem Adressenpool bundesweiter Mehrthemenbefragungen. Einschlusskriterien für beide Studienteile waren: Mindestalter 65 Jahre, Leben im Privathaushalt, Selbstständigkeit bei alltäglichen Verrichtungen und ausreichende geistige Fähigkeiten. Die Datenerhebung umfasste standardisierte Befragungen (sozio-demographischen Daten, Ernährungs- und Lebenssituation, Aktivitäten, Rauchverhalten), anthropometrische Messungen (Größe, Gewicht, Arm-Anthropometrie) sowie 3-tägige Ernährungsschätzprotokolle.

Ergebnisse: Frauen sind in der Überzahl (68%), die meisten verwitwet und allein lebend. Erkrankungen des Bewegungsapparats und Herz-Kreislauf-Erkrankungen sowie kognitive Probleme sind weit verbreitet. Der funktionelle Status war überwiegend gut (schlechter bei Frauen). Nur wenige Hochbetagte verzehren selten eine warme Mahlzeit und haben keine Hilfsperson im Krankheitsfall bzw. Personen, die für sie kochen. 80% sind sich der Bedeutung einer ausgewogenen Ernährung für Gesundheit und Wohlbefinden bewusst. Die meisten haben einen sedativen Lebensstil. Der durchschnittliche BMI liegt bei 25 kg/m² (regional: 27 kg/m² für Männer). Niedrige BMI-Werte wurden nur vereinzelt gemessen (0-4%); die Prävalenz hoher BMI-Werte (≥ 30 kg/m²) betrug 9-14%. Für Schluckbeschwerden und Appetit (Männer) bzw. Selbsteinschätzung des Gesundheitsstatus, relative Aktivität und finanzielle Probleme (Frauen) zeigen sich signifikante Zusammenhänge mit dem BMI. Die Körpergröße wurde überschätzt, das Körpergewicht (und damit der aus Selbstangaben berechnete BMI) leicht unterschätzt. Die Zufuhr an Energie und den meisten Nährstoffen entspricht der Empfehlung für über 65-Jährige; die Zufuhr von Calcium, Vitamin D, Folat und Ballaststoffen ist jedoch zu gering. Eine niedrige Nährstoffzufuhr zeigte Zusammenhänge mit dem geistigen Status (Frauen) sowie dem Bildungsstand bzw. dem Ernährungswissen. Die Flüssigkeitszufuhr war für die Hälfte adäquat; ein Drittel drank jedoch weniger als einen Liter am Tag. Eine adäquate Flüssigkeitszufuhr war mit bewusst kontrollierten Verhaltenseinstellungen verbunden.

Diskussion: Die anthropometrischen Daten ähneln im hohen Maße den von der WHO vorgeschlagenen Vergleichsdaten (für ≥ 80-Jährige) aus der NHANES III-Studie. Selbstangaben des Körpergewichts können als verlässliche Datenquelle auf Gruppenebene dienen; Körpergröße und BMI aus Selbstangaben bedürfen eines Korrekturfaktors. Insgesamt ist die Ernährungssituation für die Gesamtgruppe nicht als kritisch einzustufen, allerdings war die Zufuhr von Calcium, Vitamin D und Folat deutlich zu niedrig. Hochbetagte unterliegen somit einem erhöhten Risiko für Osteoporose, für arteriosklerotische Veränderungen und möglicherweise für kognitive Funktionseinbußen. Außerdem besteht, vor allem bei Frauen, ein Risiko für Dehydrierung. Regelmäßige UV-Licht-Exposition sowie körperliche Aktivität sind neben dem vermehrten Verzehr nährstoffdichter Lebensmittel (insbesondere Milchprodukte, Vollkornprodukte, Gemüse) und dem reduzierten Verzehr (fetter) Wurst- und Fleischwaren empfehlenswert. Die Notwendigkeit einer generellen Supplementierung bedarf weiterer Forschungsarbeit inklusive biochemischer Parameter. Die Flüssigkeitszufuhr wird leicht überschätzt, wenn anstelle der tatsächlich verzehrten Getränke nur eine Gesamttrinkmenge erfragt wird.

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I Introduction

Definitions and demographic development

Current definitions of “old age” or “elderly” for humans are under discussion. The WORLD HEALTH ORGANIZATION uses 60 years as the age limit for public health classification. In 19th century Germany, OTTO VON BISMARCK established 65 years as the age of enforced retirement, and this became the convention for “old age” until today. For the purpose of this thesis subjects aged 85 years and older are defined as “very olds” or “high aged elderly”.

Elderly persons (as defined by WHO) represent the fastest growing segment of population throughout the world (WHO 1995). One of every 10 persons is now aged 60 years or older; by 2050, the United Nations project that one person of every five will be aged 60 years or older. Moreover, the older population is itself ageing, and those aged 80 years or older are the fastest growing segment of the older population. By 2050, 19% of the older population will be aged 80 years or older; and the majority of all older persons (55%) are women (UNITED NATIONS 1999).

How about the situation in Germany? In 1999, 16% of the German population was 65 years of age and older. According to population projections by the GERMAN FEDERAL STATISTICAL OFFICE, this proportion is predicted to increase to 20% by 2010, to 26-27% by 2030, and to 26-32% by 2050 – a decline in population from now 82 millions to 65-70 millions being postulated (STATISTISCHES BUNDESAMT 2000). To put it in absolute numbers: from 13 millions today, subjects aged 65 years and more will be in total 20 millions by 2050. The proportion of individuals aged 80 years and older is estimated to increase to 5.4% of the whole German population and to one quarter of all subjects aged 65 years and more by 2025 (LEHR 1996).

Unfortunately, there is no separate up-to-date projection for the age group 85 years and older. The proportion of this population group actually amounts to 1.9% of the whole population, that is in absolute numbers 1.5 millions people, 370,000 men and 1,116,500 women (STATISTISCHES BUNDESAMT 1999).

In addition to the increase in the absolute number of elderly persons, life expectancy is also increasing in affluent countries. In Germany life-expectancy at birth amounts to 74.4 years for males and 80.5 years for females (calculated for the old West German States in 1997). A 60-year-old man has an actual life expectancy of another 19 years, a woman of the same age of another 23 years. In 2025, corresponding life expectancies are assumed to amount to 20 years (males) and 25 years (females), respectively (STATISTISCHES BUNDESAMT 2000).

Ageing process and nutrition

These demographic changes demand concentration on elderly persons who have been neglected in nutritional research until the early nineties. Yet, "the elderly" show the distinctive feature of being a very heterogeneous group: a healthy 80-year-old person is not comparable with a healthy 60-year-old person, nor are two healthy 80-year-old persons necessarily comparable with each other in biological age (DE ONIS & HABICHT 1996). In other words, the chronological age does not necessarily reflect accurately the biological age of elderly individuals. Therefore, it might be important to manage the elderly on the basis of physiologic rather than chronological age (REFAI & SEIDNER 1999). Nevertheless, for many administrative as well as public health purposes it remains useful to refer to separate age groups.

Although the process of ageing begins at birth, one must survive for many years in order for senescence to be reflected in the phenotype (HENRY et al. 2000). Yet, to date, the processes involved in the ageing procedure are still not cleared in detail. Ageing seems to be a multifactorial process, whereby the genetic component is of particular importance (NIKOLAUS 2000). What we can be sure of are some metabolic changes on multiple organ systems. Reserve and storage capacities of several organs and organ systems decline, as do recovery and regulatory abilities (BUCHOWSKI & SUN 1996). Several of the major biological changes seem to occur primarily as a result of biological process ageing (e.g., gradual loss in bone density, sarcopenia; gradual reduction in basal metabolic rate, total energy requirement, VO_2 max, and aerobic capacity), while others are frequently seen in elderly populations but seem to be more due to environmental and lifestyle factors and can be referred to as secondary factors (e.g., increased blood pressure, reduced insulin action, deranged fat metabolism) (ROUBENOFF et al. 2000). There is, however, a considerable degree of individual variation (MCGEE 2000), so the inter-individual variation among the survivors in a birth-cohort widens (HENRY et al. 2000).

Subjective health has been found as an independent predictor of mortality and functional decline in several previous studies (IDLER & BENYAMINI 1997, HELMER et al. 1999, STUCK et al. 1999). Subjective health considers the subject's psychology, experience and well-being. Among elderly people in particular, well-being is a main component of successful old age (HELMER et al. 1999).

In this context, the notion of "successful ageing" is no newly-made idea, but was probably first described by Aristotle. He used the term "eugeria", which he defined as living a long and happy life, without suffering and without being a burden to others (RITCHIE 1997). Current public health goals target at lengthening the span of life in good health, functional well-being, and autonomy, and at shortening the period of suffering from multiple disabilities, poor life

quality, and dependence on help ("compression of morbidity", FRIES 1980; "active life-expectancy", KATZ et al. 1983). This purpose does not only consider humanitarian or philanthropic aspects, but also the serious economic impacts of the dramatic rise in health care costs (STATISTISCHES BUNDESAMT 1998), and is therefore an important social issue.

Among the environmental and life-style factors, nutrition plays a key role in the course of the ageing process (ROWE & KAHN 1997), along with physical activity (WOO 2000). "Good nutrition" is considered to be integral to the overall health, independence and quality of life of older people (HOLMES 1994). As summarised in table I.1, there are many physiological changes and as well as various unfavourable physical, socio-economical, mental, and psychical circumstances that are negatively associated with energy and nutrient intake and nutritional status (modified after COLUCCI et al. 1987 and VOLKERT 2000).

Table I.1 Physiological changes with age and life circumstances affecting nutrient intake and nutritional status

Physiological changes

- impaired ability to regulate food and fluid intake (possible consequences: anorexia, dehydration)
- reduced sensation of taste and smell
- reduced basic metabolic rate caused by reduction in fat-free mass
- tendency to gastric atrophy

Physical impairments and ailments

- problems in swallowing and chewing/poor dentition
- impaired agility of hands and arms caused by arthritis, arthrosis, paralysis (stroke), tremor (M. Parkinson): problems in activities of daily living, to do the cooking, to cut with a knife, etc.
- impaired mobility: reduced ability to do the shopping, to do the cooking etc., reduced exposure to daylight (reduced production of vitamin D)
- chronic and acute diseases, frequent suffering from pain
- multiple medications (drug-nutrient interactions)

Socio-economical situation

- marital status
- living arrangement
- educational level/background
- financial situation/poverty

Mental and psychic situation

- social isolation
- depression, confusion, forgetfulness, dementia

Elderly subjects are considered to have an impaired ability to accurately regulate food intake which could lead to impaired energy regulation (ROBERTS 2000). As underlying causes several potential mechanisms are considered, both metabolic mechanisms (slower gastric emptying, increased postprandial concentrations of cholecystokinin and insulin, decrease in messenger RNA for nitric oxide synthase, impaired detection of hypoglycemia) as well as biobehavioural and social factors (reductions in the sensation of taste and smell, reduced "sensory-specific satiety", poor dentition, prescribed medications, depression, social isolation, and last but not least reduced dietary variety) (FINKELSTEIN & SCHIFFMAN 1999, ROBERTS 2000, DREWNOWSKI & SHULTZ 2001).

A variety of social and economic factors, including income and educational level, gender, living alone, age, and race have been negatively associated with dietary intake (DAVIES 1990, WHITE et al. 1991, HOUSTON et al. 1994, QUINN 1997, HOWARD et al. 1998). Several studies have suggested low income, lower educational attainment, and lower occupational status to be associated with poor dietary intake in elderly populations (HORWATH 1989a).

An individual's nutritional health results from a series of social acts. Obtaining, preparing, and eating food are, for most people, social events. It can be argued that adequate nutrition depends in part on the adequacy of the social relations an individual has with others. Consistent with these notions are several studies of the elderly that found that those who had more social relationships and found them more satisfactory also had superior diets. The elderly may face disabilities that limit their access to food (transportation), but also limit chewing, swallowing, smelling or tasting food, as well as preparing and eating food (MCINTOSH et al. 1989). Many elderly also experience social isolation caused by living alone or lack of adequate social relationships. This social isolation may lead to the frequent prospect of eating alone, which, in turn, may lead to eating less regularly scheduled meals, using convenience foods more often, and reducing the amount and types of food eaten. These circumstances may place the elderly at nutritional risk (MCINTOSH et al. 1989). On the other side, it has been suggested that marital roles, strongly connected with cooking skills, may be more important in influencing dietary intake by elderly people than companionship during mealtime (SCHLETTWEIN-GSELL et al. 1991a).

Studies on the nutritional status in the elderly

Thus, examining the nutritional situation of elderly persons, and identifying the various parameters involved in it is getting more important. Essential information about the individual's food intake and habits, activity, cultural influences, and the economic and social situation provide a fundamental base for nutritional assessment (HOWARD 1996).

In this context, examinations on the elderly have been sometimes prejudiced by taking malnutrition for granted, and the "social myth" of older subjects being poor, frail, and isolated existed (LEHR 1996, SCHLETTWEIN-GSELL et al. 1999). Yet, scientific research in this field can be divided into two sections: on the one hand investigations concerning institutionalised or hospitalised elderly and geriatric patients (where malnutrition actually is often observed) (VOLKERT 1997), and on the other side those scientific projects concentrating on non-institutionalised or free-living elderly. The latter concerns the majority of the elderly in Germany. In the mid nineties, altogether only 5.0% of subjects aged 65 years and older were institutionalised, i.e., living in nursing homes or homes for aged people, including 13.4% aged 80 years and older (BUNDESMINISTERIUM FÜR FAMILIE, SENIOREN, FRAUEN UND JUGEND 1997). An estimated 26.5% of the elderly aged 85 years and older living in private households are assumed to be dependent to a certain degree on professional help or care, respectively, which can imply total dependence on nursing care but also merely dependence on occasionally help in household activities of daily living (BUNDESMINISTERIUM FÜR FAMILIE, SENIOREN, FRAUEN UND JUGEND 1996). It follows from the above that most of the very old elderly are more or less living independently in private households.

In recent years, there has been an increase in literature targeted at institutionalised or hospitalised elderly subjects. However, as known so far institutionalised elderly differ from independently living peers in just those basic characteristics that particularly condition the autonomy of the non-institutionalised elderly, above all, by differences in health, nutritional and functional status. Therefore, though research data of institutionalised elderly can provide useful information by comparisons, it is not transferable to apparently healthy persons living in the community.

Literature concerning the nutritional status, associations between nutritional aspects and health or specific nutritional aspects in independently living elderly has also been rising during the last years all over the world. Yet, in most such studies only younger elderly cohorts or populations were included (e.g., DE GROOT ET AL. 1991: SENECA-study, BELLIN et al. 1986: Heidelberg-Michelstadt-Berlin-Studie, HARTZ et al. 1992: Boston Nutritional Status Survey). In large representative (German) population studies including information on the nutritional status elderly participants often merely formed a small part and thus were under-represented

(HESEKER et al. 1994: NVS/VERA, MENSINK et al. 1999: Bundes-Gesundheitssurvey 1998), or were not included at all (WINKLER et al. 1992: WHO-MONICA project, KREUTER et al. 1995: Deutsche Herz-Kreislauf-Präventionsstudie). On the other hand, in some of the large age-relevant studies nutritional aspects were merely investigated or not part of the investigation at all, respectively (SOMMER et al. 1998: SIMA-study, MAYER & BALTES 1996: Berliner Altersstudie, THOMAE 1993: Bonner Gerontologische Längsschnittstudie/BOLSA). One exception is the longitudinal German GISELA-project, but so far the oldest participants only reached age 80 years (NEUHÄUSER-BERTOLD 2000). Some American nutrition/health studies in the elderly included high aged individuals (HALLFRISCH et al. 1994: Baltimore Longitudinal study of Aging/BLSA, JOHNSON et al. 1992, PAREO-TUBBEH et al. 1999: New Mexico Elder Health Survey), but here ethnic and cultural differences in eating habits have to be taken into account.

Anthropometry is the single most universally applicable, inexpensive and non-invasive method available to assess the size, proportions, and composition of the human body. It reflects both health and nutritional status and may be used to predict performance, health, and survival (WHO 1995), especially when clinical data (plasma albumin etc.) are not available. As a screening method it might become even greater importance for public health goals in elderly populations especially when more complicated measurement techniques are not practicable or too strenuous. Beside the ongoing discussion about “normal“ ranges of height, weight and BMI in elderly populations, understanding the normal changes in the body (e.g., decrease in the fat-free mass), its composition with increasing age, and resulting health implications are important to the health care and nutritional support of elderly subjects.

Anthropometric data of elderly persons assessed in both American and different European regions is less scarce (BURR & PHILLIPS 1984, FRISANCHO 1984, DELARUE et al. 1994, PAOLISSO et al. 1995, DE GROOT et al. 1996, RAVAGLIA et al. 1997, REA et al. 1997, DEY et al. 1999, KUCZMARSKI et al. 2000), and changes in stature, weight, and body composition after age 60 years have well been documented, mainly from American national health studies (e.g., BAUMGARTNER et al. 1995: New Mexico Aging Process Study, SORKIN et al.1999: Baltimore Longitudinal Study of Aging, KUCZMARSKI et al. 2000: NHANES III). However, according to the WHO, different elderly populations show large geographic and ethnic variations in height, weight, and BMI, much of which reflects differences in lifestyle and environment over the life course, genetic differences, and, to an uncertain extent, differences in health status (WHO 1995). Data of other regions might therefore not be directly comparable to very old Germans.

There is little information about the nutritional status of high aged old subjects in Germany, particularly of those living in the community. Available (European) reference data for stature and weight of persons older than 80 years of age are sparse or obtained from groups that

may not be representative of the sample of elderly persons living today (CHUMLEA et al. 1994). Some European investigations on the elderly included height, weight, and BMI in high aged subjects (BURR & PHILLIPS 1984: only BMI; DEY et al. 1999, PAOLISSO et al. 1995, RAVAGLIA et al. 1997, REA et al. 1997), other previously run studies in different European regions concentrated on younger elderly (DELARUE et al. 1994, DE GROOT et al. 1996), as did the longitudinal German GISELA-study (NEUHÄUSER-BERTOLD et al. 2000).

There are a number of circumstances in epidemiological research in which direct measurement of height and weight is not possible or practical, and it is necessary to use self-reports of height and weight instead (e.g., telephone interviews, self-administered questionnaires, no availability of calibrated household scales, physical handicaps). Scientific studies scrutinising the effect of obesity on mortality or morbidity are often based on self-reported height and weight data. It is therefore of interest to ageing research if self-reports of elderly populations are valid. Many investigators have analysed associations between self-reports of body weight and height and measured values in adults (KUSKOWSKA-WOLK et al. 1989, STEVENS et al. 1990, STEWART et al. 1987, PLANKEY et al. 1997, HILL & ROBERTS 1998), but there is only one study in high aged subjects (VAILAS & NITZKE 1998), and no such investigation in German elderly populations.

There are hints for a small physiological annual weight loss of less than 1% after the age of 60 years for both male and female subjects (BECK & OLEVSEN 1998). Weight loss beyond this extension and malnutrition have been cited as common problems in older populations, and have been associated with adverse health outcomes such as infections, poor wound healing, and death (WALLACE et al. 1995). Weight loss of 5 kg or more has been associated with a small increase in the risk of all-cause mortality (YAARI & GOLDBOURT 1998). According to DAVIES & KNUTSON (1991), recent unintended weight loss can be considered as an important independent warning signal for malnutrition in the elderly. It assumes even greater urgency for various forms of practical preventive action if it is associated with other risk factors. To date, most studies on weight loss have focussed on hospitalised or nursing home patients (e.g., VOLKERT 1997). Data on community-dwelling elderly subjects are rare (WALLACE et al. 1995), and so far not available for German high aged elderly.

Measurement of skinfold thickness belongs to the simplest methods for assessment of the fat content of the human body. This measurement can be made independent of location, and is cheap, easy, and quick in performance. As about half of body fat mass is stored in subcutaneous fatty tissue, measurement of skinfold thickness on defined parts of the body can be used for orientation about overall body fat content. Measurement of triceps skinfold thickness (TSF) on the mid-point between the tip of the acromion and the oleacron process is the most commonly used method (VOLKERT 1997). Circumferences are usually measured on the same point of the upper arm as the triceps skinfold thickness. Assuming that the upper arm is cylin-

drical and ignoring the contribution to arm volume made by the humerus, the arm-muscle circumference can be calculated (using TSF and upper-arm circumference) as indicator of the somatic protein contents (BURR & PHILLIPS 1984), and the arm fat area as correlate to total body fat can also be calculated. Studies on the elderly which include such anthropometric data often concentrate on younger elderly or just provide data of some of the anthropometric standards, respectively (BURR & PHILLIPS 1984, KUBENA et al. 1991, DELARUE et al. 1994, DE GROOT et al. 1996, RAVAGLIA et al. 1997, KUCZMARSKI et al. 2000). For German high aged elderly no comparable data are available.

Assessment of daily energy and nutrient intake and their comparison with current recommendations are central issues in the analysis of the nutritional situation of population groups. Numerous studies have confirmed the concept that in humans there is a decline in food intake over the life-span which has been termed the “physiological anorexia of ageing” (MORLEY & SILVER 1988). It has many causes, including alterations in the gastrointestinal satiating system, the effect of elevated leptin levels, especially in men, and a variety of changes in central nervous system neurotransmitters (MORLEY 2001, MORLEY 2001a). In addition, energy expenditure decreases with age caused by changes in body composition as well as reduced physical activity, whereas to current knowledge nutrient requirements remain almost the same as for younger adults (DGE et al. 2000, ROUBENOFF et al. 2000). Some scientists also suggest that the gastrointestinal function is well preserved with ageing regarding the digestion and absorption of macronutrients, but the ageing gastrointestinal tract becomes less efficient in absorbing vitamin B_{12}, vitamin D, and calcium (RUSSELL 2000). In this perspective, the nutrient density of the diet is particularly useful as an indicator of the quality and adequacy of the diet (STEEN 1986), because whether nutrient requirements for high aged individuals remain almost the same as for younger adults or whether they are even higher, in any case both nutrient density and density of dietary fibre in the diet need to be increased when food intake declines. Consequently, dietary quality is difficult to ensure when overall energy intake is low (BLUMBERG 1997, MOREIRAS et al. 1996).

Studies in free-living elderly people including data on food consumption have become more popular in recent years (DE GROOT et al. 1991, VAN STAVEREN et al. 1994, LÜHRMANN 1999, NEUHÄUSER-BERTHOLD 2000, PFAU AND PIEKARSKI 2000) but with regard to high aged people data on the dietary intake are still scant. Only few German studies specifically assessed nutritional aspects, e.g. eating habits, in very old subjects (STEINMETZ 1976, MENDEN et al. 1989, BECKER et al. 1990, BRODHAGEN 1993).

Drinking habits and fluid intake of elderly persons in Germany are also rarely examined to date, although it is well-known that the age-related decrease in total-body water makes eld-

erly persons markedly susceptible to stresses on water balance. By age 75-80 years, the total-body water content has declined to 50%, with even more of a decline in elderly women (MILLER 1999, KUGLER & HUSTEAD 2000). Ageing is characterised by reduced homeostatic capacity, which includes changes in both the control of water intake and excretion (ROLLS 1990, PHILLIPS et al. 1993). There is a clear decrease in maximal urinary concentrating ability and a failure in the normal responsiveness of the kidney to the antidiuretic hormone (ADH). Changes in renal physiology and anatomy include decreased renal mass, cortical blood flow and glomerular filtration rate, as well as impaired responsiveness to sodium balance (BECK 1998, KUGLER & HUSTEAD 2000). Because of these various alterations, aged subjects are very susceptible to dehydration (i.e. thirst exsiccosis). Early signs of dehydration include dry mouth and eyes, burning sensation in the stomach, dark urine with a strong odour, and heat intolerance (KLEINER 1995, VOLKERT 1997). Furthermore, dehydration is one of the most relevant factors for constipation (WILSON 1999, ROBSON et al. 2000), the most common cause of renal impairment and failure, and also a common cause of fluid and electrolyte disturbances in the elderly (ROLLS 1990). Many signs of dehydration are primarily related to the central nervous system: the osmotic pressure gradient favours movement of water out of brain cells and leads to a decrease in brain volume. Neurologic manifestations are the result, e.g., lethargy, weakness, irritability, hyperreflexia, seizures, coma, and even death (FALL 2000).

Several studies have shown that the sensation of thirst is clearly reduced among healthy elderly people, even after stressing by thermal dehydration (PHILIPS et al. 1984, MIESCHER & FORTNEY 1989). The impaired thirst is partly due to changes in receptors in the central nervous system that detect changes in plasma osmolality (PHILLIPS 1991). Should this decrease in the sensation of thirst be accompanied by illness or physical incapacity that increases water loss or prevents access to water, dangerous dehydration could follow (ROLLS 1990), which often goes unrecognised in the elderly (AUSMAN & RUSSELL 1994). Since drinking fluids provide the biggest part of total fluid intake it is of interest if the impaired thirst in the elderly leads to inadequate drinking behaviour. Because of the described physical changes in homeostasis, cognitive aspects seem to be more important for the elderly with regard to adequate fluid intake. As thirst is no longer a (warning) signal for the necessity to drink, elderly persons should have to ensure consciously that their physical needs are satisfied. This implicates at first a certain degree of awareness in view of the described physical changes and needs. But awareness alone does not lead to adequate behaviour. Several circumstances can interact or impair it. Unfavourable attitudes towards drinking, physical handicaps (e.g., problems with going to the toilet, especially by night), forgetfulness, dementia, aspects of convenience, fear of becoming incontinent, indifference, and lack of sensibility are some of them. So far unclear is also the question whether there are associations between low fluid

intake and socio-demographics and health data which are often related to inadequate nutritional intake. Another point of concern are the beverages types consumed by the elderly, because monotonous drinking habits could be one reason of low fluid intake.

In epidemiological studies that include reliable data on fluid intake elderly subjects often represent only a small group of the total study population (BELLIN et al. 1986, HESEKER et al. 1994). In specific investigations on the elderly sample sizes are small and/or investigations are limited to younger elderly (BELLIN et al. 1986, HAVEMAN-NIES et al. 1997, PFAU AND PIEKARSKI 2000, LÜHRMANN et al. 2001), respectively, or are limited to institutionalised elderly (MÜLLER 1998) where dehydration is wide-spread (PALEVSKY et al. 1996, VOLKERT 1997). In some of these studies merely questionnaires are used for assessment of fluid intake in the elderly (BELLIN 1986, MENDEN et al. 1989/BRODHAGEN 1993, VOLKERT 1997, SOMMER et al. 1998). Thus finally, it is of interest if the amounts high aged subjects estimate to drink by themselves are equivalent to the amounts they apparently drink.

II Aims of the study

The study is aimed at evaluating the nutritional status and the nutritional intake of healthy (i.e. independent in basic activities of daily living), free-living people in Germany aged 85 years and older, by the use of anthropometry, dietary records, and a comprehensive questionnaire on various factors involved in nutritional intake.

The following specific questions should be answered:

- Is there an obvious general risk for malnutrition in this population group?
  - Is it necessary to recommend energy and/or nutrient supplements for high aged subjects?
  - Is it necessary to encourage high aged subjects to increase their fluid intake in avoidance of dehydration? If so, is it possible to identify points of contact (favoured beverage types, crucial attitudes)?
  - Is it possible to identify a gender-dependence and/or subgroups with higher risk for malnutrition, inadequate nutrient intake, and dehydration?

- Do high aged subjects reliably report their own body weight and height? Is it possible to dispense with measurements of body height and weight in studies on high aged populations?
- Is it possible to rely on estimated drinking fluids and to dispense with measurements of fluid intake in studies on high aged populations?

III Methods

III.1 Study design, inclusion criteria, subject recruitment, and data collection

In a representatively designed cross-sectional study conducted by the Department of Nutrition Science of the University of Bonn (supported by the German Ministry of Health), the nutritional situation of the elderly in Germany has been analysed (VOLKERT & STEHLE 1997).

It was the aim of the study to get basic data about the nutritional situation of free-living elderly persons for whole Germany. The project was composed of two study parts within the years 1997 and 1998. In a first, so-called "regional study part", information assessment was extensive and very detailed but restricted to a small survey town. The second "nation-wide" part served as control if the regional data can be generalised and considered as representative for whole Germany. Therefore, the size of the nation-wide random sample was four times as large as that of the regional study part, yet for practical reasons the extent of the nation-wide investigation was clearly reduced.

The "regional study part" took place in Euskirchen (50,000 inhabitants, 20 km south-west of Bonn) from May 1997 until January 1998. Euskirchen was chosen because its structures of age and inhabitants correspond to those of whole Germany (STADT EUSKIRCHEN 1997, STATISTISCHES BUNDESAMT 1998). Besides, this small traditional town was easy to reach for the co-workers of the University of Bonn. The "national study part" was conducted In cooperation with the company I+G Gesundheitsforschung, Munich, in randomly selected locations in Germany from May until June 1998.

In either study part the following inclusion criteria were defined for participation (table III.1):

Table III.1 Inclusion criteria

- minimum age 65 years
- living in private household, i.e., only non-institutionalised persons
- independence in basic activities of daily living, i.e., no confinement to bed, independence in getting up from bed and in eating
- sufficient mental capacity to answer simple questions (questions for the name, age, and place of residence of the participants had to be answered correctly)

Persons with severe hearing problems and/or persons not fluent in the German language were excluded from participation.

Regional study part

The recruitment of participants was based on an age-stratified (65-74 years, 75-84 years and older than 84 years) random sample of 1,200 inhabitants obtained from the registration office of Euskirchen (dead-line: 1st of April 1997); 400 subjects were included in each age-group.

Intensive efforts were placed on introducing and increasing the publicity of the study in Euskirchen. All subjects of the gross random sample got information about the aims and the importance of the project by letter. About one week later, these persons where contacted by telephone and checked whether they fulfilled the inclusion criteria. Given informed consent, appointments for in-home interviews were arranged. Persons without telephone and those who did not answer on the phone were visited directly by the interviewers, if necessary several attempts to meet these people have been made.

Two visits were scheduled lasting approximately one hour each. During the first visit, detailed information about eating habits, attitudes towards eating, nutrition knowledge, and the use of nutrition information as well as data on the social and mental/psychical situation (living situation, income, social networks, life-satisfaction, etc.) of the participants were obtained by standardised questionnaires in personal interviews. A food frequency-list for the assessment of food consumption of the last four weeks completed the first visit. Participants were introduced in detail in filling in a standardised consecutive 3-day dietary record and a list of regularly taken medications. Mean time needed for the first visit was 69 $\pm$ 20 minutes.

During the second visit about one week later, these two lists where controlled for completeness by the respective interviewer. Portion sizes of some foods and sizes of glasses, cups and plates were weighed by calibrated household scales. Health status, activities, life style, and smoking habits of the participants were inquired. Functional tests for assessment of physical performance and anthropometric measurements for the assessment of nutritional status completed the investigations. Each interviewer had to note the duration and (potential) particularities of the interview. The second visit lasted on average 52 $\pm$ 19 minutes.

For several reasons, not all of the elderly were able or willing to fill in the dietary records, to participate in the measurements and/or to complete the whole questionnaire. Therefore, the number of participants differs slightly in the analyses of the different investigation parts. Persons not willing to participate at all were asked to answer a brief questionnaire (extracted from the original questionnaire) to get basic data about family status, education, living situation, status of health, and mobility.

Appointment of dates, interviews, and data input were performed by ten graduated students of nutrition science of the University of Bonn. Intensive introduction in the performance of the interviews and the anthropometric measurements as well as weekly team meetings guaranteed the high quality of the study protocol.

National study part

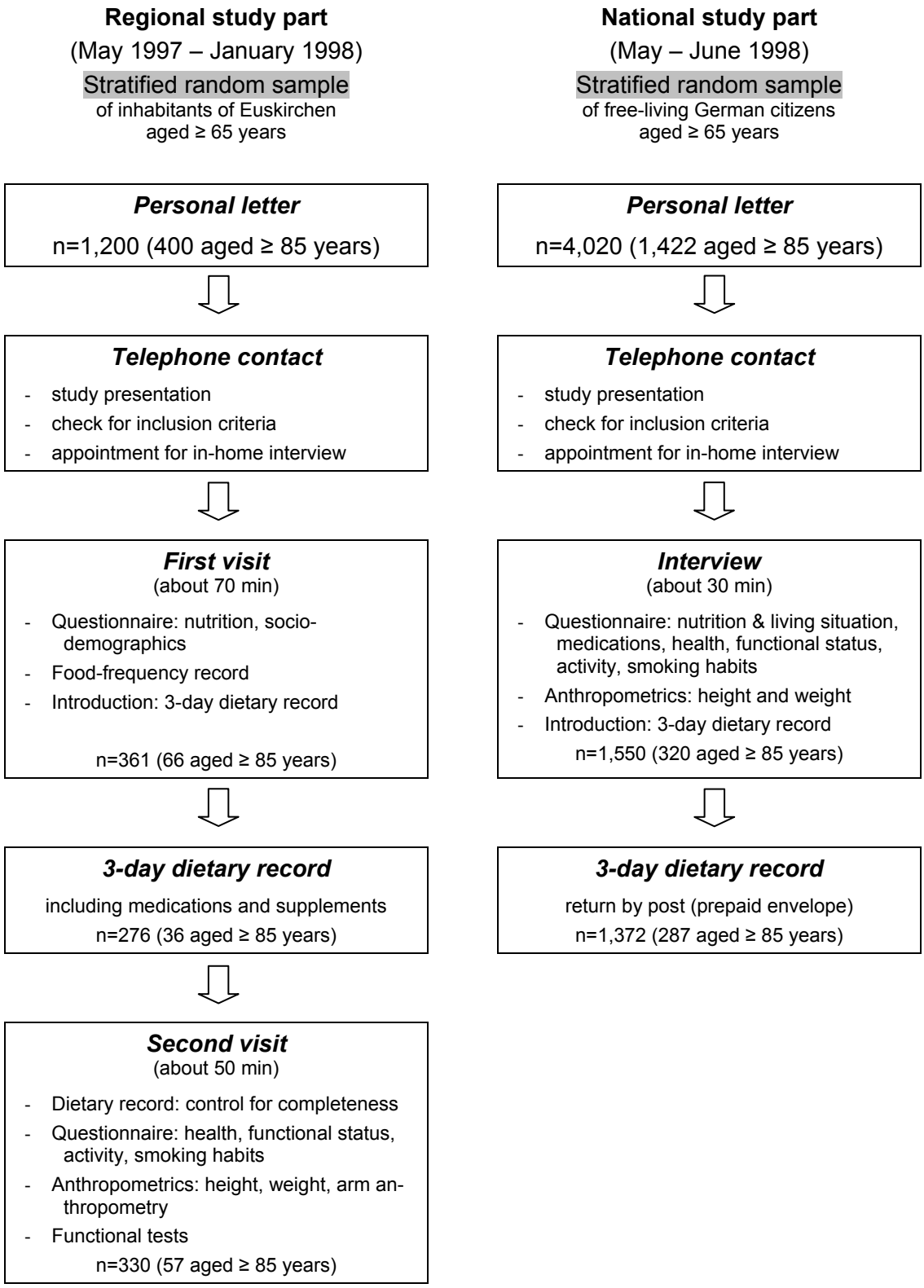
The random sample for the national part of the project originated from an address pool of a monthly contributed survey by Infratest Burke (an associated company of I+G Gesundheitsforschung, Munich), which consists of a multi-staged and stratified random sample of all German households. For this project, only addresses of subjects aged 65 and older out of this address pool were used. In this address pool no persons without registered telephone connection and no institutionalised persons were included. On the basis of the high rate of drop-outs experienced in the regional part of the study, a total number of 4,020 seniors was recruited in the random sample. In opposite to the regional part, the distribution of the age groups was disproportional: 1,701 persons aged 65-74, 897 aged 75-84, and 1,422 aged older than 84 years, respectively.

Compared to the regional study part, the study protocol was reduced to a standardised 30-minutes oral interview comprising questions of all parts of the original questionnaire and measurement of participants' body height and weight.

The 3-day dietary records had to be sent back by prepaid envelopes. A total of 375 interviewers of the staff of Infratest-Burke carried out the field-work, informed by letter about aims and procedure of the project. Analyses of computerised data took place in our Department in Bonn.

Figure III.1 illustrates procedures and contents of both study parts.

Figure III.1: Procedures and contents of the two study parts



III.2 Participants: basic characteristics

The questionnaire used in this project was especially designed to the study aims. For the original wording see the annex (VIII.1).

For the description of the study participants and also for the identification of risk groups socio-demographics, health and functional status, activities, smoking habits, and nutritional aspects were assessed as follows:

Socio-demographics

- Age and sex were noted.
- Participants were asked their family status.
- Living situation was questioned and classified as “living alone” or “not living alone”.
- Course of education was covered by school graduation (no graduation, elementary/ secondary education, O-level or comparable, and graduation for technical college/high school), and highest educational level (no educational attainment, vocational training/ foreman, technical college/university degree).
- Former professional status was classified as employee/clerk/self-employed, manual worker/family worker, and housewife/homemaker.
- Participants should judge their financial situation by the question “Do you have enough money?”. Possible answers were “yes, no problem”, “yes, fairly” or “no, does not suffice”.
- Social support was inquired by asking “Can you rely on someone who helps you in case of illness?”.

Health status

- Self-perceived health had to be judged by five possible answers and was classified for analysis as being “very good/good”, “fair”, or “less good/poor”.
- Prevalence of 16 single chronic diseases (belonging to ten different disease groups) was asked. Number of chronic diseases was calculated and classified as “none”, “1-3”, or “more than 3 chronic diseases”.
- Frequency of being in pain was inquired (“How often have you been in pain the last week?”) with four possible answers (“never”, “one time”, “several times”, and “daily”).
- Self-perceived appetite was asked with four answer possibilities and classified for analysis as being “very good/good” or “less good/poor”. Additionally, any recent loss in appetite was asked.

- Physical handicaps concerning food intake and food preparation: difficulties in chewing (always or in case of hard and sticky foods), in swallowing, and problems in cutting a piece of meat were questioned.

Mental status

- Memory was checked by one question of the Mini Mental State Questionnaire (FOLSTEIN 1975): participants should remember three simple German words (“Apfel”, “Pfennig”, Tisch”) for a few minutes while they were inquired about their diseases. If they were able to correctly recall these three words thereafter, performance of this test was judged as “good” otherwise as “poor”.

Functional status

- The capacity to perform activities of daily living (ADL, KATZ 1983) was assessed by 15 items used in the Euronut SENECA study (OSLER et al. 1991) (move outdoors, walk between rooms, use stairs, walk at least 400 m, carry a heavy object for a hundred meters, use the toilet, wash yourself, dress and undress, go in and out of bed, cut toe-nails, take own medications, manage finances, feed yourself, do light housework, do heavy housework) and 2 additionally items (bath yourself, stay alone at night) with four grades of difficulty (“can do without problem/difficulty”, “can do with difficulty but without help”, “can do only with help”, and “unable to complete”). For the three most problematic items, percentages of participants are given who “can do without help”. A mobility index was calculated for the four mobility items (move outdoors, use stairs, walk at least 400 m, and carry heavy objects): if a person did not have any difficulties in accomplishing these items he or she was judged as being “mobile” otherwise as “less mobile”.

Physical activity

- The assessment of physical activity varied in the two study parts: In the national study part participants just had to tell if they practised any kinds of sports and, if yes, how many hours they actually practise them per week. In the regional study part, participants had to itemise all kinds of sports and also to specify the time spend with these activities. In both study parts, hours spent with physical activity were summed up and classified as “regularly, 3 hours per week or more”, “regularly, less than 3 hours per week” or “no sports”.
- Relative activity compared to other persons of the same age was asked, with three possible answers (“less active”, “same active”, “more active”) in the national study part, while in the regional study part two additional answers were possible (“much less active”, “much more active”).

Smoking habits

- Smoking habits were covered by asking “Are you smoker, former smoker or non-smoker?”.

Basic nutritional aspects

- “Who does the cooking for you” was asked as open question.
- Additionally, the ability to prepare a meal without help, “even if you actually don’t do it” was inquired as “can do it without problem”, “possible with problems” or “unable to complete”.
- Frequency of getting a warm meal was asked and classified as “several times a day”, “(almost) daily” or “several times a week/occasionally”.
- Participants’ attitude towards a healthy diet was covered by the question “what do you think, how important is a “right” or well balanced diet for health and well-being?” with three answer possibilities (“very important”, “less important”, or “unimportant”).

III.3 Nutritional status

III.3.1 Questionnaire

Self-reported weight and height

Before the measurements of weight and height were carried out (see chapter III.1), participants were inquired about their current weight and height (“What is your weight at present?” and “How tall are you?”).

Unintended weight loss

In the regional study part, unintended weight loss of more than 5 kg within the past six months was requested for (“Did you lose more than 5 kg body weight in the past six months?”). In the national study part, this question was modified to assessment of recent unintended weight loss of more than 5 kg within the past twelve months.

III.3.2 Anthropometric measurements

Body weight and height

Body weight was obtained to the nearest 0.1 kg in light indoor clothing and without shoes. In the regional study part, calibrated scales (Soehnle® Typ 7502) were used that had to be placed on a hard surface. For reasons of practicability, present bathroom scales in the par-

ticipants' households were used for measurement in the national study part. Weight of the light clothes was not deducted.

Body height was measured to the nearest centimetre using a L-shaped bar and a foot-rule, participants standing erect and looking straight ahead, without shoes, back and heels against the wall, and feet close together. Persons with kyphotic backs were excluded from measurements.

Anthropometry of the upper arm (regional study part only)

The mid-point between the tip of the acromion and the oleacron process was marked on the non-dominant (i.e. mainly the left) arm while the subject held the forearm in horizontal position. Triceps skinfold thickness (TSF) was then measured over the triceps muscle on each subject's arm hanging freely along the trunk using a skinfold caliper (GPM-Hautfaltenmessgerät, Dosch Medizintechnik, Heidelberg). On the same point, mid-upper arm circumference (AC) was measured with a flexible tape. In order to adjust for inaccuracies in measurements, data analysis was performed with the mean value of three repeated measurements of the skinfold thickness and two repeated measurements of the arm circumference.

III.3.3 Calculations

Body mass index

Body mass index (BMI) was calculated as weight [kg] divided by the square of height [m²] from self-reported and measured data. Cumulative prevalences of BMI values at or above specified levels are presented (whole-integer BMI cut-off points) as proposed by KUCZMARSKI et al. (1997). BMI was additionally categorised into the three classes < 20 kg/m² (low), 20-30 kg/m² (acceptable), and ≥ 30 kg/m² (high) used in the Euronut SENECA study (DE GROOT et al. 1996).

Arm anthropometry

Arm muscle circumference (AMC), arm muscle area (AMA), bone-free or corrected arm muscle area (CAMA) and arm-fat area (AFA) were calculated according to usual equations (FIDANZA 1991, WHO 1995):

AMC [cm] = AC [cm] - π * TSF [cm]

AMA [cm²] = (AC - π * TSF [cm])² / 4π

CAMA [cm²] = AMA - 10.0 cm² (males), respectively = AMA - 6.5 cm² (females)

AFA [cm²] = (AC² - AMC²) / 4π

Comparison of self-reported with measured data

Self-reported weight and height data and therefrom calculated BMI was subtracted from corresponding measured data. Thus, these comparisons are based on participants with both respective data.

To illustrate the agreement between self-reports and measured values, the respective difference was plotted against the mean of both methods for each participant as suggested by BLAND AND ALTMAN (1986), and 95% limits of agreement were calculated (national study part only).

III.4 Energy and nutrient intake

III.4.1 Dietary record

Data concerning energy and nutrient intake were collected and assessed using a standardised estimated dietary record over three consecutive days (Sunday, Monday, Tuesday). In the regional study part, this dietary record consisted of 105 foods items, each defined by a standardised portion size. In order to make it easy in survey for the participants, foods were classified into 19 food groups as shown in table III.2. The original record is reprinted in annex VIII.2.

Table III.2 Food groups used in the dietary record

- bread
- rolls, croissants
- cakes, pastries
- jam, sweat spreads
- butter, oil, margarine
- breakfast cereals
- cheese, milk, milk products
- sausages
- meat, fish, eggs
- potatoes, noodles, rice, pizza,
- vegetables, salads
- sauces, gravy, salad sauces
- soups, hot-pots
- fruits
- deserts, sweets, nuts
- coffee, tea
- beer
- wine, sparkling wine, liqueur, spirits
- juices, refreshments, water

Empty space was given for separately noting all foods ingested which were not itemised. Study participants were introduced in detail in filling in the dietary record, in addition they received a written, exemplified instruction. The respective interviewer reviewed the records with the subjects as soon as possible after data collection for completeness and plausibility (*cp.* chapter III.1). The importance of filling in each eaten or drunken food immediately after

ingestion was emphasised, furthermore the participants were advised to choose a “normal” survey period while participation, that means, nor they should be on vacation or celebrate extraordinary events, neither suffer from acute illness at that time. Dietary records were kept preferably by the participants. In some cases relatives (mostly the wives or daughters if they usually did the cooking) filled in the record instead of the respective participant.

The dietary records used in the national study part were the same as those in the regional one, completed by five foods which had been often noted separately in the regional study part (see annex VIII.2). Since the dietary records were send back by prepaid envelope, they could not be controlled for completeness and plausibility with the respective participant alike in the regional study part (*cp.* chapter III.1).

III.4.2 Data handling

Energy and nutrient intake was calculated with the nutrient calculation system Ebis® for Windows 95 and NT. This software is based on the so-called “Bundeslebensmittelschlüssel” (Official German nutrient data base, BLS version II.2) (BGVV 1996). For each of the 105 food items an appropriate BLS code-number was defined. Additionally noted foods (e.g. “herring with cream sauce”) were assigned to foods of the dietary record as far as possible (regional study part). For foods which could not be assigned to the dietary food list (e.g. “linseed”) special BLS code-numbers were introduced systematically. Each participant got a separate data base for each day of participation; these coded data bases were checked 100% for correct data input. After transferring and aggregating of these data (mean of the three days) for each participant, further statistical analyses were performed as described below.

The procedure of assigning separately noted foods into the foods of the dietary food list and systematically introducing new BLS code-numbers for remaining foods took up very much time in the regional study part. Therefore, in the national study part, additionally noted foods could not be included in the analyses. As a spot check indicated that additionally added foods only counted for 60-70 kcal per person on the average (unpublished project data), it seemed reasonable to calculate nutrient intake regardless of these foods, keeping in mind the underlying systematic difference.

III.4.3 Calculations

Analyses are based on the intake of energy and on that of nutrients as follows: carbohydrates, protein, fat, water, alcohol, cholesterol, dietary fibre, vitamins (A [retinol equivalents], D, E [tocopherol equivalents], C, B_1, B_2, B_6, folate, and B_{12} [only in the regional study part]),

minerals and trace elements (sodium, potassium, calcium, magnesium, phosphate, iron, zinc).

Nutrient density of the diet expressed per MJ and day was calculated for those nutrients with recommended nutrient density (DGE et al. 2000). Macronutrient intake was expressed as mean percentage of energy supply. Percentage prevalences of nutrient intake of < 1/2, between 1/2 and 2/3, between 2/3 and 100% and ≥ 100% of the recommendation are given as graphs (DGE et al. 2000).

A nutrient intake score as calculated to distinguish between participants with nutrient intake below two thirds of the recommendation for two or more of the following vitamins (A, D, E, C, B_1, B_2, B_6, folate) and minerals (calcium, magnesium, iron, zinc) and those participants with adequate nutrient intake or with less than two of these nutrients below two thirds of the recommendation, respectively.

III.5 Fluid intake

III.5.1 Questionnaire

In the regional study part, participants were asked “How much do you drink in the course of a day, for example yesterday?” and should specify all beverages they usually drink. Later on, the interviewer added the enumerated beverages up, based on the same standardised portion sizes as used in the dietary records (a glass = 200 ml, a cup = 150 ml). The sums were categorised into five categories (< 0.5 litre, 0.5 up to 1 litre, 1 up to 1.5 litres, 1.5 up to 2 litres and ≥ 2 litres per day).

Participants were asked if they do or do not agree with each of the following statements (attitudes towards drinking): “I only drink when I am thirsty”, “I pay attention to sufficiently drinking”, “I do not drink much for lack of thirst”, “I drink little in order to avoid frequent trips to the toilet”, “I drink little in order to avoid frequent trips to the toilet at night”.

In the national study part, participants had to estimate the total amount of daily drunken beverages (“How many litre do you drink a day? Please think of all the beverages you usually drink in the course of a day, e.g., coffee, lemonades, mineral water, juice, alcoholic beverages etc.”). The interviewer presented them the five answer categories mentioned above and the elderly subjects should choose one of these categories.

III.5.2 Dietary record

Current individual beverage intake was analysed as average intake of beverages (in ml per day) for the 3-day dietary record period for each individual and for each part of the study. Thereby, as shown in table III.3, some beverages were grouped for a clearer presentation.

Table III.3 Examined beverages and beverage groups

Non-alcoholic beverages

- coffee
- tea
- malt coffee, herb tea, fruit tea
- water/mineral water
- fruit juices, vegetable juices, vitaminised juices, fruit nectar
- refreshments: soft drinks/sugared soda, cola, malt beer, non-alcoholic beer
- diet sodas
- milk drinks: milk, cacao, buttermilk

Alcoholic beverages

- beer
- wine, sparkling wine
- spirits, spirituous liquids

III.5.3 Calculations

Fluid intake by beverages, solid foods, total fluid intake (by beverages and solid foods), water of oxidation were calculated as average daily intake, the latter on the basis of the assessed supply of the macronutrients (107 ml per 100 g fat, 41 ml per 100 g protein, and 55 ml per 100 g carbohydrates) (DGE et al. 2000).

For each beverage or beverage group, respectively, the proportions of participants who consumed it or them, respectively, were calculated. Most beverage types lacked normal distribution and were widely spread. Nevertheless, means and standard deviations were calculated beside the medians for two reasons: first, for the possibility of comparison with other studies, and, second, for avoiding of a list of “zeros”, ensued by partly high proportions of participants who did not consume these beverages. Fluid intake by beverages was additionally classified into five categories (< 0.5 litre, 0.5 up to 1 litre, 1 up to 1.5 litres, 1.5 up to 2 litres and ≥ 2 litres per day) and percentage frequency rates of these categories were calculated. In addition, the evaluation was based on the current German recommendation for both beverage and total fluid intake for people aged 65+ years (fluid intake by beverages ≥ 1310 ml per day; total fluid intake of ≥ 1990 ml) (DGE et al. 2000), and also on the former one for beverage intake (≥ 1 litre per day) (DGE 1991).

Categorised beverage intake assessed by questionnaire was subtracted from categorised beverage intake assessed by dietary records to scrutinise the degree of their accordance. Thereby, misclassification errors of +/- 500 ml were accepted as “correct”.

III.6 Data handling and statistical analyses

III.6.1 Data handling

Data input of the questionnaires in the regional study part was performed scanner-assisted using Remark Office 3.0 (SPSS Inc., Munich). Text-fields (open-asked questions) had to be transferred by hand; the answers to such questions were categorised subsequently for statistical evaluation. The data of the national study part have been transmitted by I+G Gesundheitsforschung, Munich, as Ascii-data files or SPSS data files, respectively. At the University of Bonn, analyses were performed with the statistics program of SPSS (versions 10.0). All data were tested for plausibility and completeness. Calculations were performed separately by sex and study part.

III.6.2 Statistical analyses

Descriptive statistics

Classified variables are presented with absolute and relative frequencies. Continuous variables (anthropometry, nutrient intake) are given with mean, standard deviation, minimum (min), maximum (max), and percentiles (P5, P25, P50 [=median], P75 and P95). Differences between self-reported and measured data are described with means and standard deviations.

Explorative statistics

Dependence or independence, respectively, of classified variables was tested with Pearson’s Chi-square test, excluding subjects who did not answer the respective question. In case of more than 20% of expected prevalences (cross-tabled cells) below 5, answers were condensed and tested by Fisher’s exact test to get reliable statistical data.

Distribution of continuous variables was tested by Kolmogorov-Smirnov-test. For normally distributed continuous variables sex-dependent differences were tested by Student’s t-test for unpaired samples, differences between self-reported and measured data are tested by Student’s t-test for paired variables. Not normally distributed continuous variables were tested by Mann-Whitney-U-test (BROSIUS & BROSIUS 1995, SACHS 1988).

To scrutinise a possible selection bias caused by non-participation in the regional study part, basic information included in the short questionnaire (about family status, living situation, school graduation, educational level, self-perception of health, mobility index, smoking habits, and frequency of getting a warm meal) was compared and tested chi-square-test or Fisher's exact test, respectively, for participants and refusers.

In the national study part, the same check for selection bias caused by non-participation in the different study parts was done for study participants (*cp.* chapter III.2) with complete height and weight data and those without anthropometric measurements and for study participants with complete dietary record data and those without. For these analyses, the following variables have been tested: family status, living situation, school graduation, educational level, former professional status, judgement of the financial situation, helpers in case of illness, self-perception of health, number of chronic diseases, frequency of pain, appetite, loss of appetite in recent time, chewing difficulties, swallowing difficulties, problems in cutting a piece of meat, mobility index, practise of sports, self-perception of activity, and smoking habits, ability to prepare a meal, judgement of a healthy diet, and frequency of getting a warm meal.

For the identification of risk groups in the national study part, analyses were performed as follows: one-way-ANOVA was used to test for differences in BMI values by the basic characteristics listed above. The two nutrient intake score groups as well as subjects who met and those who did not meet the recommendation for beverage intake were tested by chi-square-test or Fisher's exact test, respectively. (Further analyses for the regional participants were considered as unessential because of the small number of participants.)

For all analyses, two-tailed p-values of below 0.05 were considered to indicate statistical significance.

IV Results

IV.1 Participation rates and participation bias

IV.1.1 Total study

Participation rates and reasons for non-participation are given in table IV.1. In both study parts participation rate from net random sample was 30%.

Table IV.1 Participation rates and reasons for non-participation

	national study part		regional study part	
	n	%	n	%
Gross random sample	**1,422**	**100.0**	**400**	**100.0**
deceased	72	5.1	26	6.5
moved / address wrong	158	11.1	8	2.0
inclusion criteria not met	117	8.2	142	35.5
institutionalised	-	-	75	18.8
physical reasons	-	-	46	11.5
mental reasons	-	-	21	5.3
total drop outs without influence on study quality	347	24.4	176	44.0
Net random sample	**1,075**	**100.0**	**224**	**100.0**
never at home / not met	149	13.9	9	4.0
communication difficulties	63	5.9	15	6.7
deaf / extremely hard of hearing	-	-	12	5.4
language problems	-	-	3	1.3
no participation because of illness	239	22.2	40	17.9
no participation at all	-	-	16	7.1
short questionnaire	-	-	24	10.7
participation refused	304	28.3	94	42.0
no participation at all	-	-	55	24.6
short questionnaire	-	-	39	17.4
Study participants	**320**	**29.8**	**66**	**29.5**

The main reasons for drop outs from random sample differed between the surveys. Whereas in the national study part no institutionalised subjects were included at all, institutionalisation counted for the biggest part of falling outs (one fifth) from the gross random sample in the regional study part. Relatively more elderly in the national survey were not met at all (14% *vs.* 4% regional). On the contrary, in the regional survey more subjects refused participation (42% *vs.* 28% national).

As expected and partly caused by the inclusion criteria, in the regional study part the health status of the participants was better that of subjects who refused participation but answered the short questionnaire for non-participants (see annex, table VIII.1). There were no other hints for a possible selection bias.

IV.1.2 Separate study parts

Questionnaire

In the national study part, complete information was available of 320 subjects (100 men, 220 women). In the regional study part 66 subjects completed the first interview (21 men, 45 women). Due to drop outs after the first interview-visit, data which belonged to the second interview visit (health and functional status, activities, and smoking behaviour; *cp.* figure III.1) were available of 57 participants (17 men and 40 women).

Anthropometry

From the whole study group in the national study part, weight data was available of 62% of the study participants, height data of 81%, and BMI data of 59%. The high proportion of missing weight data and hence also BMI data was mainly related to missing household scales.

No statistically significant differences were found with regard to basic characteristics between subjects without anthropometric data and those 190 participants (54 men, 136 women) with complete height and weight data (see annex, table VIII.2).

In the regional study part, weight data was available of 79%, both height and BMI data of respective 71%. Missing anthropometric data are mainly caused by drop outs after the first interview visit.

The evaluation of a possible selection bias showed one statistically significant difference between subjects with complete weight and height data and those without: a higher proportion of women who participated in the measurements felt able to prepare a complete meal by themselves (see annex, table VIII.3).

Dietary record

In the national study part, dietary record data was available of 90% of study participants (89 men, 198 women).

As regards a possible participation bias, there were two variables with statistically significant differences between participants and non-participants in the dietary records. Men who lived on their own refused significantly more often to fill in a dietary record, whereas women who refused participation had significantly more often financial problems (see annex, table VIII.4).

In the regional study part, complete dietary records were available of 55% of study participants (13 men, 23 women).

IV.2 Participants: basic characteristics

In table IV.2 basic characteristics of the high aged participants are presented, separately for both study parts and sexes and for the whole samples, respectively.

Socio-demographics

In the nation-wide survey, the oldest male and female participants were 95 years old each, the mean age was 87 ± 2.2 years (each sex). In the regional study part, mean age was 88 ± 1.3 years for males and 88 ± 3.0 years for females. The oldest male participant was 91 years old, the oldest female participant 96 years.

Both survey groups are distinguished by the high proportion of women (68-69%). In both study parts, significantly more women than men were widowed (85% *vs.* 55% national, 87% *vs.* 52% regional) and markedly more women than men were single living (77% *vs.* 45% national, 67% *vs.* 43% regional). Compared to the national survey, the regional one was composed of more participants without any vocational training (39% national *vs.* 62% regional) and more housewives (31% of women national vs. 58% of women regional).

In both study parts, two thirds contented themselves with their financial situation and the great majority (92%) had someone to rely on (in case of illness).

Health status

Only 8% (nation-wide) and 11% (regional) did not suffer from any chronic disease at study-time. Most participants reported to have one up to three chronic diseases, in the first place orthopaedic problems and cardiac diseases (this order was inverse in the regional survey), and to a lesser extent, diabetes mellitus, diseases of the digestive system, respiratory diseases, and diseases of the thyroid gland, to mention only the most frequent diseases. In the national study part, only 30% did not report on experiencing any pain the last week, yet 21% suffered from pain daily, mostly women. In the regional study part, 47% were free of pain while 33% experienced the feeling of pain daily.

There was good conformity between both survey parts on most relevant health issues and physical handicaps with negative effects on eating and nutritional status, except for the higher proportions of subjects with perceived good or very good health in the regional study part (53% vs. 33% nation-wide), the higher proportions of regional participants having always problems in chewing (11% vs. 2% nation-wide), and in contrast the higher proportions of national participants having problems in swallowing (10% nation-wide vs. 5% regional). The majority in both study parts (about 2/3) considered their appetite as good or very good.

Mental status

The memory test revealed that one third of participants (national study part) was able to remember the three words they should remember. In the regional study part, only 12% showed good performance of this test.

Functional status

Judged by 17 items covering the activities of daily living (ADL), functional status of participants was fairly good. Most problems appeared in “carrying heavy objects“, „cutting one’s toenails“, and “doing heavy housework“. However, women came off worse than men in most activities. The analysis of the mobility-index which includes the four mobility items: “walking from room to room“, “climbing stairs“, “leaving the house“, “walking at least 400 m“ showed that 40% in both study parts had no problems in performing these activities and could do them without help, in the national survey significantly less women than men.

Physical activity

Physical activity by practising sports was reported to a higher degree in the nation-wide study part (23% national *vs*. 5% regional). More interviewees in the national study part than in the regional study part considered themselves as “more active compared to persons of the same age“ (50% *vs.* 39%).

Smoking habits

The great majority (81% nation-wide *vs.* 72% regional) were non-smokers, in both surveys significantly more women than men. 6% national *vs.* 2% regional currently smoked.

Nutritional aspects

A warm meal was daily ingested by almost all participants. The risk of poor nutrition because of merely occasionally consumed warm meals was rarely revealed (3% national *vs.* 2% regional). Most participants, 62% (nation-wide) *vs.* 56% (regional), felt capable of preparing a complete warm meal independently, nation-wide significantly more women than men. Indeed, clearly more women than men did the cooking on their own, the female spouses did it for their males, and children ranged third in rendering this service for males but second for women. The proportions of regional participants doing the cooking by their own was lower (42% *vs.* 61% nation-wide), however this difference might be partly explained by the alteration of this question in the regional study part assessing only those persons doing the cooking always by their own (the service of children and other relatives was only asked for sepa-

rately for those not always doing the cooking by their own; therefore a direct comparison of the proportion of children doing the cooking is not possible; cp. annex VIII.1).

Meals-on-wheals were only received by 9% (nation-wide) and 7% (regional). In both surveys, away-from-home food consumption had no importance. The importance of a “right“ or “well balanced diet“ as very important for one’s health and well-being is well known (78% national *vs.* 80% regional).

Table IV.2 Main characteristics of the participants

	national							regional						
	men		women		whole sample			men		women		whole sample		
	n	%	n	%	n	%	p	n	%	n	%	n	%	p
Socio-demographics														
Sex (% of line)	*100*	*31.3*	*220*	*68.8*	*320*	*100.0*		*21*	*31.8*	*45*	*68.2*	*66*	*100.0*	
Family status														
unmarried	1	1.0	10	4.5	11	3.4	0.000	0	0.0	2	4.4	2	3.0	#0.003
married	43	43.0	14	6.4	57	17.8		8	38.1	4	8.9	12	18.2	0.013
living in divorce / separated	1	1.0	10	4.5	11	3.4		2	9.5	0	0.0	2	3.0	
widowed	55	55.0	186	84.5	241	75.3		11	52.4	39	86.7	50	75.8	
Living situation														
alone	45	45.0	170	77.3	215	67.2	0.000	9	42.9	30	66.7	39	59.1	0.106
not alone	54	54.0	50	22.7	104	32.5		12	57.1	15	33.3	27	40.9	
no data	1	1.0	0	0.0	1	0.3		0	0.0	0	0.0	0	0.0	
School graduation														
& no graduation	1	1.0	4	1.8	5	1.6	0.000	1	4.8	0	0.0	1	1.5	#0.085
& elementary/secondary education	64	64.0	167	75.9	231	72.2		16	76.2	33	73.3	49	74.2	0.556
$ O-level or comparable	17	17.0	42	19.1	59	18.4		1	4.8	10	22.2	11	16.7	
$ technical college or high school graduation	18	18.0	7	3.2	25	7.8		3	14.3	2	4.4	5	7.6	
Educational level														
no educational attainment	8	8.0	116	52.7	124	38.8	0.000	10	47.6	31	68.9	41	62.1	#0.248
& vocational training / foreman	72	72.0	96	43.6	168	52.5		10	47.6	13	28.9	23	34.8	0.111
& technical college / university degree	19	19.0	8	3.6	27	8.4		1	4.8	1	2.2	2	3.0	
no data	1	1.0	0	0.0	1	0.3		0	0.0	0	0.0	0	0.0	
Former professional status														
employee, clerk, self-employed	68	68.0	94	42.7	162	50.6	0.000	17	81.0	17	37.8	34	51.5	#0.000
& manual worker, family worker	29	29.0	58	26.4	87	27.2		3	14.3	2	4.4	5	7.6	0.000
& housewife/homemaker	2	2.0	67	30.5	69	21.6		0	0.0	26	57.8	26	39.4	
no data	1	1.0	1	0.5	2	0.6		1	4.8	0	0.0	1	1.5	
Do you have enough money?														
yes, no problem	72	72.0	145	65.9	217	67.8	0.365	13	61.9	31	68.9	44	66.7	1.000
yes, fairly – no, does not suffice	28	28.0	74	33.6	102	31.9		6	28.6	14	31.1	20	30.3	
no data	0	0.0	1	0.5	1	0.3		2	9.5	0	0.0	2	3.0	
Can you rely on s.o. who helps you if you were ill?														
yes	88	88.0	205	93.2	293	91.6	0.132	17	81.0	44	97.8	61	92.4	0.027
no	12	12.0	15	6.8	27	8.4		3	14.3	0	0.0	3	4.5	
no data	0	0.0	0	0.0	0	0.0		1	4.8	1	2.2	2	3.0	

no data: no data available/no answer; p: sex-dependent differences tested by Chi²-test/Fisher's exact test (missing answers excluded);
significance restricted because more than 20% of cross-tabled cells with expected frequency below 5, second p-value was calculated with &-marked (and $-marked) items classified

Table IV.2 (continued)

	national							regional						
	men		women		whole sample			men		women		whole sample		
	n	%	n	%	n	%	p	n	%	n	%	n	%	p
Health status														
Self-perception of health *														
good - very good	34	34.0	72	32.7	106	33.1	0.374	11	64.7	21	52.5	32	56.1	#0.434
& fair	38	38.0	70	31.8	108	33.8		2	11.8	11	27.5	13	22.8	0.545
& less good - poor	28	28.0	78	35.5	106	33.1		3	17.6	6	15.0	9	15.8	
no data	0	0.0	0	0.0	0	0.0		1	5.9	2	5.0	3	5.3	
Number of chronic diseases *														
& none	7	7.0	20	9.1	27	8.4	0.290	2	11.8	4	10.0	6	10.5	#0.210
& 1-3	67	67.0	127	57.7	194	60.6		11	64.7	17	42.5	28	49.1	0.103
more than 3	26	26.0	73	33.2	99	30.9		2	11.8	13	32.5	15	26.3	
no data	0	0.0	0	0.0	0	0.0		2	11.8	6	15.0	8	14.0	
Most frequent diseases *														
muscular-skeletal diseases	56	56.0	146	66.4	202	63.1	0.081	4	23.5	23	57.5	27	47.4	0.035
cardiac diseases	56	56.0	142	64.5	198	61.9	0.172	10	58.8	27	67.5	37	64.9	0.535
diabetes mellitus	15	15.0	31	14.1	46	14.4	0.864	2	11.8	5	12.5	7	12.3	1.000
diseases of the digestive system	11	11.0	24	10.9	35	10.9	1.000	1	5.9	6	15.0	7	12.3	0.660
respiratory diseases	14	14.0	20	9.1	34	10.6	0.239	4	23.5	6	15.0	10	17.5	0.479
diseases of the thyroid gland	3	3.0	25	11.4	28	8.8	0.017	0	0.0	1	2.5	1	1.8	1.000
How often have you been in pain the last week? *														
never	36	36.0	61	27.7	97	30.3	0.080	10	58.8	17	42.5	27	47.4	#0.469
& one time	16	16.0	28	12.7	44	13.8		1	5.9	3	7.5	4	7.0	0.372
& several times	34	34.0	71	32.3	105	32.8		0	0.0	4	10.0	4	7.0	
& daily	13	13.0	55	25.0	68	21.3		5	29.4	14	35.0	19	33.3	
no data	1	1.0	5	2.3	6	1.9		1	5.9	2	5.0	3	5.3	
How is your appetite? *														
good - very good	74	74.0	137	62.3	211	65.9	0.056	14	82.4	25	62.5	39	68.4	0.182
less good - poor	26	26.0	82	37.3	108	33.8		2	11.8	13	32.5	15	26.3	
no data	0	0.0	1	0.5	1	0.3		1	5.9	2	5.0	3	5.3	
Did you recently notice a loss of appetite? *														
yes	4	4.0	27	12.3	31	9.7	0.024	2	11.8	4	10.0	6	10.5	1.000
no	96	96.0	192	87.3	288	90.0		14	82.4	34	85.0	48	84.2	
no data	0	0.0	1	0.5	1	0.3		1	5.9	2	5.0	3	5.3	

no data: no data available/no answer; p: sex-dependent differences tested by Chi²-test/Fisher's exact test (missing answers excluded);
significance restricted because more than 20% of cross-tabled cells with expected frequency below 5, second p-value was calculated with &-marked (and $-marked) items classified
* regional study part: based on 57 subjects with complete second interview (17 men and 40 women)

Table IV.2 (continued)

	national							regional						
	men		women		whole sample			men		women		whole sample		
	n	%	n	%	n	%	p	n	%	n	%	n	%	p
Health status														
Do you have any difficulties in chewing? *														
& yes, always	1	1.0	5	2.3	6	1.9	#0.447	2	11.8	4	10.0	6	10.5	#0.975
& yes, in case of hard or sticky foods	31	31.0	79	35.9	110	34.4	0.316	6	35.3	15	37.5	21	36.8	1.000
no	68	68.0	134	60.9	202	63.1		8	47.1	19	47.5	27	47.4	
no data	0	0.0	2	0.9	2	0.6		1	5.9	2	5.0	3	5.3	
Do you have problems in swallowing? *														
yes	12	12.0	21	9.5	33	10.3	0.554	1	5.9	2	5.0	3	5.3	1.000
no	88	88.0	198	90.0	286	89.4		15	88.2	36	90.0	51	89.5	
no data	0	0.0	1	0.5	1	0.3		1	5.9	2	5.0	3	5.3	
Do you have problems in cutting a piece of meat? *														
yes	16	16.0	56	25.4	72	22.5	0.134	1	5.9	10	25.0	11	19.3	0.144
no	84	84.0	162	73.6	246	76.9		15	88.2	28	70.0	43	75.4	
no data	0	0.0	2	0.9	2	0.6		1	5.9	2	5.0	3	5.3	
Mental status														
Performance of the memory test *														
good	39	39.0	69	31.4	108	33.8	0.204	1	5.9	6	15.0	7	12.3	0.324
poor	61	61.0	150	68.2	211	65.9		14	82.4	30	75.0	44	77.2	
no data	0	0.0	1	0.5	1	0.3		2	11.8	4	10.0	6	10.5	
Functional status														
Most problematic ADL items: 'I can do without problems' *														
carry heavy objects	41	41.0	32	14.5	73	22.8	0.000	7	41.2	6	15.0	13	22.8	0.040
cut one's toenails	47	47.0	54	24.5	101	31.6	0.001	8	47.1	6	15.0	14	24.6	0.016
do heavy housework	27	27.0	36	16.4	63	19.7	0.019	9	52.9	9	22.5	18	31.6	0.029
Index of mobility *														
less mobile	48	48.0	142	64.5	190	59.4	0.007	8	47.1	25	62.5	33	57.9	0.549
mobile (4 mobility ADL without problems)	52	52.0	78	35.5	130	40.6		8	47.1	15	37.5	23	40.4	
no data	0	0.0	0	0.0	0	0.0		1	5.9	0	0.0	1	1.8	
Physical activity														
Do you practice any kind of sports? *														
no sports	71	71.0	172	78.2	243	75.9	0.126	15	88.2	38	95.0	53	93.0	#0.216
& regularly, < 3 hours per week	26	26.0	36	16.4	62	19.4		2	11.8	1	2.5	3	5.3	0.216
& regularly, ≥ 3 hours per week	3	3.0	10	4.5	13	4.1		0	0.0	0	0.0	0	0.0	
no data	0	0.0	2	0.9	2	0.6		0	0.0	1	2.5	1	1.8	

* regional study part: based on 57 subjects with complete second interview (17 men and 40 women)

Table IV.2 (continued)

	national							regional						
	men		women		whole sample			men		women		whole sample		
	n	%	n	%	n	%	p	n	%	n	%	n	%	p
Physical activity														
Compared to people of the same age, do you feel ...? *														
& less active	10	10.0	42	19.1	52	16.3	0.018	2	11.8	4	10.0	6	10.5	#0.873
& same active	29	29.0	79	35.9	108	33.8		3	17.6	8	20.0	11	19.3	0.740
more active	61	61.0	99	45.0	160	50.0		8	47.1	14	35.0	22	38.6	
no data	0	0.0	0	0.0	0	0.0		4	23.5	14	35.0	18	31.6	
Smoking habits														
Are you ...? *														
& smoker	6	6.0	12	5.5	18	5.6	0.000	0	0.0	1	2.5	1	1.8	#0.000
& former smoker	32	32.0	12	5.5	44	13.8		13	76.5	2	5.0	15	26.3	0.000
nonsmoker	62	62.0	196	89.1	258	80.6		4	23.5	37	92.5	41	71.9	
Nutritional aspects														
Who does the cooking for you? *	*multiple answers possible*							*single answer requested*						
I myself	32	32.0	162	73.6	194	60.6	0.000	4	23.5	20	50.0	24	42.1	0.079
spouse	39	39.0	0	0.0	39	12.2	0.000	3	17.6	0	0.0	3	5.3	
children	15	15.0	56	25.5	71	22.2	0.042	5	29.4	14	35.0	19	33.3	
restaurant	6	6.0	0	0.0	6	1.9	0.001	0	0.0	1	2.5	1	1.8	
meals on wheels	14	14.0	14	6.4	28	8.8	0.032	3	17.6	1	2.5	4	7.0	
others	8	8.0	6	2.7	14	4.4	0.041	2	11.8	3	7.5	5	8.8	
Are you able to prepare a complete meal, even if you actually don't do it? *														
& yes, without any problem	45	45.0	152	69.1	197	61.6	0.000	8	47.1	24	60.0	32	56.1	#0.500
& yes, with problems	26	26.0	40	18.2	66	20.6		2	11.8	5	12.5	7	12.3	0.344
no	28	28.0	28	12.7	56	17.5		7	41.2	10	25.0	17	29.8	
no data	1	1.0	0	0.0	1	0.3		0	0.0	1	2.5	1	1.8	
How often do you get a warm meal?														
& several times a day	10	10.0	11	5.0	21	6.6	0.132	2	9.5	3	6.7	5	7.6	#0.733
& (almost) daily	88	88.0	202	91.8	290	90.6		19	90.5	41	91.1	60	90.9	1.000
several times a week/occasionally	1	1.0	7	3.2	8	2.5		0	0.0	1	2.2	1	1.5	
no data	1	1.0	0	0.0	1	0.3		0	0.0	0	0.0	0	0.0	
What do you think, how important is a “right” or **balanced diet for health and well-being?**														
very important	72	72.0	178	80.9	250	78.1	0.095	18	85.7	35	77.8	53	80.3	#1.000
& less important	26	26.0	35	15.9	61	19.1		1	4.8	2	4.4	3	4.5	1.000
& unimportant	2	2.0	7	3.2	9	2.8		1	4.8	2	4.4	3	4.5	
no data	0	0.0	0	0.0	0	0.0		1	4.8	6	13.3	7	10.6	

IV.4 Nutritional status – anthropometric measurements

IV.4.1 Weight, height, and BMI

Descriptive statistics for weight, height and BMI are shown in table IV.3.

In the nation-wide survey, mean weight of men was 71.6 kg and mean height was 169 cm. Thus, on average men were 9 kg heavier and 11 cm taller than women. Mean BMI was 25 kg/m² for both sexes.

In the regional study part, men were 11 kg heavier and 10 cm taller than women. on average. Mean weight was very similar to those of the national study part for men (72.0 kg), and about 2 kg lower for women (60.7 kg), whereas mean height was about 4 cm lower (both sexes). On average, BMI was two units (exactly: 1.6 units) higher for men than for women (26.9 *vs.* 25.3 kg/m²), this sex-dependent difference was not significant.

Table IV.3 Measured body height, weight, and BMI

Study part	Parameter / sex	n	mean	sd	min	P5	P25	median	P75	P95	max	p
National	**Weight [kg]**											
	men	57	71.6	9.4	49.0	55.9	65.5	72.0	76.8	92.1	96.0	0.000
	women	141	62.8	14.1	43.0	45.1	54.0	60.5	70.0	90.6	150.0	
	Height [cm]											
	men	77	169.1	7.7	150.0	152.9	164.5	169.0	174.0	180.6	189.1	0.000
	women	181	158.5	6.8	139.0	148.1	154.0	158.2	162.0	170.9	185.0	
	BMI [kg/m²]											
	men	54	25.0	3.1	17.6	19.3	23.2	24.6	26.4	30.8	32.4	0.919
	women	136	25.1	5.2	16.9	18.5	21.9	24.5	27.3	32.9	60.9	
Regional	**Weight [kg]**											
	men	15	72.0	10.5	56.8	56.8	63.2	70.6	80.7	–	90.0	0.002
	women	37	60.7	10.8	41.4	43.0	53.2	59.0	67.6	82.7	83.0	
	Height [cm]											
	men	14	164.8	4.9	155.6	155.6	161.9	164.8	167.0	–	175.0	0.000
	women	33	154.9	5.4	145.0	145.1	151.3	154.5	158.5	165.2	168.0	
	BMI [kg/m²]											
	men	14	26.9	3.1	21.2	21.2	24.3	26.9	29.4	–	32.3	0.129
	women	33	25.3	3.1	20.5	20.6	23.1	24.7	27.8	31.5	32.9	

sd: standard deviation, min: minimum, P: percentile, max: maximum, p: Student's t-test

Table IV.4 shows the cumulative prevalences of BMI values at or above specified levels.

5.6% of men in the national study part had BMI values below 20 kg/m², 85.1% between 20-30 kg/m², and 9.3% had high values defined as ≥ 30 kg/m². The corresponding percentages

for women of this study part are 10.3% (< 20 kg/m²), 78.7% (20-30 kg/m²), and 11.0% (≥ 30 kg/m²).

In the regional study part no one had a BMI below 20 kg/m² (marked by the dashes in table IV.4). 85.7% of the male participants in this study part had BMI values between 20-30 kg/m², and 14.3% of them had high values defined as ≥ 30 kg/m². Corresponding percentages for females are 90.9% (20-30 kg/m²) and 9.1% (≥ 30 kg/m²).

Table IV.4 Cumulative percent distribution of BMI

BMI cut-off point [kg/m²] *	national study part men n=54	national study part women n=136	regional study part men n=14	regional study part women n=33
≥ 18	98.1	97.1	–	–
≥ 19	96.3	91.9	–	–
≥ 20	94.4	89.7	–	100.0
≥ 21	92.6	82.4	100.0	90.9
≥ 22	88.9	75.0	–	87.9
≥ 23	83.3	64.7	92.9	78.8
≥ 24	66.7	55.1	78.6	60.6
≥ 25	42.6	45.6	71.4	45.5
≥ 26	31.5	33.8	64.3	36.4
≥ 27	–	29.4	50.0	30.3
≥ 28	20.4	22.1	42.9	24.2
≥ 29	11.1	16.2	28.6	15.2
≥ 30	9.3	11.0	14.3	9.1
≥ 31	–	8.1	–	–
≥ 32	1.9	5.1	7.1	3.0

* the percentage of participants below any two cut-off points shown can be calculated by subtracting the value shown in the table from 100%; the percentage of participants between any two cut-off points by subtracting the two corresponding percentages

IV.4.2 Risk groups (national study part)

For men who had difficulties in swallowing and those who had poor appetite mean BMI was significantly lower than for those men who denied to have difficulties in swallowing and those who confirmed to have good appetite, respectively. None of the other basic characteristics involved in adequate nutritional intake (*cp.* chapter IV.3) showed statistically significant associations with BMI values (table IV.5).

Concerning the two topics relevant for men, no significant differences in mean BMI were found in females. In return, very old women with difficulties in chewing and women with poor self-perceived health had higher mean BMI values than those women without chewing difficulties and with self-perceived health being “good”, respectively. Women who admitted to

have financial problems and women who felt less active than subjects of the same age had also higher mean BMI values than those women who denied to have financial problems (and also those with insufficient money) and those who considered themselves as more or same active, respectively.

Table IV.5 BMI [kg/m²] in relation to basic characteristics – national study part

	men				women			
	n	mean	sd	p	n	mean	sd	p
Family status								
unmarried	-	-	-	0.746	8	27.5	6.3	0.334
married	23	25.4	2.3		9	22.8	3.5	
living in divorce / separated	1	25.1	-		5	25.2	3.1	
widowed	30	24.7	3.6		114	25.1	5.3	
Living situation								
alone	23	24.9	4.0	0.864	107	25.0	4.2	0.748
not alone	30	25.1	2.3		29	25.4	8.1	
School graduation								
no graduation	1	30.1	-	0.200	4	27.6	4.4	0.212
elementary/secondary education	37	24.8	2.9		99	25.3	5.7	
O-level or comparable	7	24.1	2.3		28	24.6	3.7	
techn. college -/ high school grad.	9	26.1	4.0		5	20.9	1.8	
Educational level								
no educational attainment	2	27.3	4.0	0.542	74	25.3	6.1	0.175
vocational training / foreman	41	24.9	2.8		58	25.1	4.0	
technical college / university degree	10	25.3	4.1		4	20.3	1.3	
Former professional status								
employee, clerk, self-employed	36	24.6	2.9	0.138	56	24.7	3.8	0.555
manual worker, family worker	17	26.0	3.4		43	25.1	4.5	
housewife/homemaker	-	-	-		36	25.9	7.5	
Do you have enough money?								
yes, no problem	39	25.2	3.2	0.491	92	24.4	4.1	0.022
yes, fairly	15	24.6	2.6		38	27.1	7.1	
no, does not suffice	-	-	-		6	23.4	3.5	
Can you rely on s.o. who helps you if you were ill?								
yes	48	24.8	2.9	0.142	125	24.9	4.3	0.179
no	6	26.8	3.9		11	27.1	11.9	
Self-perception of health								
good - very good	20	26.0	2.6	0.204	41	24.2	4.0	0.025
fair	19	24.3	2.9		48	24.2	4.2	
less good – poor	15	24.7	3.6		47	26.8	6.6	
Number of chronic diseases								
none	4	25.3	2.3	0.083	14	25.6	5.2	0.454
1-3	36	25.6	2.7		74	24.6	4.1	
more than 3	14	23.5	3.7		48	25.7	6.7	
How often have you been in pain the last week?								
never	19	24.8	3.4	0.750	40	24.1	4.0	0.217
one or more times	34	25.1	3.0		92	25.3	5.5	
How is your appetite?								
good – very good	42	25.5	2.9	0.021	81	24.9	4.3	0.579
less good - poor	12	23.3	3.0		54	25.4	6.5	
Did you recently notice a loss of appetite?								
yes	1	19.6	-	0.072	15	23.8	4.3	0.307
no	53	25.1	3.0		120	25.3	5.4	
Do you have any difficulties in chewing?								
yes	18	24.6	2.5	0.473	49	23.9	3.6	0.039
no	36	25.2	3.3		86	25.8	5.9	
Do you have problems in swallowing?								
yes	6	22.0	3.3	0.009	13	24.1	4.4	0.476
no	48	25.4	2.9		122	25.2	5.4	

Table IV.5 (continued)	men				women			
	n	mean	sd	p	n	mean	sd	p
Do you have problems in cutting a piece of meat?								
yes	9	25.0	1.6	0.957	33	24.5	4.3	0.479
no	45	25.0	3.3		101	25.3	5.6	
Performance of the memory test								
good	21	25.0	2.8	0.965	46	25.0	3.6	0.851
poor	33	25.0	3.3		90	25.2	5.9	
Index of mobility								
less mobile	25	25.0	3.3	0.991	85	25.5	6.0	0.203
mobile (4 ADL without problems)	29	25.0	2.9		51	24.4	3.5	
Do you practice any kind of sports?								
no sports	37	25.3	3.0	0.179	103	25.3	5.6	0.585
regularly, less than 3 hours/week	15	24.1	3.1		26	24.9	3.7	
regularly, more than 3 hours/week	2	27.9	2.1		7	23.2	3.7	
Compared to people of the same age, do you feel ...?								
less active	4	22.0	3.7	0.056	30	27.6	7.9	0.013
same active	19	24.6	1.9		46	24.4	4.5	
more active	31	25.7	3.4		60	24.4	3.6	
Smoking habits: are you ...?								
smoker	4	24.7	1.0	0.066	6	24.3	3.9	0.443
former smoker	18	23.7	3.7		8	22.9	3.5	
never smoked	32	25.8	2.6		122	25.3	5.4	
How often do you get a warm meal?								
several times a day	6	24.5	3.5	0.551	9	25.4	4.5	0.808
(almost) daily	46	25.1	3.1		122	25.1	5.4	
several times a week/occasionally	1	28.2	-		5	23.6	2.3	
Are you able to prepare a complete meal, even if you actually don't do it?								
yes, without any problem	25	24.8	3.4	0.853	94	25.4	5.2	0.413
yes, with problems	12	25.1	2.5		25	25.0	6.2	
no	16	25.4	3.1		17	23.6	3.9	
What do you think, how important is a "right"/ balanced diet for health and well-being?								
very important	42	24.8	2.9	0.243	111	24.9	5.4	0.465
less important	12	25.9	3.5		25	25.8	4.6	

sd: standard deviation, p: One-way-ANOVA

IV.4.3 Self-reported height, weight, and BMI and comparison with measured data

Comparisons of measured with self-reported data given with means and standard deviations in table IV.6.

In the national study part, self-reports of weight were on the average about 0.7 kg (women) and 1.1 kg (men), respectively, lower than measurements of weight. In contrast to this under-estimation of weight, body height was over-estimated by 1.6 cm (both sexes). These errors in self-estimation resulted in a slight under-estimation of mean BMI calculated from self-reported data: mean error was 0.7 kg/m² for both sexes.

In the regional study part, weight was under-estimated to a minor degree (0.0 kg men, 0.4 kg women), whereas over-estimation of height was markedly higher (4.0 cm men, 6.0 cm women), and, consequently, resulting errors in BMI calculated by self-reports were higher (1.7 kg/m² men, 1.8 kg/m² women).

Except for weight in the regional study part, all means of measured and self-reported data differed statistically, whereas there was no sex-dependent difference in mean errors in neither study part.

Table IV.6 Self-reported and measured data of weight, height, and BMI

			Measured (M)		Self-reported (S)			Difference (M-S)		
Study part	parameter / sex	n	mean	sd	mean	sd	p	mean	sd	p sex
National	**Weight [kg]**									
	men	45	72.7	9.5	71.6	9.3	0.000	1.1	1.8	0.323
	women	107	63.1	15.0	62.4	14.6	0.000	0.7	2.1	
	Height [cm]									
	men	55	169.8	8.0	171.4	7.0	0.000	-1.6	2.5	0.999
	women	122	158.6	6.6	160.1	6.9	0.000	-1.6	2.9	
	BMI [kg/m²]									
	men	44	25.2	3.2	24.5	3.1	0.000	0.7	1.0	0.747
	women	98	24.9	5.8	24.3	5.7	0.000	0.7	1.2	
Regional	**Weight [kg]**									
	men	11	74.2	10.2	74.2	10.8	0.968	0.0	2.2	0.679
	women	28	59.8	10.0	60.2	10.5	0.497	0.4	2.9	
	Height [cm]									
	men	10	164.0	5.3	168.0	7.4	0.003	-4.0	3.1	0.147
	women	20	154.6	6.2	160.6	5.1	0.000	-6.0	3.7	
	BMI [kg/m²]									
	men	8	25.7	3.9	27.4	3.2	0.003	1.7	1.1	0.823
	women	16	23.3	3.1	25.1	3.0	0.000	1.8	1.5	

sd: standard deviation, p: Student's t-test for paired variables between self-reported and measured data;
p sex: Student's t-test for independent (unpaired) variables (for sex-dependent differences in the variable "mean difference")

For the participants of the national study part, misclassification of self-reports is illustrated by BLAND & ALTMAN-plots (figures IV.1-3). As shown in these figures, also extreme misclassifications (about more than two standard deviations) existed for both sexes. No trend in misclassification by increasing weight, height, or BMI was obvious (no increased scatter of the differences as the anthropometric parameter increases).

There was moderate agreement between measurements and self-reports for body weight, with 95% limits of agreement (mean difference ± 1,96 sd) of -2.6 to 4.7 kg (males) and of -3.4 to 4.9 kg (females), while for body height agreement was rather poor with 95% limits of agreement of -6.6 to 3.5 cm (males) and -7.4 to 4.2 cm (females). This resulted in moderate agreement for BMI: -1.2 to 2.6 kg/m² (males) and -1.8 to 3.1 kg/m² (females).

Figure IV.1: BLAND & ALTMAN-plots to illustrate agreement between self-reports of body weight [kg] and corresponding measurements – national study part

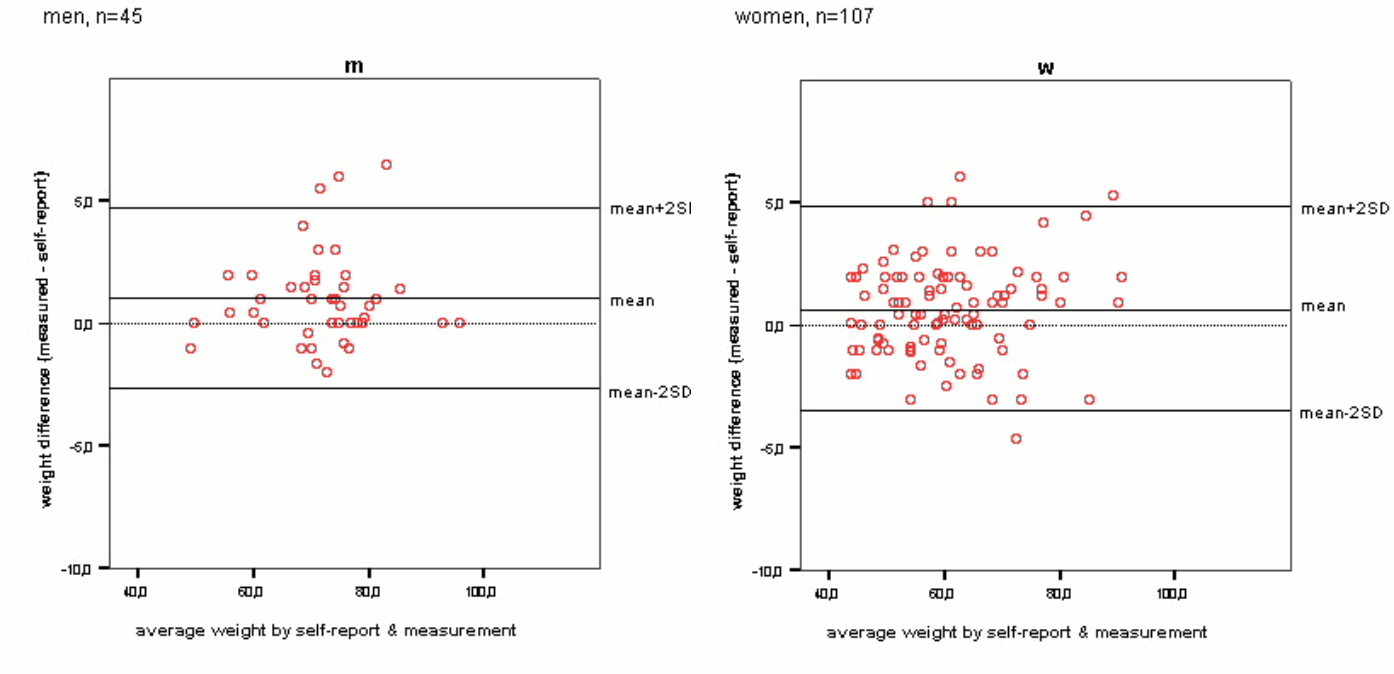


Figure IV.2: BLAND & ALTMAN-plots to illustrate agreement between self-reports of body height [cm] and corresponding measurements – national study part

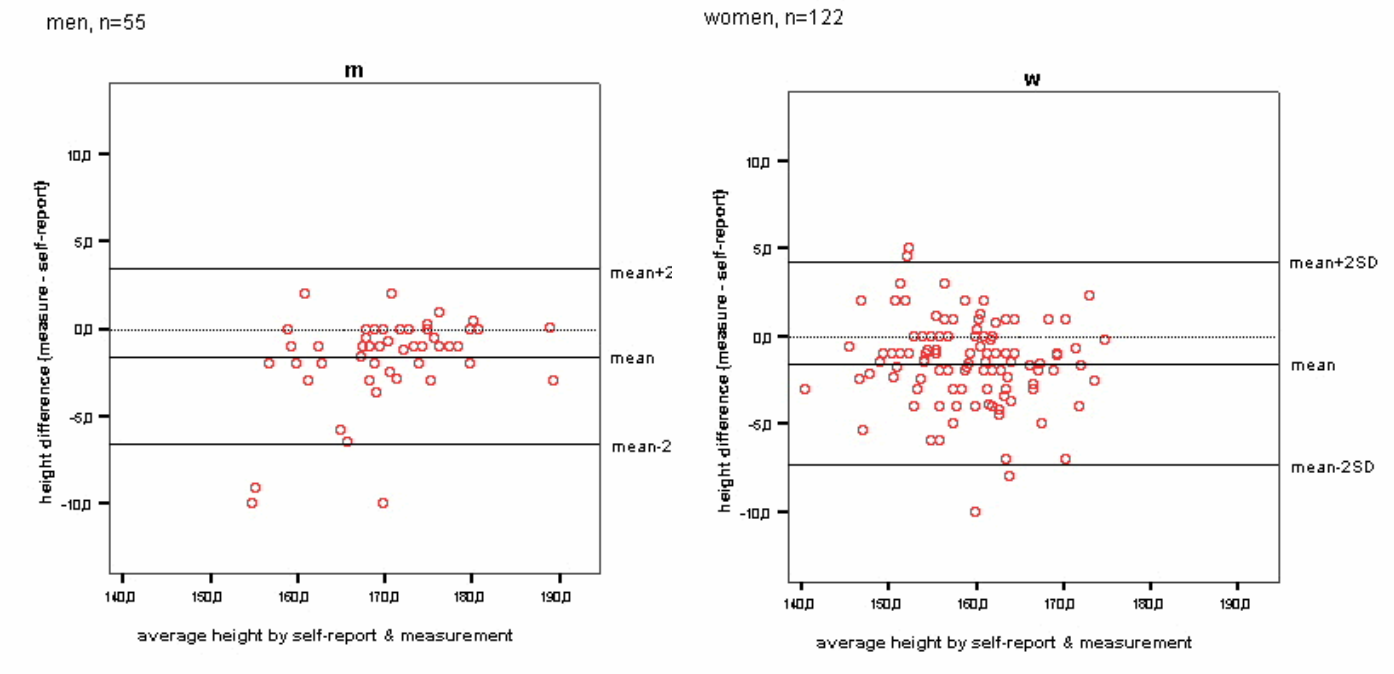
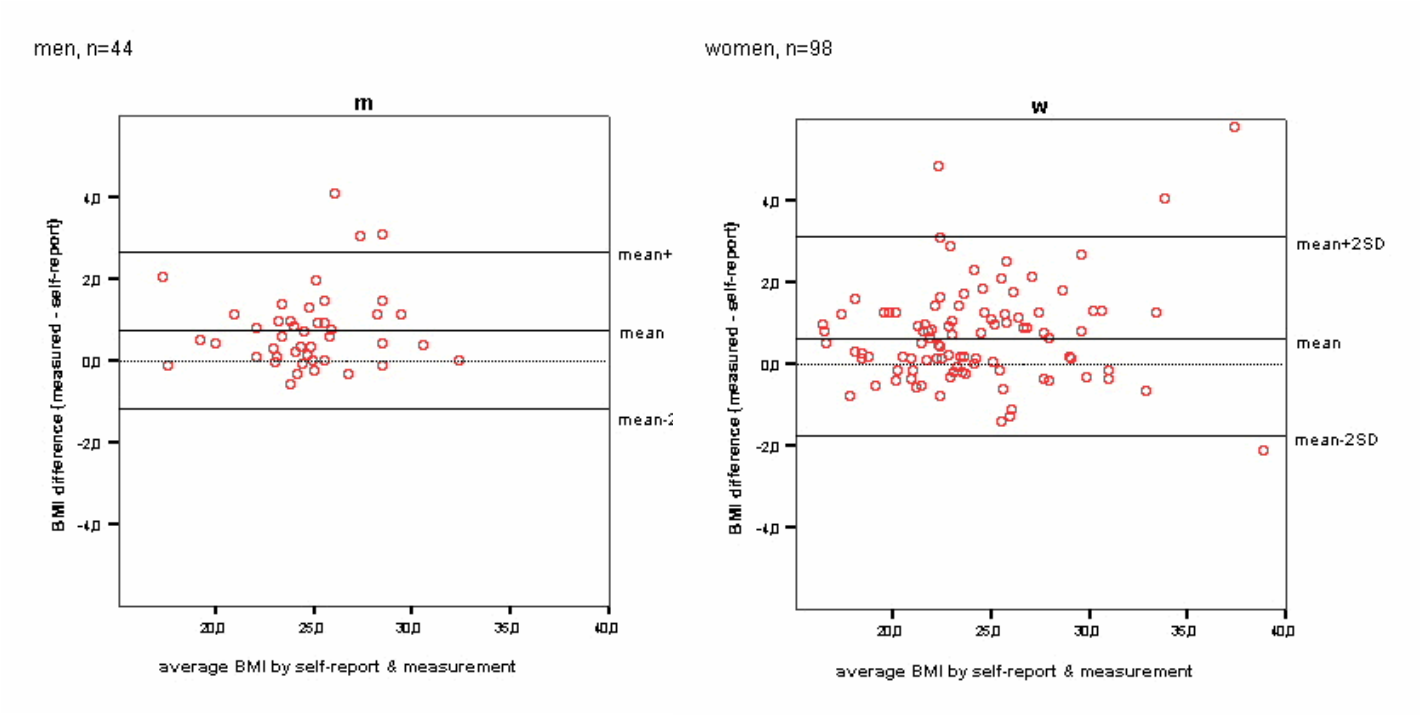


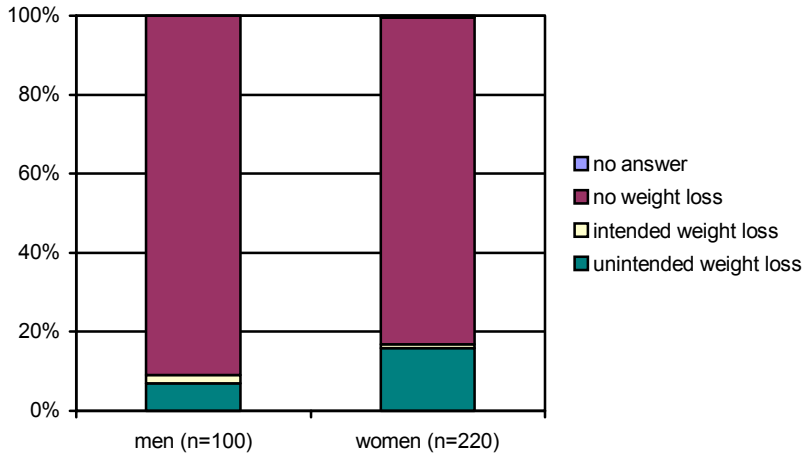
Figure IV.3: BLAND & ALTMAN-plots to illustrate agreement between BMI [kg/m²] calculated by self-reports of body height and weight and BMI calculated by measured values – national study part



IV.4.4 Unintended weight loss

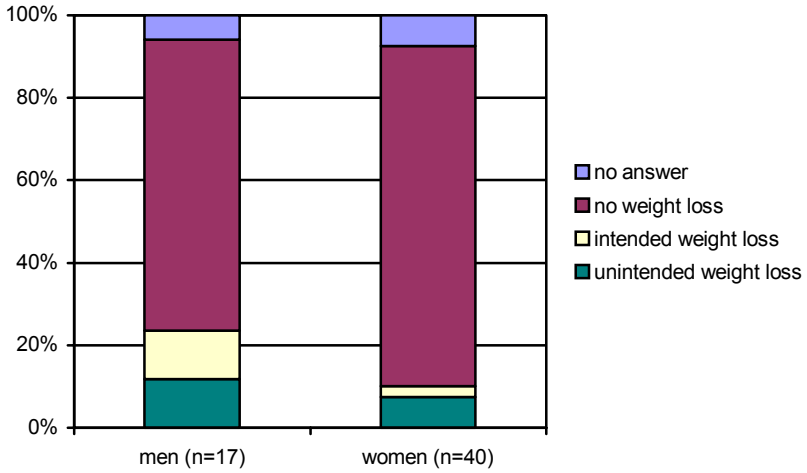
In the national study part, 14.4% of the very old reported on a weight loss of more than 5 kg during the last year, 91.3% of these weight losses were unintended (= 13.1% of the whole group). There was a statistically significant sex-dependent difference: 15.9% of women, but only 7.0% of men experienced an unintended weight loss in this study group ($p<0.05$, unintended weight loss *vs.* no weight loss/intended weight loss) (figure IV.4).

Figure IV.4: Prevalence of weight loss [%] – national study part



In the regional study part, prevalence of unintended weight loss of more than 5 kg was lower (figure IV.5): 14.0% of the participants reported on a weight loss in the last six months, 62.5% of these changes in weight were unintended. In other words, only 8.8% of the whole group (i.e. five subjects) reported on an unintended weight loss. The sex-dependent difference (11.8% of men *vs.* 7.5% of women) was not statistically significant (unintended weight loss *vs.* no weight loss/intended weight loss).

Figure IV.5: Prevalence of weight loss [%] – regional study part



IV.4.5 **Anthropometric data of the upper arm** (regional study part)

Anthropometric data of the upper arm were available of 13 men and 37 women. Results and the distribution of the data is shown table IV.7. On average old women had significantly higher values in triceps skinfold thickness, whereas men had greater muscle areas and circumferences.

Table IV.7 Arm-anthropometry – regional study part

Anthropometric parameter / sex	mean	sd	min	P5	P25	median	P75	P95	max	p
Triceps skinfold [mm]										
men	12.7	4.6	6.1	6.1	8.6	13.1	15.5	–	23.1	0.039
women	15.8	5.2	5.4	5.5	12.2	16.4	19.3	24.2	26.6	
Upper arm circumference [cm]										
men	28.9	3.3	23.5	23.5	25.9	29.4	31.3	–	35.3	0.435
women	28.1	5.2	15.5	18.7	26.1	27.4	29.7	40.0	42.3	
Arm muscle circumference [cm]										
men	25.1	2.3	21.1	21.1	23.2	25.2	27.3	–	28.0	0.017
women	23.2	4.6	10.2	16.6	21.0	22.8	24.5	33.2	36.1	
Arm muscle area [cm²]										
men	50.4	9.0	35.5	35.5	42.7	50.5	59.3	–	62.6	0.017
women	44.3	18.2	8.2	22.2	35.0	41.3	47.6	87.9	104.0	
Corrected arm muscle area [cm²]										
men	40.4	9.0	25.5	25.5	32.7	40.5	49.3	–	52.6	0.095
women	37.8	18.2	1.7	15.7	28.5	34.8	41.1	81.4	97.5	
Arm fat area [cm²]										
men	17.5	8.0	7.4	7.4	10.5	17.1	22.1	–	36.6	0.203
women	20.6	8.6	5.0	5.4	14.7	20.7	25.6	38.6	39.6	

sd: standard deviation, min: minimum, P: percentile, max: maximum, p: Student's t-test

IV.5 Energy and nutrient intake

IV.5.1 Absolute and relative intake

Energy

In the national study part, median energy intake was 9.3 MJ (men) and 8.6 MJ (women), respectively. Corresponding values of the regional study part are 8.3 MJ (men) and 7.9 MJ (women) (tables IV.8-IV.11).

As shown in figures IV.6-IV.9, in the national study part only 2% of men *vs.* 7% of women had an energy intake below 2/3 of the recommended value. In the regional study part, corresponding values were 14% (males) and 9% (females).

Nutrients

The daily intake of macronutrients, and micronutrients is shown in tables IV.8-IV.11, together with nutrient densities. Mean and medium intake as well as nutrient densities are marked if below recommended values (or above recommended values for alcohol and cholesterol, respectively). As can be seen by the percentiles and the standard deviation, almost all nutrients were widely scattered.

Table IV.12 provides mean percentages of energy derived from the macronutrients. Mean carbohydrate intake is around 44-46% of energy intake, fat provides 35-37% of energy, protein 17-18%, and percentage of energy intake from alcohol covers 1-2% (females) and 4-6% (males), respectively. In the national study part, there are sex-dependent differences concerning the higher percentage of alcohol contributing to the energy intake of males and in return the higher percentage of energy derived from fat (and carbohydrate) of females.

In both study parts, for most nutrients recommended values were met or clearly exceeded (e.g. the protein intake clearly exceeded the recommended 54 g per day for males and 44 g per day for females).

In return, Vitamin D come off worse in both study parts: in the national study part 61% of men and 76% of women did not meet half the recommendation of 10 µg per day, in the regional study part, corresponding percentages were 100% and 96%, respectively.

More than 10% of both sexes in either study part did not reach half the recommendation for calcium and dietary fibre, and except men in the regional part also for vitamin E. More than 10% of men in both surveys did not met half the recommendation for vitamin A. Additionally, in the regional study part 15% of men and 13% of women did not meet the half the recommendation for vitamin C.

Table IV.8 Daily energy and nutrient intake of men (n=89) – national study part										
	mean	sd	min	P5	P25	median	P75	P95	max	nd*
Energy [kcal]	2366.3	707.0	1171.4	1324.6	1805.1	2232.5	2888.3	3600.9	4788.0	
Energy [MJ]	9.9	3.0	4.9	5.5	7.6	9.3	12.1	15.1	20.0	
Carbohydrate [g]	252.2	83.4	118.7	136.6	198.5	246.4	308.1	384.1	634.6	
Protein [g]	94.4	29.6	37.3	55.2	72.2	90.9	114.1	150.5	177.3	9.6
Fat [g]	90.5	33.5	35.5	44.5	66.7	82.4	109.8	153.0	188.2	
Alcohol [g]	20.6	18.7	0.0	0.0	2.9	19.8	33.8	56.2	79.3	
Water [g]	2346.2	691.2	860.6	1297.8	1834.4	2288.7	2804.3	3826.5	4225.3	238.1
Cholesterol [mg]	448.2	187.2	149.1	182.2	307.1	422.9	560.9	852.0	943.5	
Fibre [g]	24.6	8.9	8.9	11.8	17.3	23.7	30.9	40.0	54.2	2.4
Potassium [mg]	3580.9	1208.6	1159.8	1980.8	2784.8	3328.0	4511.1	5633.7	8455.6	
Calcium [mg]	765.2	326.8	127.9	311.4	536.7	721.0	940.6	1404.4	1864.9	74.8
Magnesium [mg]	385.5	110.2	166.6	214.3	302.4	387.9	452.8	599.8	724.8	39.0
Iron [mg]	15.2	6.2	6.8	7.4	11.3	13.3	16.8	28.5	36.4	1.4
Zinc [mg]	15.0	8.8	6.2	6.8	10.2	12.5	16.8	38.9	54.1	1.3
Vit. A [µg RE]	1753.0	2927.9	193.4	356.6	749.7	1036.6	1511.9	8224.6	23708.9	106.5
Vitamin D [µg]	5.7	4.8	0.2	0.9	2.3	3.8	8.4	15.3	25.0	0.3
Vit. E [mg TE]	12.8	8.0	3.4	4.3	6.5	10.6	16.3	29.1	45.8	
Vitamin B1 [mg]	1.6	0.6	0.7	0.8	1.2	1.5	1.9	2.6	3.8	
Vitamin B2 [mg]	1.8	0.8	0.6	1.0	1.3	1.6	2.0	2.8	6.3	
Vitamin B6 [mg]	2.3	0.8	0.7	1.2	1.7	2.2	2.8	3.7	4.7	0.2
Folate [µg FE]	160.6	129.6	44.4	57.9	90.3	122.7	172.4	517.9	685.9	
Vitamin C [mg]	133.2	80.3	10.4	44.0	73.2	113.8	169.5	312.8	377.0	11.8

Table IV.9 Daily energy and nutrient intake of women (n=198) – national study part										
	mean	sd	min	P5	P25	median	P75	P95	max	nd*
Energy [kcal]	2064.9	862.7	494.6	1008.8	1517.0	1930.1	2434.1	3442.5	7728.4	
Energy [MJ]	8.6	3.6	2.1	4.2	6.3	8.1	10.2	14.4	32.3	
Carbohydrate [g]	224.4	92.7	62.5	105.0	160.6	205.3	278.5	377.9	863.8	
Protein [g]	85.9	40.3	14.4	33.7	63.1	78.3	99.8	161.4	371.9	10.0
Fat [g]	83.8	40.3	13.6	37.6	57.3	75.1	100.1	163.3	289.9	
Alcohol [g]	7.0	10.1	0.0	0.0	0.0	0.3	11.2	29.3	44.0	
Water [g]	2122.4	752.8	583.4	1072.9	1589.5	2069.0	2544.6	3576.5	5612.9	250.6
Cholesterol [mg]	395.9	207.2	9.4	127.6	254.8	363.1	488.9	811.3	1407.0	
Fibre [g]	22.4	11.4	3.7	9.7	15.9	19.9	26.6	41.6	113.2	2.5
Potassium [mg]	3243.5	1422.5	813.5	1491.1	2378.5	2911.4	3915.3	5794.1	12929.4	
Calcium [mg]	790.8	397.9	115.9	256.5	503.9	729.0	1023.4	1439.0	2721.1	89.9
Magnesium [mg]	348.9	138.0	98.0	171.7	251.8	330.1	423.0	582.5	1269.8	40.3
Iron [mg]	14.2	7.2	2.8	6.0	9.8	12.6	16.6	26.4	62.1	1.5
Zinc [mg]	14.9	10.4	2.2	4.9	8.9	12.1	16.0	41.3	63.9	1.5
Vit. A [µg RE]	1535.9	1768.3	98.8	298.0	718.6	1106.9	1635.9	3807.2	11607.0	123.8
Vitamin D [µg]	4.0	3.7	0.2	0.5	1.7	2.7	4.7	12.6	19.1	0.3
Vit. E [mg TE]	13.7	9.1	1.1	3.8	6.8	11.4	18.4	34.0	54.9	
Vitamin B1 [mg]	1.4	0.7	0.3	0.5	1.0	1.3	1.7	2.5	5.8	
Vitamin B2 [mg]	1.6	0.8	0.3	0.6	1.1	1.4	2.0	2.8	5.8	
Vitamin B6 [mg]	2.1	1.0	0.3	1.0	1.5	1.9	2.4	3.9	8.1	0.2
Folate [µg FE]	157.6	145.9	24.7	42.4	74.2	105.6	165.9	533.9	742.1	
Vitamin C [mg]	145.9	94.9	2.9	35.0	83.6	129.3	188.8	337.3	766.1	15.9

sd: standard deviation, min: minimum, P: percentile, max: maximum, nd* nutrient density (median of nutrient intake per MJ) for those nutrients with available recommendation; marked = below or above (alcohol, cholesterol) recommendation, respectively
RE: retinol-equivalents; TE: tocopherol-equivalents; FE: folate-equivalents, according to the old definition of total folate = mono-glutamate + (0.2 x polyglutamate) (DGE 1995)

Table IV.10 Daily energy and nutrient intake for men (n=13) – regional study part										
	mean	sd	min	P5	P25	median	P75	P95	max	nd*
Energy [kcal]	1994.9	610.5	930.7	930.7	1653.9	1984.0	2104.1	–	3442.3	
Energy [MJ]	8.3	2.6	3.9	3.9	6.9	8.3	8.8	–	14.4	
Carbohydrate [g]	213.5	69.8	84.2	84.2	163.5	225.5	241.9	–	347.7	
Protein [g]	84.3	23.3	56.8	56.8	67.6	86.0	91.6	–	145.9	11.1
Fat [g]	77.1	26.4	34.6	34.6	60.6	79.2	87.1	–	145.3	
Alcohol [g]	12.5	18.2	0.0	0.0	0.0	6.6	18.7	–	63.9	
Water [g]	1941.6	802.7	1346.7	1346.7	1457.2	1743.2	2002.1	–	4103.8	232.6
Cholesterol [mg]	335.4	87.4	196.8	196.8	288.2	300.2	418.1	–	482.7	
Fibre [g]	21.4	11.2	9.7	9.7	13.4	18.4	28.3	–	50.6	2.3
Potassium [mg]	2776.1	811.6	1626.8	1626.8	2298.7	2762.3	2850.0	–	4597.8	
Calcium [mg]	724.4	366.0	200.2	200.2	420.6	663.4	985.8	–	1466.3	93.5
Magnesium [mg]	335.0	157.3	185.2	185.2	241.7	321.2	361.0	–	802.6	38.2
Iron [mg]	12.7	4.1	7.2	7.2	10.1	12.1	15.3	–	22.3	1.6
Zinc [mg]	12.7	4.6	7.1	7.1	9.1	12.7	14.9	–	23.2	1.7
Vit. A [µg RE]	1382.0	2219.9	385.5	385.5	664.5	832.5	956.4	–	8739.9	92.5
Vitamin D [µg]	2.0	0.9	0.9	0.9	1.3	2.0	2.7	–	3.8	0.2
Vit. E [mg TE]	11.5	6.8	3.6	3.6	6.7	8.8	15.1	–	28.0	
Vitamin B1 [mg]	1.3	0.4	0.6	0.6	1.1	1.3	1.4	–	2.5	
Vitamin B2 [mg]	1.5	0.6	0.9	0.9	1.1	1.4	1.7	–	2.7	
Vitamin B6 [mg]	1.8	0.5	1.1	1.1	1.5	1.7	1.9	–	3.3	0.2
Vitamin B12 [µg]	7.2	7.8	2.1	2.1	3.7	5.3	7.2	–	32.5	0.5
Folate [µg FE]	93.5	51.7	42.7	42.7	58.3	69.7	120.1	–	208.5	
Vitamin C [mg]	90.5	40.5	24.4	24.4	70.8	86.2	102.1	–	183.4	11.0

abbreviations: see table IV.8

Table IV.11 Daily energy and nutrient intake of women (n=23) – regional study part										
	mean	sd	min	P5	P25	median	P75	P95	max	nd*
Energy [kcal]	2145.6	862.5	493.7	559.6	1553.6	1877.1	2737.9	3931.0	3956.5	
Energy [MJ]	9.0	3.6	2.1	2.3	6.5	7.9	11.5	16.4	16.6	
Carbohydrate [g]	237.0	104.9	61.8	67.9	160.5	221.9	310.9	493.3	506.1	
Protein [g]	91.4	36.7	24.1	28.3	60.9	87.3	116.4	163.0	168.2	10.4
Fat [g]	85.2	33.5	15.9	18.6	63.0	85.1	111.3	139.2	139.8	
Alcohol [g]	5.0	8.2	0.0	0.0	0.0	0.1	8.7	26.7	27.3	
Water [g]	2294.7	897.0	516.5	541.1	1786.8	2338.1	2916.1	3973.6	4007.1	250.0
Cholesterol [mg]	384.3	199.5	151.2	155.2	242.2	301.6	526.1	862.8	879.8	
Fibre [g]	22.9	9.8	6.6	6.8	16.6	21.4	29.8	41.5	41.7	2.6
Potassium [mg]	3381.3	1584.5	958.1	976.5	2392.0	2987.6	4362.7	7313.6	7530.0	
Calcium [mg]	895.6	360.4	172.6	220.0	591.9	832.6	1277.7	1372.8	1380.6	101.6
Magnesium [mg]	364.9	144.5	99.6	101.6	284.9	332.7	457.7	657.7	662.9	39.8
Iron [mg]	14.1	5.9	3.1	3.4	9.6	12.5	18.8	24.2	24.6	1.5
Zinc [mg]	12.8	5.5	2.1	2.6	7.9	12.0	18.7	20.3	20.4	1.4
Vit. A [µg RE]	1413.6	1715.2	216.9	245.2	713.7	1017.6	1524.9	7586.0	8964.0	118.6
Vitamin D [µg]	2.4	1.3	0.5	0.6	1.4	2.0	3.3	5.1	5.2	0.2
Vit. E [mg TE]	13.0	7.7	2.3	2.6	7.1	10.3	17.7	30.0	30.1	
Vitamin B1 [mg]	1.5	0.8	0.3	0.3	1.0	1.4	2.0	3.3	3.5	
Vitamin B2 [mg]	1.7	0.9	0.4	0.4	1.1	1.5	2.1	4.2	4.3	
Vitamin B6 [mg]	2.1	1.1	0.6	0.6	1.2	2.1	2.7	4.6	4.6	0.2
Vitamin B12 [µg]	7.0	7.6	1.5	1.5	3.0	4.2	8.3	33.4	38.4	0.7
Folate [µg FE]	126.5	82.2	24.5	28.6	62.0	106.3	168.7	344.2	369.2	
Vitamin C [mg]	140.3	98.1	18.9	20.3	61.2	121.2	223.7	356.1	357.3	12.0

abbreviations: see table IV.9

Figure IV.7: Prevalence [%] of nutrient intake of < 1/2, between 1/2 and 2/3, between 2/3 and 100% and ≥ 100% of the recommendation – men, national study part (n=89)

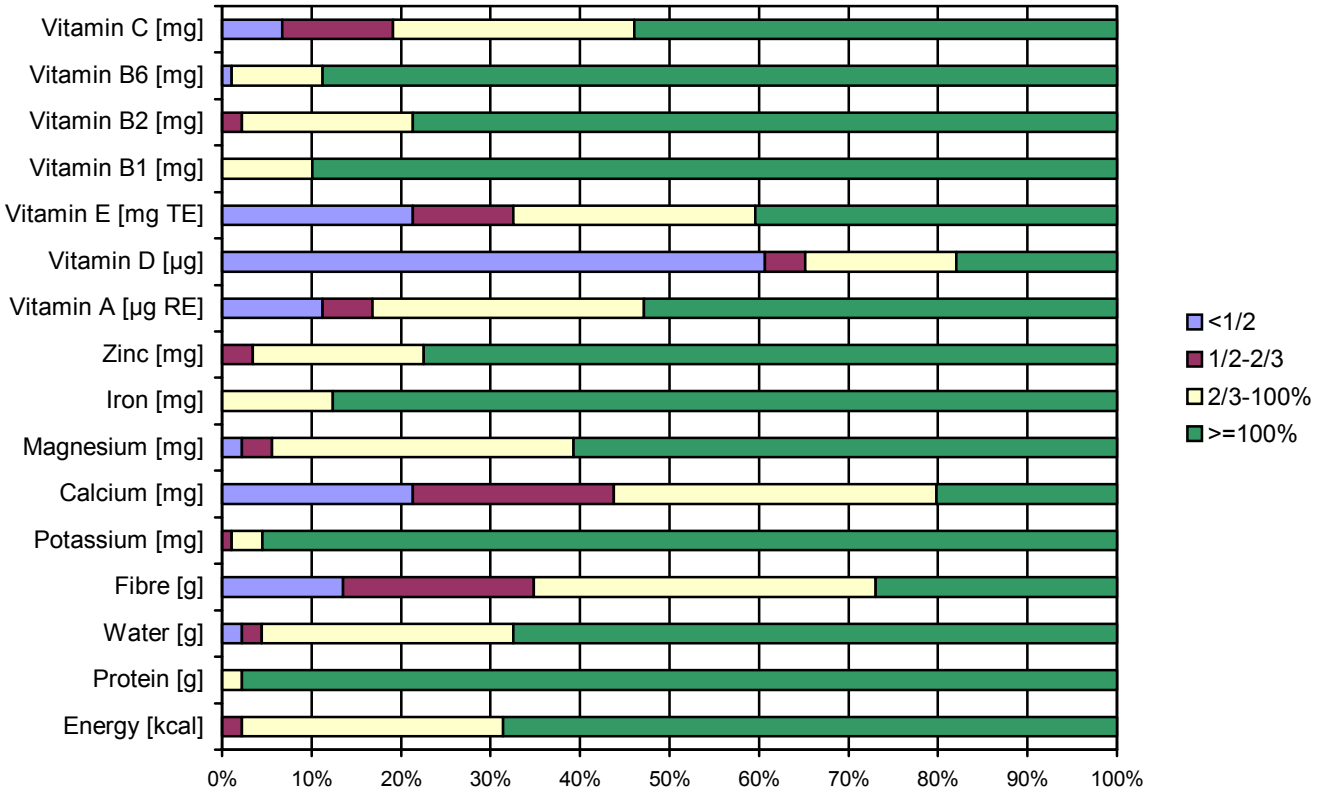


Figure IV.8: Prevalence [%] of nutrient intake of < 1/2, between 1/2 and 2/3, between 2/3 and 100% and ≥ 100% of the recommendation – women, national study part (n=198)

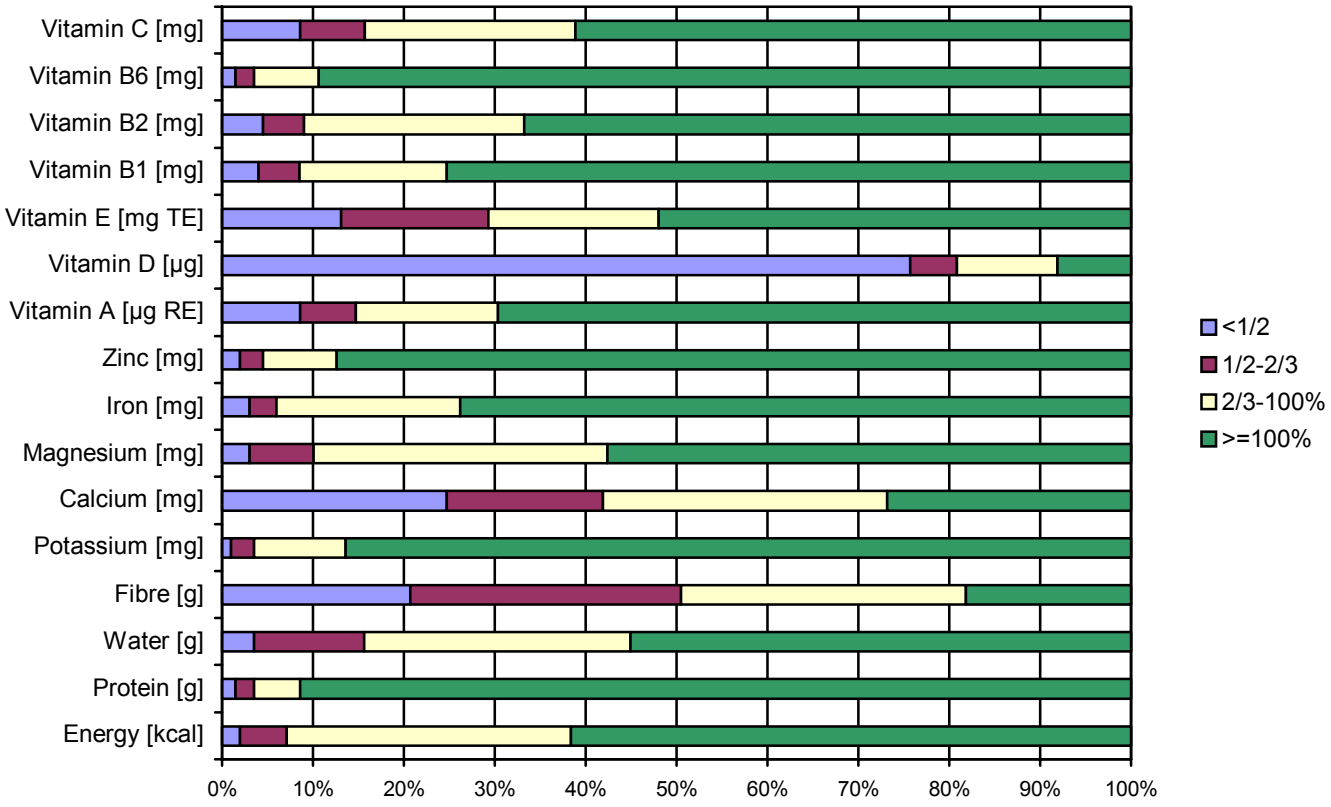


Figure IV.9: Prevalence [%] of nutrient intake of < 1/2, between 1/2 and 2/3, between 2/3 and 100% and ≥ 100% of the recommendation – men, regional study part (n=13)

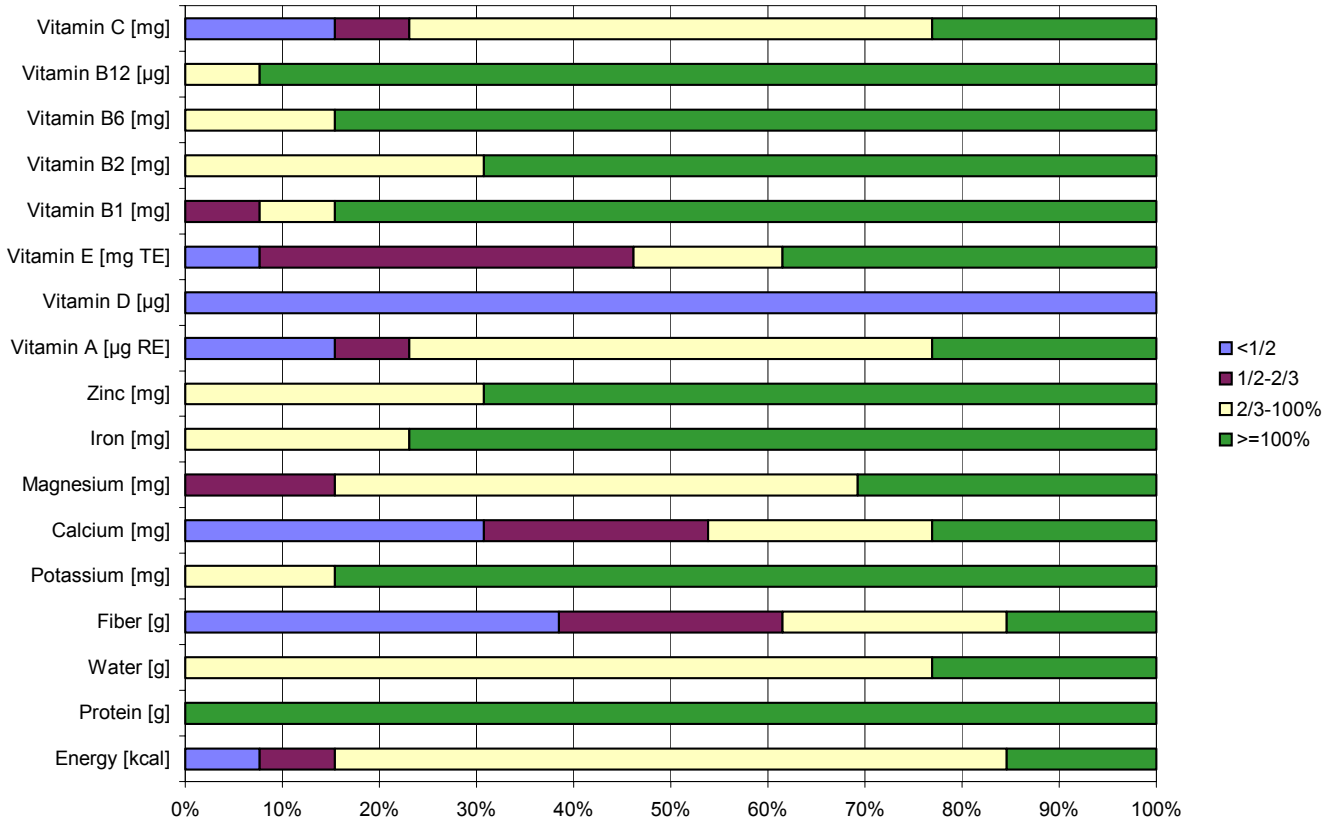


Figure IV.10: Prevalence [%] of nutrient intake of < 1/2, between 1/2 and 2/3, between 2/3 and 100% and ≥ 100% of the recommendation – women, regional study part (n=23)

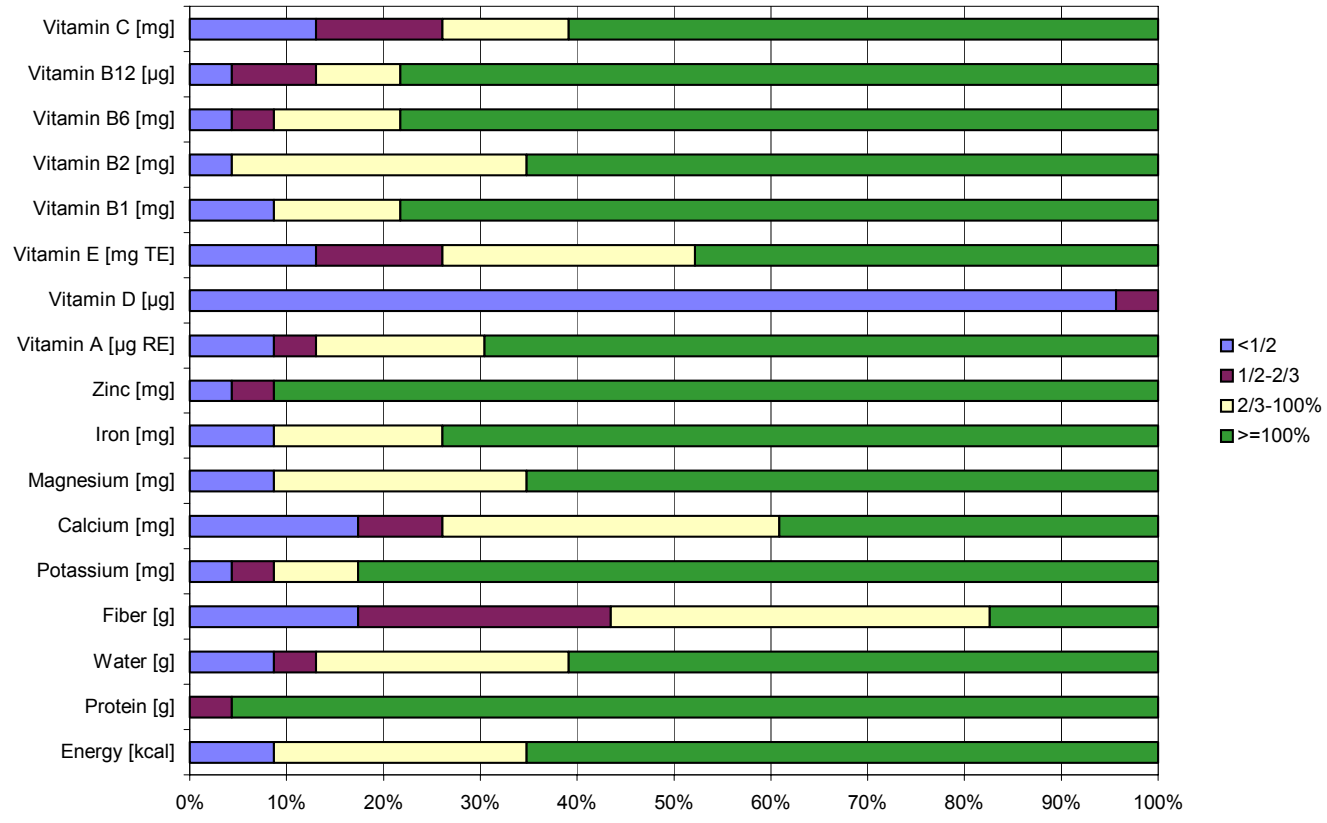


*Table IV.12 Mean percentage energy from macronutrients**						
	national study part			regional study part		
Energy-% from	men (n=89)	women (n=198)	p	men (n=13)	women (n=23)	p
Carbohydrate	43.7	45.1	0.091	43.6	45.2	0.408
Fat	35.4	37.2	0.021	35.8	37.0	0.528
Protein	16.6	17.1	0.286	18.1	17.8	0.814
Alcohol	6.1	2.4	0.000	4.1	1.3	0.091

* rounded values = do not sum up exactly to 100%; p: Student's t-test for unpaired variables

IV.5.2 Risk groups (national study part)

Basic characteristics involved in adequate nutritional intake (*cp.* chapter IV.3) showed few associations with a nutrient intake score (based on reaching at least two thirds of the recommendation for vitamins and minerals; see chapter III.6).

Both men and women with low nutrient intake score were distinguished by lower educational level and lower former professional status. Men with low nutrient intake score valued nutrition as being less important than men with higher score; for women performance of the memory test was positively associated with the intake score. Additionally, for women the frequency of warm meals showed a borderline significance (table IV.13).

*Table IV.13 Nutrient intake score * in relation to selected basic characteristics – national study part*

	men					women				
	high score (n=57)		low score (n=32)			high score (n=129)		low score (n=69)		
	n	%	n	%	p	n	%	n	%	p
Family status										
& unmarried	1	1.8	0	0.0	#0.741	3	2.3	6	8.7	#0.046
married	26	45.6	14	43.8	1.000	11	8.5	2	2.9	0.226
& living in divorce / separated	1	1.8	0	0.0		7	5.4	1	1.4	
& widowed	29	50.9	18	56.3		108	83.7	60	87.0	
Living situation										
alone	22	38.6	14	43.8	0.822	99	76.7	51	73.9	0.728
not alone	34	59.6	18	56.3		30	23.3	18	26.1	
no data	1	1.8	0	0.0		0	0.0	0	0.0	
School graduation										
& no graduation	0	0.0	1	3.1	#0.357	1	0.8	3	4.3	#0.239
& elementary/secondary education	36	63.2	21	65.6	0.649	98	76.0	55	79.7	0.271
§ O-level or comparable	13	22.8	4	12.5		26	20.2	9	13.0	
§ techn. college -/ high school grad.	8	14.0	6	18.8		4	3.1	2	2.9	
Educational level										
no educational attainment	2	3.5	6	18.8	#0.053	59	45.7	44	63.8	#0.047
& vocational training / foreman	44	77.2	20	62.5	0.025	65	50.4	24	34.8	0.017
& technical college / university degree	10	17.5	6	18.8		5	3.9	1	1.4	
no data	1	1.8	0	0.0		0	0.0	0	0.0	
Former professional status										
employee, clerk, self-employed	43	75.4	17	53.1	#0.053	62	48.1	24	34.8	0.047
& manual worker, family worker	12	21.1	14	43.8	0.032	34	26.4	15	21.7	
& housewife/homemaker	1	1.8	1	3.1		33	25.6	29	42.0	
no data	1	1.8	0	0.0		0	0.0	1	1.4	
Do you have enough money?										
yes, no problem	43	75.4	23	71.9	0.802	92	71.3	44	63.8	0.261
yes, fairly – no does not suffice	14	24.6	9	28.1		36	28.1	25	36.2	
no data	0	0.0	0	0.0		1	0.8	0	0.0	
Can you rely on s.o. who helps you if you were ill?										
yes	51	89.5	29	90.6	1.000	121	93.8	63	91.3	0.566
no	6	10.5	3	9.4		8	6.2	6	8.7	
Self-perception of health										
good - very good	21	36.8	7	21.9	0.113	42	32.6	20	29.0	0.872
fair	24	42.1	12	37.5		42	32.6	24	34.8	
less good – poor	12	21.1	13	40.6		45	34.9	25	36.2	
Number of chronic diseases										
& none	4	7.0	2	6.3	#0.683	12	9.3	5	7.2	0.607
& 1-3	40	70.2	20	62.5	0.452	71	55.0	43	62.3	
more than 3	13	22.8	10	31.3		46	35.7	21	30.4	
How often have you been in pain the last week?										
never	18	31.6	13	40.6	0.490	33	25.6	18	26.1	1.000
one or more times	38	66.7	19	59.4		91	70.5	51	73.9	
no data	1	1.8	0	0.0		5	3.9	0	0.0	
How is your appetite?										
good – very good	44	77.2	22	68.8	0.452	85	65.9	38	55.1	0.126
less good - poor	13	22.8	10	31.3		43	33.3	31	44.9	
no data	0	0.0	0	0.0		1	0.8	0	0.0	
Did you recently notice a loss of appetite?										
yes	1	1.8	3	9.4	0.131	16	12.4	9	13.0	1.000
no	56	98.2	29	90.6		112	86.8	60	87.0	
no data	0	0.0	0	0.0		1	0.8	0	0.0	
Do you have any difficulties in chewing?										
yes	19	33.3	8	25.0	0.477	48	37.2	26	37.7	1.000
no	38	66.7	24	75.0		80	62.0	43	62.3	
no data	0	0.0	0	0.0		1	0.8	0	0.0	

* high score = intake of selected vitamins and minerals reached at least 2/3 of the recommendation, low score = at least 2 nutrients with intake below 2/3 of the recommendation; no data: no data available/no answer; p : Chi²-test/Fisher's exact test;
# significance restricted because more than 20% of cross-tabled cells with expected frequency below, second p-value was calculated with &-marked (and §-marked) items classified

Table IV.13 (continued)

	men					women				
	high score (n=57)		low score (n=32)			high score (n=129)		low score (n=69)		
	n	%	n	%	p	n	%	n	%	p
Do you have problems in swallowing?										
yes	4	7.0	6	18.8	0.158	12	9.3	9	13.0	0.472
no	53	93.0	26	81.3		116	89.9	60	87.0	
no data	0	0.0	0	0.0		1	0.8	0	0.0	
Do you have problems in cutting a piece of meat?										
yes	10	17.5	4	12.5	0.763	30	23.3	20	29.0	0.493
no	47	82.5	28	87.5		97	75.2	49	71.0	
no data	0	0.0	0	0.0		2	1.6	0	0.0	
Performance of the memory test										
good	27	47.4	9	28.1	0.115	50	38.8	16	23.2	0.039
poor	30	52.6	23	71.9		79	61.2	52	75.4	
no data	0	0.0	0	0.0		0	0.0	1	1.4	
Index of mobility										
less mobile	24	42.1	19	59.4	0.129	84	65.1	45	65.2	1.000
mobile (4 ADL without problems)	33	57.9	13	40.6		45	34.9	24	34.8	
Do you practice any kind of sports?										
no sports	40	70.2	24	75.0	#0.887	97	75.2	58	84.1	0.394
& regularly, less than 3 hours/week	15	26.3	7	21.9	0.806	22	17.1	9	13.0	
& regularly, more than 3 hours/week	2	3.5	1	3.1		8	6.2	2	2.9	
no data	0	0.0	0	0.0		2	1.6	0	0.0	
Compared to people of the same age, do you feel ...?										
& less active	4	7.0	3	9.4	#0.604	22	17.1	15	21.7	0.712
& same active	20	35.1	8	25.0	0.506	48	37.2	25	36.2	
more active	33	57.9	21	65.6		59	45.7	29	42.0	
Smoking habits: are you ...?										
& smoker	2	3.5	3	9.4	#0.508	8	6.2	3	4.3	#0.406
& former smoker	18	31.6	9	28.1	0.822	9	7.0	2	2.9	0.243
never smoked	37	64.9	20	62.5		112	86.8	64	92.8	
How often do you get a warm meal?										
& several times a day	9	15.8	1	3.1	#0.198	6	4.7	4	5.8	#0.106
& (almost) daily	46	80.7	31	96.9	1.000	122	94.6	61	88.4	0.051
several times a week/occasionally	1	1.8	0	0.0		0	0.0	3	4.3	
no data	1	1.8	0	0.0		1	0.8	1	1.4	
Are you able to prepare a complete meal, even if you actually don't do it?										
yes, without any problem	27	47.4	12	37.5	0.618	90	69.8	44	63.8	0.624
yes, with problems	14	24.6	10	31.3		24	18.6	14	20.3	
no	15	26.3	10	31.3		15	11.6	11	15.9	
no data	1	1.8	0	0.0		0	0.0	0	0.0	
What do you think, how important is a "right"/ balanced diet for health and well-being?										
very important	48	84.2	17	53.1	0.003	109	84.5	51	73.9	0.088
less important	8	14.0	14	43.8		17	13.2	14	20.3	
unimportant	1	1.8	1	3.1		3	2.3	4	5.8	

* high score = intake of selected vitamins and minerals reached at least 2/3 of the recommendation, low score = at least 2 nutrients with intake below 2/3 of the recommendation; no data: no data available/no answer; p : Chi²-test/Fisher's exact test;

\# significance restricted because more than 20% of cross-tabled cells with expected frequency below, second p-value was calculated with &-marked (and §-marked) items classified

IV.6 Fluid intake

IV.6.1 Amounts by dietary record

In the national study part, fluid intake by beverages amounted to 1300 ml per day (median) for the total sample. However, there were clear sex-dependent differences which also persisted in the total fluid intake (by beverages and solid foods) and in the water of oxidation (table IV.14).

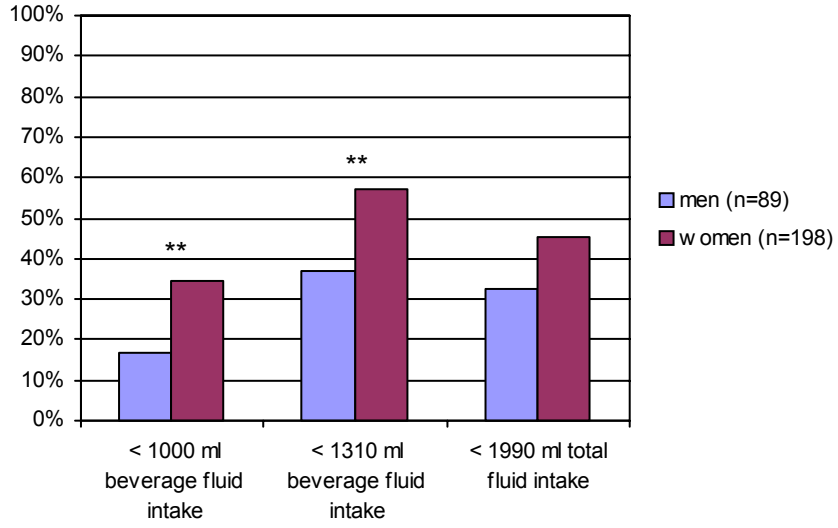
Tables IV.14 Fluid intake [ml] by beverages, by solid foods, total water intake, and water of oxidation – national study part

	men (n=89)			women (n=198)			
Fluid source	**median**	**mean**	**sd**	**median**	**mean**	**sd**	**p**
Fluid intake by beverages	1417	1488	572	1208	1281	557	0.003
Fluid intake by solid foods	807	858	343	754	841	417	0.288
Total fluid intake	2289	2346	691	2069	2122	753	0.010
Water of oxidation	260	274	84	232	248	105	0.003

sd: standard deviation, p: Student's t-test

Figure IV.11 shows the respective percentage of male and female participants not meeting different cut-off points for adequate fluid intake (national study part). 17% of men *vs.* 34% of women drank less than 1 litre per day (p=0.003). 4% drank even less than 0.5 litre per day (not shown), and 37% of men *vs.* 57% of women did not achieve the new recommendation for elderly people to drink 1310 ml per day (p=0.002). 41% of the whole group did not meet the recommendation of 1990 ml total fluid by beverages and solid foods, in this case the sex-specific difference was not significant.

Figure IV.11: Percentage of participants who do not meet different cut-off points for adequate fluid intake – national study part (** p<0.01)



One fourth of those 146 subjects with beverage intake below 1310 ml per day achieved a total fluid intake of more than 1990 ml per day (27% men and 24% women), i.e., their food choice included solid foods rich in water which could compensate their low drinking amounts.

With 1325 ml per day, median fluid intake by beverages was slightly higher in the regional study part (table IV.15), however, male median beverage intake was remarkable low (1095 ml), whereas that of the corresponding women was high (1550 ml). Corresponding median total fluid intakes (by beverages and solid foods) in the regional study part were 1743 ml (men) and 2338 ml (women), respectively. There was good conformity with the nation-wide survey as regards the median intake of water of oxidation.

Tables IV.15 Fluid intake [ml] by beverages, by solid foods, total water intake, and water of oxidation – regional study part

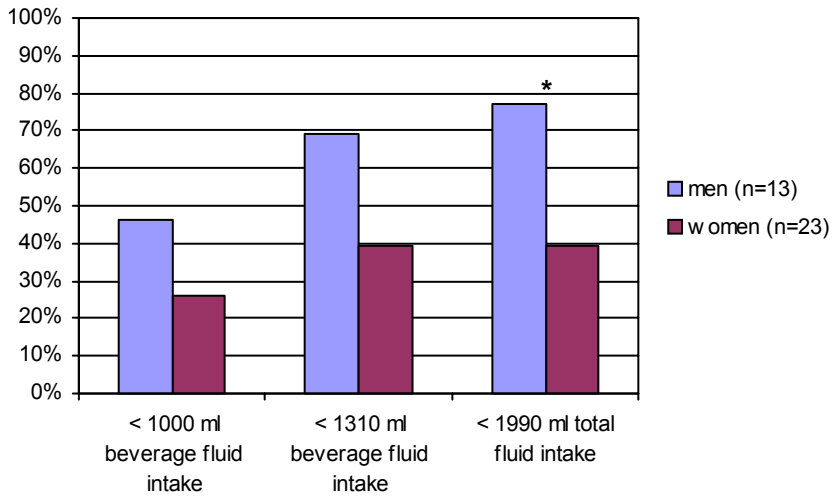
	men (n=13)			women (n=23)			
Fluid source	**median**	**mean**	**sd**	**median**	**mean**	**sd**	**p**
Fluid intake by beverages	1095	1234	715	1550	1485	636	0.140
Fluid intake by solid foods	632	708	231	689	810	372	0.580
Total fluid intake	1743	1942	803	2338	2295	897	0.093
Water of oxidation	238	235	71	231	259	102	0.558

sd: standard deviation, p: Student's t-test

In the regional study part, low fluid intake was more prevalent in men than in women. As shown in figure IV.12, 46% of men and 26% of women drank less than 1 litre per day. 6% of the regional participants drank even less than 0.5 litre per day (not shown). 50% of the very olds ingested less than the recommended fluid intake of 1310 ml per day (69% of men, 39% of women). 77% of the male *vs.* 39% of the female participants did not achieve a total fluid intake of more than 1990 ml per day (p=0.041).

In contrast to the national study part, none of those regional participants with beverage intake below 1310 ml achieved the recommended total water intake (by foods and beverages) of 1990 ml per day.

Figure IV.12: Percentage of participants who do not meet different cut-off points for adequate fluid intake – regional study part (* p<0.05)



IV.6.2 Beverage types by dietary record

The great majority of subjects in the national study part drank both coffee and mineral water. These beverages shared the biggest parts of the ingested beverages (mineral water: 400 ± 360 ml, coffee: 310 ± 202 ml). Beer took the third place in the rank of beverages (116 ± 233 ml), followed by the group herb-tee/fruit-tea/malt coffee with about 125 ± 195 ml, and juices with another 100 ± 155 ml. All other beverages or beverage groups, respectively, counted for less than 70 ml per day each.

As shown in table IV.16, this ranking for the whole group corresponded to that of the men, whereas for women beer ranked significantly lower. Some further sexes-dependent differences could be recognised: on average women drank significantly less wine, beer, and spirits than men, in return they drank more juices and mineral water.

Altogether, beverage intake was mainly composed by the non-alcoholic and non-caloric beverages water and coffee. Overall intake of alcoholic beverages was low, yet remarkably higher for men than for women. High energy (and also nutrient-dense) beverages such as fruit juices, vegetable juices or milk were ingested to minor portions. There was neither preference for soft drinks nor for diet sodas.

In the regional study part, too, water (mineral and tap water) and coffee (incl. decaffeinated coffee) counted for the biggest parts of fluid intake. In comparison with the national study part, especially the intake of milk drinks and water was slightly higher while the intake of beer lower, and there was a higher percentage of milk drinks consumers (table IV.17).

Table IV.16 Beverages types – national study part

Beverages	men (n=89) median [ml]	mean [ml]	sd [ml]	drinker [%]	women (n=198) median [ml]	mean [ml]	sd [ml]	drinker [%]	p
Coffee	300	345	203	91	300	294	200	84	0.699
Tea	0	75	233	21	0	54	158	24	0.050
Malt coffee, herb-tea, fruit-tea	0	102	150	47	0	135	212	49	0.478
Water	200	337	337	76	400	429	368	82	0.026
Juices	0	81	173	28	0	108	146	47	0.008
Refreshments	0	84	231	26	0	51	118	20	0.253
Diet sodas	0	13	67	6	0	17	79	7	0.752
Milk drinks	0	87	149	40	0	94	129	49	0.264
Beer	167	260	321	55	0	51	139	15	0.000
Wine, sparkling wine	0	100	144	45	0	47	90	29	0.002
Spirits	0	5	9	29	0	2	8	11	0.000
Non-alcoholic beverages (without milk drinks)	1033	1036	514	99	1033	1088	520	100	0.412
Alcoholic beverages	257	365	361	75	0	100	172	43	0.000
Non-caloric beverages (water, tea, coffee)	850	858	442	98	850	912	482	99	0.420
Total beverages	1417	1488	572	99	1208	1281	557	100	0.003

'sd: standard deviation; drinker': participants who drank this beverage;
p: sex-dependent difference in mean intake (Student's t-test for independent variables)

Table IV.17 Beverages types – regional study part

Beverages	men (n=13) median [ml]	mean [ml]	sd [ml]	drinker [%]	women (n=23) median [ml]	mean [ml]	sd [ml]	drinker [%]	p
Coffee	300	355	236	100	450	439	269	100	0.369
Tea	0	46	128	15	0	35	90	17	0.939
Malt coffee, herb-tea, fruit-tea	0	8	19	15	0	117	221	39	0.079
Water	400	462	519	85	400	434	271	96	0.498
Juices	0	51	119	23	0	138	205	44	0.179
Refreshments	0	53	93	31	0	65	113	30	0.903
Diet sodas	0	0	0	0	0	70	187	17	0.117
Milk drinks	50	81	99	54	100	120	138	61	0.526
Beer	0	90	188	23	0	34	110	13	0.388
Wine, sparkling wine	0	87	145	46	0	32	61	35	0.300
Spirits	0	3	6	23	0	1	3	9	0.239
Non-alcoholic beverages (without milk drinks)	900	974	530	100	1367	1297	568	100	0.078
Alcoholic beverages	83	179	296	62	0	68	135	39	0.205
Non-caloric beverages (water, tea, coffee)	850	870	578	100	1000	1025	507	100	0.270
Total beverages	1095	1234	715	100	1550	1485	636	100	0.138

'sd: standard deviation; drinker': participants who drank this beverage;
p: sex-dependent difference in mean intake (Student's t-test for independent variables)

IV.6.3 **Risk groups** (national study part)

Male participants with inadequate fluid intake had attained less vocational training than men who met the recommendation for beverage intake (table IV.18). With regard to women, subjects with too low fluid intake declared to a higher degree to have poor or less good appetite, had more often problems in cutting a piece of meat, showed a poorer performance of the memory test, and a lower percentage of them felt able to prepare a complete meal by their own.

Table IV.18 Beverage intake below/above the recommendation in relation to selected basic characteristics – national study part

	men					women				
	< 1310 ml (n=33)		≥ 1310 ml (n=56)			< 1310 ml (n=113)		≥ 1310 ml (n=85)		
	n	%	n	%		n	%	n	%	
Family status										
& unmarried	0	0.0	1	1.8	#0.750	6	5.3	3	3.5	#0.890
married	15	45.5	25	44.6	1.000	8	7.1	5	5.9	0.781
& living in divorce / separated	0	0.0	1	1.8		4	3.5	4	4.7	
& widowed	18	54.5	29	51.8		95	84.1	73	85.9	
Living situation										
alone	11	34.4	25	44.6	0.376	83	73.5	67	78.8	0.407
not alone	21	65.6	31	55.4		30	26.5	18	21.2	
School graduation										
& no graduation	0	0.0	1	1.8	#0.558	3	2.7	1	1.2	#0.758
& elementary/secondary education	24	72.7	33	58.9	0.357	89	78.8	64	75.3	0.479
§ O-level or comparable	5	15.2	12	21.4		18	15.9	17	20.0	
§ techn. college -/ high school grad.	4	12.1	10	17.9		3	2.7	3	3.5	
Educational level										
no educational attainment	6	18.2	2	3.6	#0.067	61	54.0	42	49.4	#0.793
& vocational training / foreman	21	63.6	43	76.8	0.048	49	43.4	40	47.1	0.567
& technical college / university degree	6	18.2	10	17.9		3	2.7	3	3.5	
no data	0	0.0	1	1.8		0	0.0	0	0.0	
Former professional status										
employee, clerk, self-employed	21	63.6	39	69.6	#0.173	49	43.4	37	43.5	0.952
& manual worker, family worker	10	30.3	16	28.6	0.489	27	23.9	22	25.9	
& housewife/homemaker	2	6.1	0	0.0		36	31.9	26	30.6	
no data	0	0.0	1	1.8		1	0.9	0	0.0	
Do you have enough money?										
yes, no problem	24	72.7	42	75.0	0.808	76	67.3	60	71.4	0.640
yes, fairly	9	27.3	14	25.0		37	32.7	24	28.6	
Can you rely on s.o. who helps you if you were ill?										
yes	30	90.9	50	89.3	1.000	105	92.9	79	92.9	1.000
no	3	9.1	6	10.7		8	7.1	6	7.1	
Self-perception of health										
good - very good	11	33.3	17	30.4	#0.833	31	27.4	31	36.5	0.397
fair	12	36.4	24	42.9	0.816	40	35.4	26	30.6	
less good – poor	10	30.3	15	26.8		42	37.2	28	32.9	
How is your appetite?										
good – very good	25	75.8	41	73.2	1.000	62	55.4	61	71.8	0.026
less good – poor	8	24.2	15	26.8		50	44.6	24	28.2	
Did you recently notice a loss of appetite?										
yes	2	6.1	2	3.6	0.625	15	13.3	10	11.8	0.830
no	31	93.9	54	96.4		97	85.8	75	88.2	
no data	0	0.0	0	0.0		1	0.9	0	0.0	
Do you have any difficulties in chewing?										
yes	8	24.2	19	33.9	0.474	45	39.8	29	34.1	0.458
no	25	75.8	37	66.1		67	59.3	56	65.9	
no data	0	0.0	0	0.0		1	0.9	0	0.0	

Table IV.18 (continued)

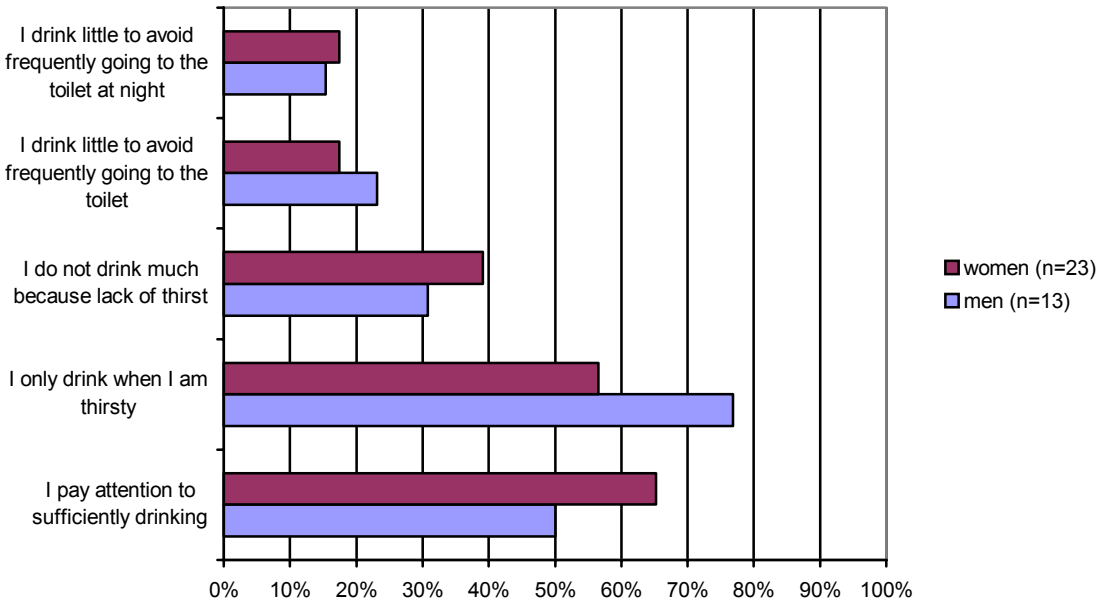
	men					women				
	< 1310 ml (n=33)		≥ 1310 ml (n=56)			< 1310 ml (n=113)		≥ 1310 ml (n=85)		
	n	%	n	%	p	n	%	n	%	p
Do you have problems in swallowing?										
yes	4	12.1	6	10.7	1.000	12	10.7	9	10.6	1.000
no	29	87.9	50	89.3		100	89.3	76	89.4	
Do you have problems in cutting a piece of meat?										
yes	7	21.2	7	12.5	0.367	35	31.0	15	17.6	0.032
no	26	78.8	49	87.5		76	67.3	70	82.4	
no data	0	0.0	0	0.0		2	1.8	0	0.0	
Performance of the memory test										
good	13	39.4	23	41.1	1.000	31	27.4	35	41.2	0.050
poor	20	60.6	33	58.9		81	71.7	50	58.8	
no data	0	0.0	0	0.0		1	0.9	0	0.0	
Number of chronic diseases										
& none	3	9.1	3	5.4	#0.550	9	8.0	8	9.4	0.352
& 1-3	20	60.6	40	71.4	0.465	70	61.9	44	51.8	
more than 3	10	30.3	13	23.2		34	30.1	33	38.8	
How often have you been in pain the last week?										
never	10	30.3	21	37.5	0.646	29	25.7	22	25.9	0.870
one or more times	22	66.7	35	62.5		83	73.5	59	69.4	
no data	1	3.0	0	0.0		1	0.9	4	4.7	
Index of mobility										
less mobile	17	51.5	26	46.4	0.667	74	65.5	55	64.7	1.000
mobile (4 ADL without problems)	16	48.5	30	53.6		39	34.5	30	35.3	
Do you practice any kind of sports?										
no sports	23	69.7	41	73.2	#0.908	90	80.4	65	77.4	0.531
& regularly, less than 3 hours/week	9	27.3	13	23.2	0.808	18	16.1	13	15.5	
& regularly, more than 3 hours/week	1	3.0	2	3.6		4	3.6	6	7.1	
Compared to people of the same age, do you feel ...?										
less active	3	9.1	4	7.1	#0.392	26	23.0	11	12.9	0.104
same active	13	39.4	15	26.8	0.187	43	38.1	30	35.3	
more active	17	51.5	37	66.1		44	38.9	44	51.8	
Smoking habits: are you ...?										
& smoker	1	3.0	4	7.1	#0.203	6	5.3	5	5.9	#0.708
& former smoker	7	21.2	20	35.7	0.109	5	4.4	6	7.1	0.501
never smoked	25	75.8	32	57.1		102	90.3	74	87.1	
How often do you get a warm meal?										
& several times a day	3	9.1	7	12.5	#0.634	8	7.1	2	2.4	#0.175
& (almost) daily	30	90.9	47	83.9	1.000	101	89.4	82	96.5	0.394
several times a week/occasionally	0	0.0	1	1.8		4	3.5	1	1.2	
no data	0	0.0	1	1.8		0	0.0	0	0.0	
Are you able to prepare a complete meal, even if you actually don't do it?										
yes, without any problem	10	30.3	29	51.8	#0.111	69	61.1	65	76.5	0.045
yes, with problems	12	36.4	12	21.4		28	24.8	10	11.8	
no	11	33.3	14	25.0		16	14.2	10	11.8	
no data	0	0.0	1	1.8		0	0.0	0	0.0	
What do you think, how important is a "right"/ balanced diet for health and well-being?										
very important	21	63.6	44	78.6	#0.309	91	80.5	69	81.2	#0.993
& less important	11	33.3	11	19.6	0.144	18	15.9	13	15.3	1.000
& unimportant	1	3.0	1	1.8		4	3.5	3	3.5	

no data: no data available/no answer; p: Chi²-test/Fisher's exact test; # significance restricted because more than 20% of cross-tabled cells with expected frequency below, second p-value was calculated with &-marked (and §-marked) items classified

IV.6.4 **Attitudes towards drinking** (regional study part)

58% of the high aged regional participants claimed “to pay attention to sufficiently drinking”, however, 64% also stated to drink when they were thirsty only, and 36% of the very old participants confessed to drink little amounts “for lack of thirst”. 19% admitted to drink little “to avoid frequent trips to the toilet”, 17% are used to drink little to avoid the same at night. There were no significant sex-dependent differences in both agreement and disagreement to these statements (figure IV.13).

Figure IV.13: Percentages of participants who agreed with different attitudes towards drinking (regional study part)



The cross-table of attitudes towards drinking and actual beverage intake categorised by the two fluid intake groups < 1310 ml per day (= below recommendation) and ≥ 1310 ml per day (= above recommendation) is shown in table IV.19.

Subjects who ingested less fluids than recommended agreed significantly more often (83%) with the statement “I only drink when I am thirsty” than people with adequate fluid intakes (44%). There was no other significant difference neither for the whole group nor for males and females separately.

Table IV.19 Beverage intake below/above recommendation in relation to attitudes towards drinking (regional study part)						
		< 1310 ml		≥ 1310 ml		
Statement	**answer**	**n**	**%**	**n**	**%**	**p**
I pay attention to sufficiently drinking	that's right	8	44.4	13	72.2	0.086
	that's wrong	10	55.6	4	22.2	
	no answer	0	0.0	1	5.6	
I only drink when I am thirsty	that's wrong	3	16.7	10	55.6	0.035
	that's right	15	83.3	8	44.4	
I do not drink much, because of lack of thirst	that's wrong	9	50.0	14	77.8	0.164
	that's right	9	50.0	4	22.2	
I drink little to avoid frequent trips to the toilet	that's wrong	12	66.7	17	94.4	0.088
	that's right	6	33.3	1	5.6	
I drink little to avoid frequent trips to the toilet at night	that's wrong	16	88.9	14	77.8	0.658
	that's right	2	11.1	4	22.2	

p: Fisher's exact test

IV.6.5 Estimated beverage intake by questionnaire and comparison with beverage intake by dietary record

Assessed by questionnaire, 9% of the elderly in the national study part estimated their total amount of daily drunken beverages at below 1 litre, 61% declared to drink at least 1.5 litres per day without sex-dependent differences (table IV.20).

In the regional part of the study, for 19% of the participants fluid intake was calculated at below 1 litre according to their specified beverages, without sex-dependent differences. One third estimated their beverage intake at the range of at least 1.5 litres a day or more.

Table IV.20 Classified beverage intake assessed by questionnaire										
	national					regional				
Fluid intake category	men		women			men		women		
	n	**%**	**n**	**%**	**p**	**n**	**%**	**n**	**%**	**p**
< 500 ml	0	0.0	1	0.5	#0.378	1	7.7	1	4.3	#0.350
500-1000 ml	8	8.0	20	9.1	0.805	1	7.7	4	17.4	0.720
1000-1500 ml	30	30.0	67	30.6		6	46.2	11	47.8	
1500-2000 ml	35	35.0	92	42.0		3	23.1	7	30.4	
≥ 2000 ml	27	27.0	39	17.8		2	15.4	0	0.0	

significance restricted because more than 20% of cross-tabled cells with expected frequency below 5, second p-value for fluid intake "< 1500 ml" *vs*. "≥ 1500 ml"

As shown in table IV.21, in comparison to calculated fluid intake by 3-day dietary records, the estimations of the majority of the elderly in the national study part (78%) were correct, estimation errors of ± 0.5 litres admitted. One fifth of the participants overestimated their fluid intake by at least 0.5 litre, only 2% underestimated it about at least 0.5 litre.

In the regional study part, the proportion of overestimated fluid intakes was lower, that of underestimated fluid intakes was higher than in the national study part (table IV.21): 8% overestimated their fluid intake by beverages about at least 0.5 litre (23% of men but no woman) whereas 17% underestimated it about the same range. 75% of the estimations were correct within the range of ± 0.5 litre.

Table IV.21 Comparison of classified beverage intake by questionnaire with classified beverage intake by dietary records

Estimation error*	national					regional				
	men		women			men		women		
	n	%	n	%	p	n	%	n	%	p
overestimated > 0.5 litre	15	16.9	42	21.3	#0.666	3	23.1	0	0.0	#0.054
correct +/- 0.5 litre	72	80.9	150	76.1	0.444	8	61.5	19	82.6	0.235
underestimated < 0.5 litre	2	2.2	5	2.5		2	15.4	4	17.4	

*Classified difference "intake by dietary record" – "intake by questionnaire"
20% of cross-tabled cells with expected frequency below 5, second p-value for "correct" *vs.* "over-/underestimated"

V Discussion

High aged individuals form a fascinating study cohort. Born in or just before World War I, subjects aged 85 years and older past almost whole the last century. Briefly, they experienced the world-wide economic crisis ("great depression") in the 1920ies and 1930ies, World War II, the post-war period ("economic miracle") etc., and besides an enormous amount of technological developments. However, although this underlying contemporary history was the same for all high aged subjects living in Germany, it might have been individually experienced in quite different ways, depending on the geographic region as well as on various social, economical, personal, and also nutritional circumstances.

Individuals living up to very high ages and especially those managing life outside institutional care are to a great extent "selected". They can be regarded as the elite of their cohort as to state of health (RAJALA et al. 1990). Due to the age-stratified sample, the present study provides for the first time detailed information of the nutritional situation and living circumstances of a large group of likewise "selected" high-aged free-living Germans.

In the following, besides the discussion of methods and interpretation of results, findings of the high aged participants are compared with the data of the younger elderly in our project as well as with data of other studies on the elderly and put in perspective for future research.

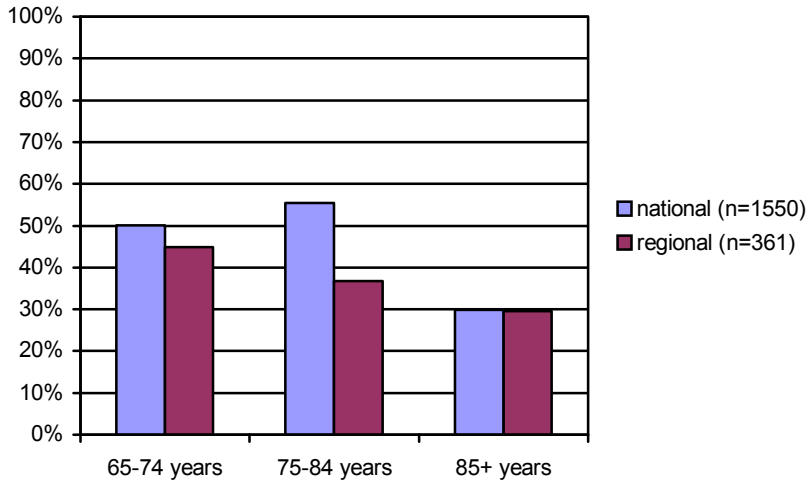
Participation rates

Differences in drop outs between the study parts (table IV.1) were mainly favoured by the different random sample systems. In the nation-wide survey, the random sample originated from an address pool of a monthly contributed survey. In this address pool, institutionalised subjects and subjects with severe physical and mental handicaps were excluded a priori. This was the reason for the markedly lower rate of drop outs from the gross random sample. The proportion of institutionalised elderly in the regional gross study sample was even higher than the average rate of institutionalised subjects ≥ 80 years in Germany (13.4%, BUNDESMINISTERIUM FÜR FAMILIE, SENIOREN, FRAUEN UND JUGEND 1997). In future investigations, the latter result should be taken into account when using data from registration offices.

Also in contrast to the regional study part, belonging to the address pool used in the national study part represents a general interest in survey participation; this might be the reason for the lower rate of subjects who totally refused participation at all in comparison to the regional study part (table IV.1). On the other side, if necessary, only in the regional study part several attempts have been made to meet people not at home (at fixed date or without date due to lack of telephone or contact). For logistic (and economical) reasons this was not possible in the national study part. As experienced in the regional study part, such an expense is worth to be taken into consideration to reach high(er) participation rates in elderly populations.

However, after all, participation rate from net random sample was equally low in both study parts (30%). To date, comparable data from other German surveys on high aged elderly are missing. Response rates are known to decline with increasing age (HERZOG & RODGERS 1988) This finding was confirmed in our project. As shown in figure V.1, the participation rates of subjects aged 65-74 years and 75-84 years (*cp.* chapter III.1) were higher in both study parts. Thus, the willingness to participate in population studies obviously decreases with age. However, there are also physical reasons: younger elderly did less often suffer from an acute illness that restricted their participation (4-9% *vs*. 18-22% among the high aged elderly) (STEHLE et al. 1999). The better health status of study participants compared to non-participants (table VIII.1) corresponds with the inclusion criteria but has to be kept in mind as a (methodological) selection bias when trying to generalise the study results.

Figure V.1: Participation rates in both study parts by age groups



In literature, participation rates of voluntary European elderly examinees greatly vary. In the Euronut SENECA study ("Nutrition and the Elderly in Europe") the nutritional situation of Europeans born 1913-1918 in 20 small traditional European towns was investigated in both cross-sectional and longitudinal analyses. The average participation rate of all 70-75-year-old subjects was 51% in the baseline study. However, although strictly standardised methodology, there was a wide variation among study centres, reaching from 12-88% (VAN'T HOFF et al. 1991).

The interdisciplinary SIMA study deals with he conditions of "maintaining and supporting independent living in old age" of randomly recruited participants aged 75 years and older in the German areas Nürnberg/Fürth/Erlangen. This project included an experimental study part with various training units from which participants could personally benefit. Enthusiasm,

however, did not persist: 53% of subjects who primarily showed interest in this study actually participated (GUNZELMANN et al. 1996). In the so-called Berliner Altersstudie among randomly selected senior citizens aged 70 years and older, 49% were willing to participate in a first part, whereas only 27% finished the intensive questionnaire and medical investigation units of this study (LINDENBERGER et al. 1996). In studies on younger elderly subjects with nutritional, medical or psychological background, participation rates are often higher (42%) (MARTIN et al. 2000).

Thus, besides dropping out from illness, motivation is a main topic in investigations on the elderly. Lack of motivation can be a potential source of error in both subjects and interviewers. It is critical that the interviewers and/or others who introduce the study to the subjects be enthusiastic about the study and able to convey this enthusiasm to the participants (BUZZARDS 1998). Taking time to explain the purpose and importance of the research and to establish a friendly and relaxed but business-like rapport with the participants creates an atmosphere of trust and motivates the participants to provide accurate information (BUZZARDS 1998). Especially for investigations in elderly populations patience and frequent probing are required, considering for instance the decline in short-term memory with ageing. A visit to an older person usually requires more time of field workers (VAN STAVEREN et al. 1994), this experience was often confirmed in the weekly team meetings in the regional study part (unpublished data and personal communications).

Study participants: basic characteristics

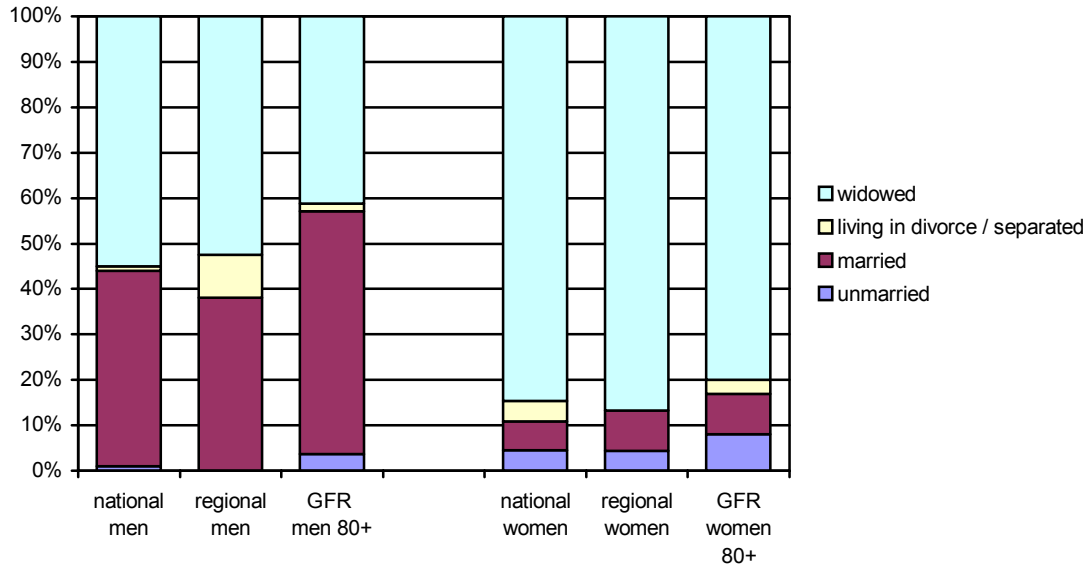
Socio-demographics

As regards socio-demographics, many sex-dependent differences were obvious in both study populations (table IV.2). As expected, they reflect the traditional situation of high aged males and females in the twentieth century in Western societies as well as the sex-specific difference in life-expectancy. In both study parts, the relation men to women was 68% to 32% which corresponds to the annual statistics of the German population. In 1998, 1.161.500 women aged 80 years and older (76%) and 370,000 men of this age group (24%) currently lived in Germany (STATISTISCHES BUNDESAMT 1999). In German sociological literature, the growing segment of females among the elderly population has been expansively described by the term “Feminisierung des Alters” (LEHR 1996, PRAHL & SCHROETER 1996, TEWS 1993).

In our study, the proportion of widowed women clearly exceeded that of bereaved men, more women in this cohort currently lived alone, and women were inferior to men concerning school education and professional status. As shown in figure V.2, compared to the annual

statistics of the German population, the ratio of married to widowed males is inverse in both study parts in support of the widowed.

Figure V.2: Family status of men and women in our project compared to German statistics



GFR = German Federal Republic; men 80+ = 370.000, women 80+ = 1.161.500

There is a second general trend in (industrialised) elderly populations which was confirmed in our survey, too. In Germany, this trend has been termed “Singularisierung”. This social phenomenon is mainly determined by widowhood in a society with decreasing more-than-one-generation-households (LEHR 1996, PRAHL & SCHROETER 1996).

Indeed, the living situation reflects the marital status as well as the overnumbering of women: living alone is mainly a female task (77% national *vs.* 67% regional). In the Euronut SENECA study the proportion of the slightly younger elderly women living alone reached from 22-54%. Only in the Greek examination town an extremely rate was found (7%) (SCHLETTWEIN-GSELL et al. 1991a), probably indicating that living together with the family is still more respected there than in northern European countries.

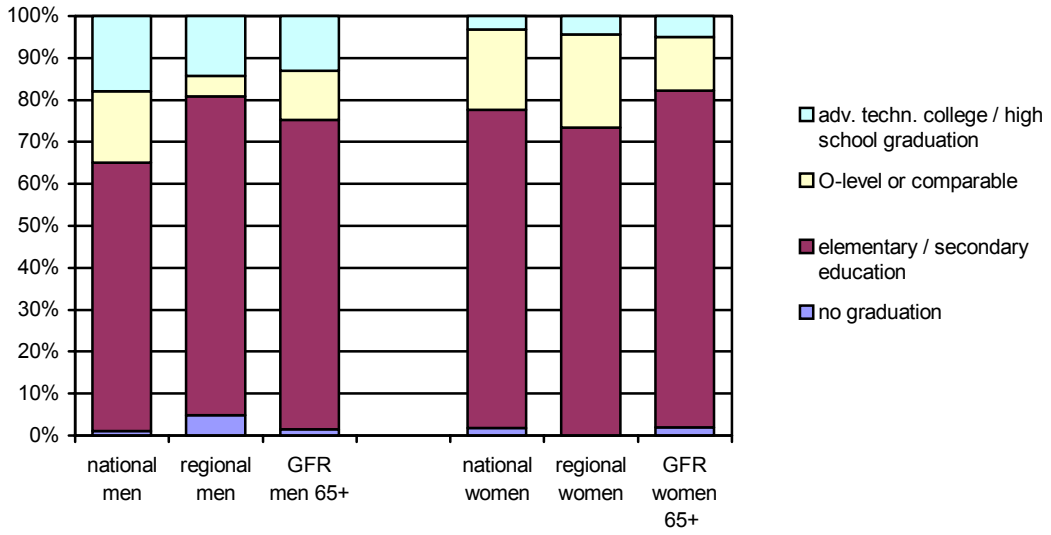
Among the younger women of our project 63% (national) and 46% (regional), respectively, lived alone at the time of participation. These comparisons indicate that living alone, caused by marital status, increases with age and also suggest that living alone is more present in Germany than in other European countries.

Living alone is actually not identical with loneliness; there is general agreement that loneliness is the result of an expectation and not related to objective criteria. As regards the nutritional risk by living alone, conflicting data have been published on the nutritional content of

diets eaten by persons living alone (SCHLETTWEIN-GSELL et al. 1991a); these aspects will be discussed in more detail in context with the dietary records (see below).

As regards the school career, the historical situation and development during the 20th century is partly reflected in our results. According to the chronicle of Euskirchen (STADT EUSKIRCHEN 1997), only few possibilities for higher education were given in this rural district in the beginning of the last century. Indeed, in the regional study part, the proportion of male subjects with higher education is lower than that of the German population aged 65 years and older (STATISTISCHES BUNDESAMT 1999). However, the proportion of females subjects with higher education in this study part is even higher than that of the respective German population, just as described for both sexes in the national study part (*cp.* figure V.3). Thus, a certain educational bias exists in our study population as it is often found in epidemiological studies: higher educated persons are often more willing to participate in scientific studies (GUNZELMANN et al.1996, SCHNELL 1997, THEFELD et al. 1999).

Figure V.3: School graduation of the study cohorts *vs.* that of the German population aged 65+ years (STATISTISCHES BUNDESAMT 1999: Mikrozensus*)



GFR = German Federal Republic; men 65+ = 4,650000, women 65+ = 7,3440000
* subjects who answered the Mikrozensus only

It is not easy to get reliable data on the financial situation by questionnaire. For this reason exact income level was not assessed. Most participants in our investigation contented themselves with their financial situation (table IV.2). In contrast to earlier decades of the last century, poverty in the elderly is considered to be an exception nowadays (BUNDESMINISTERIUM FÜR FAMILIE, SENIOREN, FRAUEN UND JUGEND 1996). However, alike subjects with lower edu-

cation (and partly caused by this lower education), subjects with poor financial status who might be at higher nutritional risk (HELMERT et al. 1997) probably refused participation.

Most of the high aged subjects have a person to rely on in case of illness (table IV.2). This findings goes in agreement with the results of different European countries (SCHLETTWEIN-GSELL et al. 1991a). Despite the described "Singularisation", this might indicate functioning social networks by children and neighbours.

Health, mental and functional status, activities, and smoking habits

As regards the health status of the examinees, (fairly) healthy free-living high aged individuals have been recruited. That means, this are subjects without any acute illness that could restrict their independence yet not necessarily without any chronic disease at all. Indeed, the latter concerned 9-11% of participants only, although there has been a certain selectivity in favour of the subjects in better health caused by drop outs (table IV.1) which is well known in literature (SCHROLL et al. 1991, GUNZELMANN et al.1996, VAN'T HOF & BUREMA 1996, SCHNELL 1997). As already mentioned above, this selectivity could be an important source of bias if results of our study were generalised to the whole German high aged population.

The recently presented data of a study on the elderly in Gießen, Germany, shows a comparable low rate of 7% of the 487 free-living volunteers aged 60-80 years who claimed to be free of any chronic disease (NEUHÄUSER-BERTHOLD 2000). Among the 75-80 years old Europeans in the Euronut SENECA follow-up study a slightly lower proportion of morbidity was found: on average, 32% of the males and 22% of the females had no chronic disease (SCHROLL et al. 1996). In US America, an estimated 12% of individuals aged 65 years and older is currently living without any chronic condition (MINKLER et al. 2000).

Actually, multi-morbidity is wide-spread among the elderly population (HEIKKINEN 1987, SCHLIERF et al. 1990, VOLKERT 1997, NIKOLAUS 2000), and the most frequent diseases assessed in the present investigation (cardiac diseases, muscular-skeletal diseases) correspond to those previously described as the most frequent ones in elderly populations (SCHROLL et al. 1991, GASSMANN et al. 1996, NIKOLAUS 2000).

As regards the activities of daily living, our results reflect the leading diseases involved in multi-morbidity, too: activities which are linked with physical exertion (like carrying heavy objects or doing heavy housework) and activities which are linked with agility (like cutting one's toenails) are the most restricted ones (table IV.2). The commonly reported feeling of pain (table IV.2) is presumably linked to these diseases, too, and might enhance a sedentary lifestyle.

There is a growing body of research showing that self-perceptions of health are linked to mortality, even when more "objective" health measures are controlled (MOSSEY & SHAPIRO 1982, IDLER & BENYAMINI 1997, HELMER et al. 1999, MENEC et al. 1999). The perception of one's own health status in the present investigation was better than one might have expected by the high prevalence of multiple chronic diseases – this phenomenon has previously been described in studies with elderly participants (BRODHAGEN 1993). According to these previous investigations, 32-57% of elderly examinees judged their health as being "excellent/very good" or "good". In the Euronut SENECA study, judgement of present health as "good" or "very good" even ranged form 20-84% in the different study centres (SCHROLL et al. 1991).

The criteria that people use in their health ratings are not well known. There seems to be general tendency for the health-aspiration level to decline with ageing, with the result that the desired level is achieved although the clinically defined status of health has deteriorated (HEIKKINEN 1987). Our present data (table IV.2) are within the wide ranges described in the Euronut SENECA study and are distinguished by a clear difference between the examination areas (33% national *vs.* 56% regional with self-perceived health as "good" or "very good"), although a similar prevalence in the number of chronic diseases as well as in the types of the present diseases was observed.

The lack of a significant sex-specific difference in our investigation is inconsistent with the SENECA study where male subjects in almost all study towns had a better self-perceived health than females (SCHROLL et al. 1991), and also with the nationally representative data of high aged Swedish individuals (THORSLUND & LUNDBERG 1994) and the data of the German BOLSA study (Bonner Gerontologische Längsschnittstudie) (LEHR 1987). The finding that men generally rather tend to value their health status as good than females is only partly explained by the actually better health status of men (BRODHAGEN 1993). On the other side, the data of a British examination on individuals aged at least 60 years showed that older women's much higher level of functional impairment co-existed with a lack of gender difference in self-assessed health (ARBER & COOPER 1999). For a given level of disability women were less likely to assess their health status as being poor than men of the same age after accounting for structural factors as age, class, and income (ARBER & COOPER 1999). The data of our survey partly supports this thesis, the poorer functional level of women (index of mobility) in the national study part did not go along with a lower self-perceived health.

The results concerning appetite, problems in swallowing, chewing, and cutting a piece of meat with a knife did not indicate that the study group was at nutritional risk because of these related problems (table IV.2). However, the proportion of participants with problems in chewing was higher in the regional study part (11% *vs*. 2% national). This finding calls attention to the importance of dental status since adequate food intake requires satisfactory dental

health. Dentition may be a key factor impacting the nutrient needs of an older person (McGee 2000). Previous research shows an increase of chewing problems with increasing age as well as an increase of toothless subjects (Johnson et al. 1992, Nitschke & Hopfenmüller 1996). Consequences of poor oral health and also of related problems like xerostomia that might lead to specific food avoidance and that might contribute to poor nutrition in those elderly who additionally have other risk factors are comprehensively discussed in literature (Loesche et al. 1995, Griep et al. 1996). The markedly higher proportion of subjects having always problems with chewing in the regional survey rises the question whether the elderly in the rural area of Euskirchen paid less attention to the meaning of dental health and to dentists' visits compared to their nation-wide peers.

Losses in short time memory are considered as sensible indicator of cognitive impairments. Given time restrictions and also restrained acceptance to perform more comprehensive tests, the single question of the Mini Mental State Questionnaire (Folstein 1975) used is this study is recommended as a screening tool for easily testing of mental capacity of the elderly (Lachs et al. 1990). Sufficient mental capacity to answer simple questions was indispensable for study participation (table III.1). Consequently, subjects with severe mental problems were excluded a priori. Nevertheless, our test showed a high proportion of high aged individuals with restricted memory (66% national, 77% regional).

For comparison, younger participants in our project showed a notably better performance of this test (50% national and 42% regional with "good performance"). Cognitive impairments are well known to increase with age. High aged subjects are at markedly higher risk for dementia than younger elderly (Oster 1990) with enormous consequences for their own (and their caregivers) quality of life. In recent time there are many hints for a modest but positive influence of micronutrients on cognitive performance (Riedel & Jorissen 1998, Gonzalez-Gross et al. 2001), this issue will be discussed in more detail in connection with nutrient intake (see below).

The rate of participants practising physical activities (sports) was generally low, but higher in the national than in the regional study part (24% *vs.* 5%). As handicaps or ailments are equally spread among both study populations (table IV.2), this might indicate that practising sports is not as usual in the rural area of Euskirchen as it is in larger urban areas. Additionally, assessment of practised sports was different in the two study parts (*cp*. chapter III.2): in the national study part participants just had to tell if they practised any kinds of sports and, if yes, how many hours they actually practise them per week. In the regional study part, participants had to itemise all kinds of sports and also to specify the time spend with these ac-

tivities. Thus, the procedure used in the national study part might have caused some overestimation of time spent with sports.

In general, inactivity should be prevented even in the very aged population. If not limited by physical handicaps and ailments, physical activity is important at all ages to maintain bone and muscle mass. According to ROUBENOFF (2000), treatment of sarcopenia (loss of muscle mass) with progressive resistance training is safe and effective and thus a crucial public health approach to avoiding an epidemic of disability in the future causing catastrophic health and societal costs. Physical activity is also very important to maintain energy balance as well as energy requirements (see below).

Compared to the data of the younger elderly (aged 65-84 years) in the national study part, a general decrease in health, functional status and physical activity with increasing age becomes obvious (table V.1). The comparison with the data of the younger elderly in the regional survey mainly revealed age-dependent differences in the functional status, e.g., in the activities of daily living (data not shown).

The increasing loss of functional capacity with age ("functional decline") as well as the increase of health related problems has been described in literature before (LEHR 1996, HÉBERT 1997, VOLKERT 1997, ELIA et al. 2000). In the SENECA follow-up (1993), there was no significant change in the prevalence of chronic diseases after 5 years, but the proportion of ADL-independent men and women decreased by 25% and the number of people perceiving their health to be poor increased by 21% (SCHROLL et al. 1996).

Table V.1 Comparison of the study cohort with younger elderly concerning health, functional status and physical activity – national study part

Characteristics of health, functional status and physical activity	men 85+ y (n=100) %	men 65-84 y (n=554) %	p	women 85+ y (n=220) %	women 65-84 y (n=676) %	p
Self-perceived health as "good" or "very good"	34.0	50.9	0.005	32.7	49.1	0.000
Appetite "good" or "very good"	74.0	85.2	0.007	62.3	75.6	0.000
Loss of appetite in recent time	4.0	4.2	1.000	12.3	4.4	0.000
Difficulties in chewing (always & hard/sticky foods)	32.0	15.2	0.000	38.2	16.5	0.000
Problems in swallowing	12.0	4.9	0.010	9.5	6.4	0.130
Problems in cutting a piece of meat (always & sometimes)	16.0	5.1	0.000	25.4	6.5	0.000
No chronic disease	7.0	16.1	0.030	9.1	13.8	0.005
ADL without problems: to carry heavy objects	41.0	69.5	0.000	14.5	51.5	0.000
ADL without problems: to cut one's toenails	47.0	77.1	0.000	24.5	68.2	0.000
ADL without problems: to do heavy housework	27.0	64.3	0.000	16.4	59.2	0.000
Mobility index: 4 mobility ADL without problems	52.0	74.2	0.000	35.5	70.6	0.000
Practice of sports: regularly more than 3 hours per week	3.0	22.6	0.000	4.5	19.1	0.000

p: age-dependent differences tested by Chi²-test/Fisher's exact test (answer categories as presented in table IV.2); for an easier representation only one answer category is presented in this table

Smoking is mainly a male task in our project, yet not very important (any more) for the high aged individuals. The proportion of smokers at the time of the survey was low in both our survey parts (2-6%), while 14-26% were former smokers. This smoking behaviour might change in the future: 14%, and thus significantly more of the younger elderly in our survey currently smoked and 25%-34% were ex-smokers. Future European generations of the elderly are in general expected to include more smokers or ex-smokers than previously, with increasing prevalence and incidence of related pathological conditions (HEIKKINEN 1987). In other European countries, the proportion of smokers is (already) higher: 8-46% of the elderly (aged 75-80 years) in the Euronut SENECA currently smoked (SCHLETTWEIN-GSELL et al. 1991a).

Nutritional aspects

As regards the nutritional aspects presented in table IV.2, the main impression was that most high aged individuals are not at nutritional risk.

First, they seem to be aware of the importance of nutrition: about 80% considered a well balanced diet as very important for health and well-being. As participants knew that the focus of our investigation was their nutritional situation, this result certainly included some elderly who gave "social desirable answers" (WORSLEY et al. 1984, WISWEDE 1991). Nevertheless, this finding might indicate that public health education in various forms has contributed to this result. Ten years ago, (only) two thirds of the examinees aged 80 years and older in Gießen valued nutrition as very important in this context (BECKER 1990).

According to our findings of the national survey, with increasing age the importance of nutrition was considered to be significantly less important: 78% of the subjects aged 85+ years considered a well balanced diet as "very important" *vs.* 87% of the subjects aged 65-84 years. This result can indicate a difference in health knowledge by age as well as a decreasing interest in such health topics with increasing age.

Infrequently taken warm (principal) meals are considered as a risk factor for inadequate nutrition. Only 2-3% of the participants are subject to such a risk (table IV.2). This finding is in agreement with the SENECA investigation where more than 90% of the examinees in different European regions received a warm meal daily (SCHLETTWEIN-GSELL et al. 1991). Warm meals are an important component in the daily time-table of elderly subjects: almost all senior citizens (98%) conform to tradition and consume three main dishes per day (STEHLE et al. 2000), with mostly regular eating times and lunch being the main meal of the day (BROMBACH 2001).

Doing the cooking traditionally belongs to female tasks, although half the oldest old men declared to feel capable of preparing a complete meal independently (table IV.2). In this context

adequate social networks are (still) existent, too: children respectively other relatives assume this service if necessary. The professional help service “meals on wheels” was accepted by merely minor parts of both study cohorts. Such a service is probably called on to a higher degree by more physically disabled elderly (non-participants of our study and excluded elderly). Moreover, it is likely that the latter results might change in future elderly generations, partly because of secular trends away from family traditions (TÖPFER et al. 1998), and possibly also because the elderly of the future will be more used to call on service companies.

Nutritional status – anthropometric measurements

Weight, height, and BMI

Anthropometric measurements in elderly populations are rendered more difficult with increasing age. Some elderly subjects in our project were not compliant to be measured, but others were not able to participate because they had a feeling of uneasiness or discomfort, problems in balancing or kyphotic backs. The latter would falsify measurements and was therefore an exclusion criteria for these measurements (*cp.* chapter III.3.2). Since for the analysis of complete height and weight data no obvious selectivity in participation was apparent in neither study part (tables VIII.1 and VIII.2), the social and health attributes described for the study samples in chapter IV.2 can be considered as suitable characterisation of the investigated sub-samples.

Accuracy of anthropometric measurements is important to get reliable data. There is a clear hierarchy in the precision of different nutritional anthropometric measures, with weight and height being most precise (ULIJASZEK & KERR 1999). In this project, the interviewers were intensively introduced into the measuring procedures to ensure a high measurement standard. Comparable to other population studies, however, there are also some limitations concerning data assessment in this project. Whereas in the regional study part calibrated scales were brought along by the respective interviewer, present household scales of the participants had to be used for reasons of practicability in the national study part for which precision could not be guaranteed. Depending on the arranged dates, measurements were performed at various times of the day, and concerning the regional study part also at various times of the year (May-January), therefore these (weight) measurements might reflect diurnal and seasonal variations. Yet, these limitations are not discussed in more detail because they are not specific for this project but well-known limitations of larger population studies.

Given reliable anthropometric data, its interpretation in the very aged is still difficult as only few previous studies included very old persons, reference data are not available or regional differences prevent from clear conclusions, respectively. The EXPERT COMMITTEE convened

by the WORLD HEALTH ORGANIZATION (WHO) to re-evaluate the use of anthropometry at different ages (for assessing health, nutrition, and social well-being) expressed particular concern regarding the applicability of any available data to other populations, and recommended rather the collection of data describing local levels and patterns (WHO 1995).

BMI values are often used as categorical variables to describe nutritional status as underweight, normal weight, and overweight. However, since there is no consensus about an adequate and uniform classification for elderly persons, comparisons with the available data of other scientific investigations is often rendered difficult. Some studies use age-dependent and sex-dependent reference values while others do not, and moreover, there is a great variety in age groups of the elderly examinees. In addition to this, methods of measurement are often not clearly described or differ, respectively.

As summarised in table V.2, often used reference ranges for normal BMI values are 20-25 kg/m² for men and 19-24 kg/m² for women (BRAY 1987).

Table V.2 Comparison of different BMI values and ranges used to describe the nutritional status of elderly populations

BMI / BMI range	particularities	source / author
19-24 kg/m² (females) 20-25 kg/m² (males)	for adults, no age-differentiation	BRAY (1987)
24-29 kg/m²	≥ 65 years, no sex-differentiation	NATIONAL RESEARCH COUNCIL (1989) based on ANDRES et al. (1985)
18.5-30 kg/m²	"possibly relevant" for 60-69 years	WHO (1995) DE ONIS & HABICHT (1996)
20-30 kg/m²	no age- and sex-differentiation	DE GROOT et al. (1996)
18.5-30 kg/m²	no age- and sex-differentiation	REA et al. (1997)
< 27 kg/m²	no age- and sex-differentiation	VAILAS & NITZKE (1998)
24 kg/m² (males) 22 kg/m² (females)	≥ 65 years "desirable values"	DGE et al. (2000)

These ranges do not account for the age of the examinees and might therefore lead to inadequate overestimation of overweight. The NATIONAL RESEARCH COUNCIL of the USA (1989) suggests BMI values 24-29 kg/m² as reference range for the elderly (aged 65 years and more) based on data of ANDRES et al. (1985). Values below 24 kg/m² are interpreted as underweight or risk of malnutrition, values above 29 kg/m² as overweight for both sexes. In the Euronut SENECA study, portions of participants with BMI values below 20 kg/m² and above 30 kg/m² were classified as underweight and obese, respectively (DE GROOT et al. 1996). Some investigators used a BMI of 27 kg/m² as cut-off value (VAILAS & NITZKE 1998), or described portions below 18.5 kg/m² and above 30 kg/m² (REA et al. 1997). The latter cut-offs are those suggested by the WHO for adults. The WHO stated that these BMI cut-offs might

be relevant for the elderly, at least from 60-69 years, but whether different ones were more appropriate in individuals of 70 or more years of age was uncertain (WHO 1995, DE ONIS & HABICHT 1996). Finally, the DGE currently suggests 24 kg/m² for men and 22 kg/m² for women as desirable values, i.e. as reference values for the calculation of the basic metabolic rate for persons aged 65 years and more (DGE et al. 2000).

In this context, there is an ongoing discussion about the question which single BMI values or BMI ranges, respectively, are associated with the lowest mortality rate in the elderly, and the cliché "needs more research" is often emphasised. The relationship of body weight to mortality throughout the range of BMI has been described as being J-shaped, U-shaped, inverse, positive, and even absent (CASPER 1995, LANDI et al. 1999). According to CALLE et al. (1999), the majority of the vast literature examining the relation between body weight and mortality supports the hypothesis of a curve-linear relation (U-shaped curve), in which the risk is increased among both the very heavy and the very lean. Therefore, the proposed ranges by the SENECA-INVESTIGATORS (< 20 kg/m² and ≥ 30 kg/m²) were used for additional classification of BMI values in this thesis besides the preferred tabular presentation of cumulative prevalences as proposed by KUCZMARSKI et al. (1997). The latter has the essential advantage that percentages of the elderly between, below or above any given BMI can easily be calculated and used for comparisons.

In the following (table V.3), present data are related to the suggested reference values by the DGE (2000), compared with the those of the younger participants in the present project, the available data from previous studies on the elderly in different European regions (BURR & PHILLIPS 1984, DELARUE et al. 1994, PAOLISSO et al. 1995, DE GROOT et al. 1996, RAVAGLIA et al. 1997, REA et al. 1997, DEY et al. 1999), the data of HNANES III (KUCZMARSKI et al. 2000), and BMI was also compared with the data of younger voluntary elderly in Gießen, German (NEUHÄUSER-BERTOLD et al. 2000, not shown in table V.3).

The height differential observed in the two study parts (both men and women from Euskirchen were smaller than the nation-wide measured elderly study participants) are partly responsible for the higher BMI values found in the regional study part (table IV.3 and V.3). Interpretation of height alone as an indicator of the nutritional status of groups is difficult; it can be used to estimate past and chronic malnutrition rather than the present nutritional status but it also reflects genetically determined differences (FIDANZA 1991). As to this thesis, it is unknown if the elderly in the rural districts of Euskirchen were starving to a higher degree in their childhood around the First World War than their nation-wide peers, if their size is rather genetically determined, if they were subject to a higher degree of shrinkage, or if other determinative factors are responsible for the observed height differences.

Mean weights of both man and women in our project clearly exceed the suggested reference values by the DGE et al. (2000), whereas mean heights (national) are almost identical to them (table V.3). Accordingly mean BMI in our project exceed the DGE values about 1-3 units (males) and 3 units (females), respectively.

Compared to the data of the slightly younger participants (aged 75-80 years) of the Euronut SENECA follow-up study (table V.3), examinees in the regional study part were just above the lowest values of the wide ranges of height, weight, and BMI values assessed in the different regions of this European study (DE GROOT et al. 1996). Because of the higher values for height assessed in the national study part, these values are just in the middle of the height ranges of the SENECA study; whereas BMI values of the oldest men in the national study part are below those assessed in the SENECA study, and those of the corresponding women are also borderline values. Despite the fact that old Swedish men are taller, the data of our national study part are very similar to those assessed by DEY et al. (1999). Median BMI of the 487 voluntary, free-living elderly aged 60-80 years in Gießen, Germany, was 26 kg/m² for both men and women (NEUHÄUSER-BERTOLD et al. 2000), and thus only one unit lower than in our nation-wide study part, and one unit higher (men) respectively lower (women) than in our regional study part.

Data very similar to those of our participants in weight and BMI were suggested as references for persons aged 80+ years by the investigators of HNANES III (KUCZMARSKI et al. 2000). A total of 6,561 persons aged 60 years and older participated in their anthropometric measurements, including nearly 1,500 subjects aged 80 and older (maximum age was 106 years). For those countries that have no local data (or that lack the resources to develop them) EXPERT COMMITTEE convened by the WHO recommended the use of NHANES III data for comparisons between different population groups (WHO 1995). The findings of our examination suggest that the anthropometric data of NHANES III actually offer a suitable basis for comparisons in high aged German individuals.

In comparison with the younger elderly investigated in our project (table V.3), high aged participants were smaller and less heavy, with similar sex-dependent differences (i.e., male/female differential in height and weight) within the age groups: on average high aged men and women had 7-8 kg (national) and 10 kg (regional), respectively, less body weight than their younger peers and were 3 cm smaller. Only for men in the regional study the height difference was markedly higher (8 cm). Thus, mean BMI of the high aged participants was 1-3 units lower than that of the younger ones.

Table V.3 Comparison of body weight, height and BMI assessed in different studies													
Author/region		**Weight [kg]**				**Height [cm]**				**BMI [kg/m²]**			
Age group	**sex**	**n**	**mean**	**sd**		**n**	**mean**	**sd**		**n**	**mean**	**sd**	
National study part													
≥ 85 years	m	57	71.6	9.4		77	169.1	7.7		54	25.0	3.1	
	w	141	62.8	14.1		181	158.5	6.8		136	25.1	5.2	
65-84 years	m	340	79.9	11.6		418	172.4	6.7		320	26.8	3.1	
	w	428	69.6	12.1		538	161.4	6.1		409	26.8	4.7	
Regional study part													
≥ 85 years	m	15	72.0	10.5		14	164.8	4.9		14	26.9	3.1	
	w	37	60.7	10.8		33	154.9	5.4		33	25.3	3.1	
65-84 years	m	103	82.3	11.7		103	172.2	6.2		103	27.7	3.3	
	w	148	70.3	11.0		152	158.3	5.9		148	28.1	4.3	
DGE (2000) ≥ 65 years													
(Reference values for	m		68.0				169.0				24.0		
calculation of BMR)	w		55.0				158.0				22.0		
KUCZMARSKI (2000)				SE								SE	
NHANES III	m	700	71.8	0.74		–	–	–		699	25.0	0.22	
≥ 80 years	w	790	60.5	0.68		–	–	–		788	25.2	0.26	
DEY et al. (1999)													
Sweden	m	203	72.9	–		203	172.0	–		203	24.5	–	
79 years	w	314	63.9	–		314	158.0	–		314	25.7	–	
RAVAGLIA et al. (1997)													
Italy	m	24	58.6	7.6		24	160.0	5.0	*	24	22.8	3.2	*
90-99 years	w	33	48.8	7.2		33	143.0	7.0		33	23.7	3.7	
REA et al. (1997)													
Northern Ireland	m	70	63.9	9.1		49	161.7	5.9		49	24.3	3.0	
≥ 90 years	w	168	54.4	11.9		102	150.1	6.7		102	24.6	5.4	
PAOLISSO et al. (1995)													
Italy	m	11	70.1	1.8		11	177.0	2.4		–	–	–	
75-100 years	w	24	64.5	0.7		24	173.0	2.0		–	–	–	
SENECA (1996)					#				#				#
'Minimum mean values'	m	67	71.7	10.7	B	13	162.0	6.0	P	67	26.0	3.3	B
75-80 years	w	79	59.7	9.6	P	73	150.0	5.0	P	56	25.1	4.9	DK
'Maximum mean values'	m	49	78.4	13.5	F	53	172.0	6.0	DK	49	27.4	4.0	F
75-80 years	w	66	70.8	10.9	NL	66	158.0	6.0	DK	58	28.6	5.0	B
BURR & PHILLIPS (1984)										n	P5	median	P95
Great Britain	m	–	–	–		–	–	–		41	17.9	23.1	28.4
≥ 85 years	w	–	–	–		–	–	–		88	16.7	23.6	30.5

* calculated from knee height; # region concerned in the SENECA study ; SE = standard error; BMR = basic metabolic rate

Cross-sectional analyses of body weight suggest that mean body weight increases with age (in high-income countries) until late middle age, then plateaus and decreases for higher aged persons (FERRO-LUZZI et al. 2000). Weight gains in males tend to plateau at around 65 years of age and generally declines thereafter; in females, however, the weight increases are frequently greater and the plateau occurs about 10 years later than (WHO 1995). Body weight varies also within a given individual during ageing caused by a reduction of body water con-

tent, decline in muscle cell mass, and in cell mass in general, which is more pronounced in men (WHO 1995).

Decline in height with age has been noted in both cross-sectional and longitudinal studies throughout the world (CHUMLEA & BAUMGARTNER 1989, REA et al. 1997, SORKIN et al. 1999). Thereby, longitudinal studies offer a more reliable interpretation, because cross sectional study of height development can be confounded by secular trends towards increased stature (CHUMLEA & BAUMGARTNER 1989). The rate of decline by longitudinal data is 1-2 cm/decade and more rapid at older ages. Stature is known to decrease with age due to a shrinkage of the spinal vertebrae, loss of muscle tone, postural changes, and due to kyphosis. According to longitudinal analyses of the Baltimore Longitudinal Study of Aging (SORKIN et al. 1999), women loose height more rapidly than men do (-0.161 *vs.* -0.091 cm/year).

Like weight, average BMI in industrialised populations tends to increase in middle age and stabilises somewhat earlier in males than in females. In males, plateau may begin at 50-60 years or even at 70 years of age; in women it starts at 70 years or later. Both sexes generally show a decrease in average BMI after 70-75 years of age (WHO 1995). This decrease in BMI, however, might be masked by the decline in height. As BMI is inversely proportional to the square of height, even a small change in height may have a large effect on the BMI (SORKIN et al. 1999). For example, in the Baltimore Longitudinal Study of Aging, assuming constant weight, height loss examined with age would have accounted for an "artificial" increase in BMI of approximately 0.7 kg/m² (males) and 1.6 kg/m² (females) by age 70 years that increased to 1.4 and 2.6 kg/m², respectively, by age 80 years. Thus, a given BMI could have different meanings for adults at different ages, even if no other changes in body composition occurred with ageing. However, because there are other aspects of body composition that change with age (loss of lean body mass and shifts in body fat distribution), a simple adjustment of the observed BMI for height loss would not make BMI an age-invariant measure (SORKIN et al. 1999).

Prevalence of low and high BMI values

Percentages of low BMI values (20 kg/m²) presumably indicating a great risk of malnutrition did not occur in the regional part of our project our study, but amounted to 6-10% in the national study part (table IV.4). 4% of both sexes (i.e., altogether eight individuals) in the national study part had BMI values below the cut-off value suggested by the WHO for adults (18.5 kg/m²). Thus, underweight respectively malnutrition does obviously not play a decisive role for the study participants.

On the opposite, BMI values of up to 14% were classified as high (≥ 30 kg/m²). Thus, the sample of the regional study part included a higher portion of persons who can be classified as "well-nourished" or over-weighted (obese), respectively, than underweight. For compari-

son, in the Euronut SENECA follow-up study BMI was low in 0-6% of men and in 0-11% of women, whereas it was high in 4-23% of men and 7-38% of women (DE GROOT et al. 1996). Data of our participants are thus within these wide ranges. For subjects aged 70-79 years in the German Bundesgesundheitssurvey, higher prevalences of obesity have been described (around 18% of men and 35% of women) (BERGMANN & MENSINK 1999). Obesity was also more frequent among the younger elderly participants of the present project (national: 13% of men and 22% of women *vs.* regional: 24% of men and 26% of women). This finding goes in agreement with the described decline of BMI with increasing age (see above).

Although there might be a selective mortality of over-weighted persons in younger ages (RAJALA et al. 1990), there is evidence that the prevalence of obesity (defined as BMI ≥ 30 kg/m²) is rising world-wide, in elderly population as well (KOTZ et al. 1999). The mean values for both body weight and BMI examined in NHANES III (time period 1988-1994) are greater than those examined in both HNANES II (1976-1980) and HNANES I (1971-1974) for elderly age groups, which were presented in 1984 by FRISANCHO. This increase in weight and BMI goes in agreement with other international studies (KUCZMARSKI et al. 2000, DEY et al. 2001). According to the data of NHANES III, the prevalence was 8% and 15% among the high aged American men and women, respectively. These values are similar to those of our study, and are in also agreement with the finding that for almost all ages, the prevalence of obesity in women is higher than in men (KOTZ et al. 1999).

As already mentioned, interpretation of these prevalences is difficult. Yet, the concentration on the association of BMI with mortality only in literature raises the question if decreasing mortality (and thus lengthening lifetime) is the only point at issue concerning elderly populations. With regard to the aim “add life to years” (WHO 1985) which also stresses the meaning of the quality of life, it might be preferable to base desirable weights on other outcomes, such as disability or risk of disease (DIEHR et al. 1998). Weight is a modifiable risk factor which may benefit not only the risk of mortality, but the risk of morbidity as well (CORNONI-HUNTLEY et al. 1991). In 1994, in a secondary data analysis of the NHANES I follow-up participants (65-86 years) the relationship between BMI and functional capabilities have been investigated. This relationship fitted roughly the same U-shaped curve that had previously described the relationship between mortality and BMI: the greater the extreme of BMI (either higher or lower), the greater the risk for functional impairment (GALANOS et al. 1994).

With regard to public health goals, the question still remains unanswered if heavy (obese) older adults – this concerns up to 14% of our high aged examinees – should be counselled about their weight. If risks and benefits of obesity average out within individuals, there seems to be no reason to do so, provided no special diseases demand counselling approaches tailored to the individual (DIEHR et al. 1998). For example, assumed no risk factors for nutritional

diseases exist, with regard to the risk of osteoporosis in older women a moderate high BMI (up to 27-28 kg/m²) is acceptable or even more desirable, respectively, than (too) low BMI values, because of increased biological availability of estrogens and stronger mechanical strain on the bones (ZITTERMANN 1999, GILLETTE-GUYONNET et al. 2000), and a protective effect against hip fractures due to local energy absorption in case of fall (BERNSTEIN et al. 1999).

Risk groups (national study part)

As already described, no obviously malnourished persons were found in the study sample. Therefore only few associations of basic characteristics with BMI values should be expected. As regards male participants, physical disorders like swallow difficulties and loss of appetite showed associations with BMI values, while for high aged women self-perceived health, relative physical activity, difficulties in chewing, and self-reported financial restrictions showed comparable associations (table IV.5). These findings suggest that the importance of selected topics which are often associated with malnutrition might be gender-dependent.

The economical situation has been described to have a very strong impact for the quality of nutrition (MCGANDY et al. 1986, SCHLETTWEIN-GSELL et al. 1999). Previous research has stressed the strong impact of socio-economic problems and food budgeting problems, respectively, with inadequate nutrient intake and malnutrition (MUNRO et al. 1987, RYAN & BOWER 1989, BIANCHETTI et al. 1990, HELMERT et al. 1997). Somehow controversial to these findings, whereas women with insufficient money had lower BMI values indeed, women with self-reported financial restrictions did not have lower but higher BMI values in our study. However, this might indicate rather unfavourable food choices (low intake of vegetable, fruits, and whole-grain bread and high intake of fatty foods) resulting in high energy (macronutrient) intake as previously reported for elderly of lower socio-economic groups (HORWATH 1989a, VAN ROSSUM et al. 2000).

As known from literature (see above), both very low and high BMI values are significantly related to functional status (GALANOS et al. 1994). Extreme BMI values have only exceptionally been revealed by our analyses, and there were no significant associations between BMI and mobility index. However, in contrast to men, women with a high BMI actually felt significantly less healthy and also less active than people of the same age. Indeed, there is some evidence in older women that elevated BMI is associated with impairment of health, disability, and reduced quality of life (FERRO-LUZZI et al. 2000), the importance of self-perceived health status has already been intensively discussed above.

Elderly people (especially men) living alone have often been considered to be at nutritional risk because of lonely meals, irregularly consume of (warm) meals or skipping of meals, restricted variety, low food intake, and poorer dietary quality (DAVIS et al. 1988, HORWATH 1989,

MCINTOSH et al.1989, WALKER & BEAUCHENE 1991, DAVIS et al. 2000) which could result in reduced nutritional status. In contrast to this findings, other analysts did not found any negative effect on the nutritional status by living alone (PEARSON et al. 1998, RYAN & BOWER 1989), this applies also to the Euronut SENECA investigators (SCHLETTWEIN-GSELL et al. 1999). In our investigation, no significant effect on BMI was found, not neither for men.

Comparison of self-reported height, weight, and BMI with measured data

As summarised in table V.4, there are a number of reasons for errors in self-reported data of height and weight. Most of the surveys investigating the associations between self-reports of body weight and height and measured values insofar agree that self-reports of height and weight lead more or less to an underestimation of relative weight (BMI) because of consistently overestimation of body height and underestimation of weight. Misclassification could occur when using relative weight (calculated by self-reports of height and weight) as a categorical variable, whereas using it as continuous variable would have little effect on analyses (STEWART et al. 1987, VAILAS & NITZKE 1998, ROWLAND 1990).

The misreporting of height appears to have a physiological basis due to the effect of age and gravity: older people possibly report their heights as they remember them from an earlier age before the shrinkage (by osteoporosis) occurred (ROWLAND 1990), especially since for the "average person" normally a certain time has elapsed since body height (and weight) was measured.

Another point of concern is the so-called "end-digit preference". Subjects often prefer to round weight and height reports to the nearest half or full kg or cm, respectively. This might explain to a certain degree the differences between the self-reported and the (mostly) more detailed measured values (PLANKEY et al. 1997). In this thesis, self-reports of height were assessed to the nearest cm only, which might have had a small enhancing effect on the reporting error.

It is supposed that individuals in the Western societies tend to report values of weight and height that they believe conform with current norms (KUSKOWSKA-WOLK et al. 1989), resulting in an overestimation of size by small and thin subjects and in an underestimation of size by tall and heavy subjects ("flat slope syndrome"). It is unknown in how far the present generation of oldest old individuals is subject to such cultural influences, but there are hints that this topic is less pronounced in the present study group (see below). That means, the importance of appearance seems to decrease with age (LAHMANN & KUMANYIKA 1999).

Table V.4 Possible sources of error in self-reports of body height and weight
♦ random error
♦ using self-reports as categorical variables (STEWART et al. 1987, ROWLAND 1990)
♦ low health consciousness
♦ long time period since the last measurement
♦ no awareness of shrinkage (body height)
♦ end-digit preference (PLANKEY et al. 1997)
♦ desire for going conform with current norms / "flat slope syndrome" (KUSKOWSKA-WOLK et al. 1989)

None of the cited papers used the approach suggested by BLAND & ALTMAN (1986) for comparison of measurement methods in spite of its various advantages, e.g., as against the correlation coefficient which is a measure of the strength of the relationship between two variables, but not of the agreement between them. BLAND & ALTMAN (1995) doubt whether any (medical) measurements are made without any error whatsoever, even so called "gold standards". In our project, measurements of both height and weight could be taken as "gold standards", of course, but there also some limitations (cp. chapter III.3): measurements were made at various times of the day and therefore reflect diurnal variations, body weight was measured with present bathroom scales in the participants' households in the national study part, and weight of the light clothes was not deducted. These limitations are not particular for this thesis but also equal for most of the published papers where alike measurements are presented as valid and reliable.

In this thesis, judged by the mean difference, self-reported height and weight showed a high degree of accuracy, except for the values of height in the regional study part (4-6 cm), without hints for sex-dependent differences (table IV.6). Altogether, mean relative errors of self-reported height were higher than those of self-reported weight. This finding goes in agreement with previous US American data: self-reported weight was somewhat more valid than self-reported height in a study-group of 131 subjects aged 62-92 years who participated in congregate and home delivered meal programs in a rural Wisconsin county (VAILAS & NITZKE 1998) and also in an epidemiological study on 7,455 adults including 365 subjects aged 70-79 years (NIETO-GARCÍA et al. 1990).

As shown in table V.5, mean error in self-reported height was higher for the oldest participants than for younger elderly of this study. On the other side, at least as regards weight data in the regional study part, younger elderly underestimated their weight to a higher ex-

tend than the high aged subjects. This finding probably indicates that high aged subjects are less likely than younger elderly to present themselves conform with current weight norms.

All these data possibly support the cited findings of ROWLAND (1990): high aged subjects possibly report their heights as they remember them from an earlier age unless their height has decreased. Moreover, it is much more usual to measure one's body weight from time to time than body height.

Table V.5 Mean differences (measurements - self-reports) of weight, height, and BMI in comparison with younger elderly of both study parts

Study part / parameter	men					women				
	85+ y		65-84 y			85+ y		65-84 y		
	mean	sd	mean	sd	p	mean	sd	mean	sd	p
national										
weight difference [kg]	1.1	1.8	0.9	2.3	0.555	0.7	2.1	0.7	1.7	0.932
height difference [cm]	-1.6	2.5	-0.7	1.8	0.014	-1.6	2.9	-1.0	2.0	0.038
BMI difference [kg/m²]	0.7	1.0	0.5	0.9	0.230	0.7	1.2	0.6	1.0	0.589
regional										
weight difference [kg]	0.0	2.2	1.9	2.2	0.005	0.4	2.9	2.0	2.8	0.005
height difference [cm]	-4.0	3.1	-2.2	2.3	0.034	-6.0	3.7	-3.6	2.8	0.034
BMI difference [kg/m²]	1.7	1.1	1.4	1.0	0.419	1.8	1.5	1.9	1.4	0.419

p sex: Student's t-test for independent variables (for age-dependent differences)

In our survey, mean BMI values that were based on self-reports were 1-2 units lower than corresponding values calculated by measurements. As shown in the BLAND & ALTMAN-plots (figures IV.1-IV.3), also extreme misclassifications (= more than two standard deviations) existed for individuals of both sexes in the national study part. These extremes were not excluded from the calculation of mean errors, thus strengthening in this way over-estimations of height and under-estimations of weight, and resulting BMI. The scattering of values observed in the plots gave no hind for a "flat slope syndrome" in the very old elderly.

The findings of our survey support the use of self-reports of weight as a reliable data source in high aged population groups on group level. The use of self-reported height data is somehow more restricted and calls for a certain correction factor (95% limits of agreement were rather poor). When using BMI by self-reported data, it has be to corrected (raised) by 1-2 units. This is especially important when BMI ranges are used for classification of elderly population groups.

Unintended weight loss

Controversial findings are described concerning the association between weight, weight loss, weight gain, or weight cycling, respectively, and risk of mortality in longitudinal studies. Yet,

these studies notably differ in periods of follow-up, consideration of associated variables, rules for initial exclusion of subjects from the study (e.g., smoker, concurrent illness, etc.) and techniques of assessing data (ANDRES 1985, REYNOLDS et al. 1999). On the whole, (unintentional) in the elderly weight loss more than weight gain seems to pose considerable risk for decreased survival (RAJALA et al. 1990, WALLACE et al. 1995, STEVENS et al. 1998, PAYETTE et al. 2000, DE GROOT et al. 2002). Information about recent unintended weight loss points to considerable nutritional problems, whereby extent and rate of weight losses are meaningful.

Irrespective of the design difference between the two study parts of our project concerning the duration of the requested time period of weight losses or changes (nation-wide: past twelve months, regional: past six months), for both can be concluded that unintended weight loss indicating nutritional risk refers only to a minor part of the very old participants (9-13%) (figures IV.4-IV.5). This rises the question if this “minor part” is a normal size in elderly populations.

In literature, unintended weight losses are known among elderly patients (VOLKERT 1990, WILLSON et al. 1998) and institutionalised elderly (DWYER et al. 1987, SILVER et al. 1988, MORLEY & KRAENZLE 1994), but also among (younger) free-living elderly (WALLACE et al. 1995, VISSER et al. 1998). However, comparisons with previous studies that investigated the health implications of (involuntary) weight loss in older persons are not only restricted because younger age groups were included, but also because different cut-off points were used, indicating that the parameters for defining clinically important weight changes have not been well described. The range of weight loss cited in the literature as clinically important includes 2 kg a year, 4.5 kg over two years, 5% of initial body weight over 6-12 months, 7.5% over six months and 10% over six months (WALLACE et al. 1991). In the check-list of the NUTRITION SCREENING INITIATIVE weight loss of 10 pounds (= 4,53 kg) or more in the past six months is considered to indicate nutritional risk and hence asked for (QUINN 1997). Among 288 frail elderly aged 60-94 years, weight loss ≥ 5 kg was an important predictor of early institutionalisation after controlling for social network, health, and functional status (PAYETTE et al. 2000). A prospective cohort study of 247 community-dwelling male veterans aged 65 years and older indicated a prevalence of 13% involuntary weight loss greater than 4% of body weight. This defined size of weight loss appeared to be an independent predictor of increased mortality (WALLACE et al. 1995).

Actually, for many high aged elderly it is not as easy as it sounds to realise past weight loss. For example, in the Bethanien study 10% of the participants aged 75 years and older were not able to give any information to this topic at all, another 40% could not specify the extend of recent weight loss (VOLKERT 1997). Moreover, people who are especially health conscious (body conscious) and who frequently have doctor’s consultations or hospital stays may be

better aware of their current body weight as well as of recent changes in weight than the "average person" for whom a greater time may have elapsed since body weight was measured. An unintended weight loss in the range of 5 kg initial body weight as inquired in this project seems to be a perceptible size, even for persons with lack of interest in their health. To our purpose, it would also have been sufficient if the participants clearly realised any marked weight loss by their own, even if they could not figure it at exactly 5 kg.

In the SENECA follow-up study, a higher rate (16%) of the participants aged 75-80 years had experienced a weight loss of 5 kg or more than the high aged subjects in our project (DE GROOT et al. 1996). In contrast to these findings, less of the younger elderly in our project (national study part) notified weight losses (9%), and moreover, these were intended to a greater extent (29%). Thus, weight losses of only 6% of the whole group of people aged 65-85 years were not intended. In the younger age group of the regional study part, 8% of participants were aware of recent weight losses, and 39% of these were not intended (= 3% of the whole age group). Thus, the prevalence of unintended weight loss was apparently higher among the very old than among the younger elderly.

In conclusion, a comparatively low proportion of very old subjects in this project were affected by a marked unintended weight loss in recent time. Those persons concerned of weight loss demand special attention. On the whole, however, our data (*cp.* chapter IV) confirm that the examined population was apparently very well, which goes in agreement with their BMI data.

Anthropometric data of the upper arm

Anthropometry of the upper arm is a rapid, inexpensive and non-invasive method of obtaining information on the amount and localisation of body muscle and fat, provided that the assessment of measurements has been well trained. However, as the WORLD HEALTH ORGANIZATION realised in 1995, there is a considerable lack of understanding of the functional and health-related implications of anthropometric indicators in older people (WHO 1995, DE ONIS & HABICHT 1996). Moreover, since in elderly people the body fat distribution changes from superficial to internal body regions adequate estimation of body composition is restricted when anthropometric models based on younger adults are applied. This concerns both arm muscle mass and arm fat area; anthropometric measurements of subcutaneous fat do neither reflect the progressive redistribution of fat from the extremities to the visceral area nor the replacement of muscle tissue by intra-muscular fat. The latter is known by data derived from magnetic resonance imaging and computerised tomographic scanning. This loss of muscle mass (and strength) by ageing is called sarcopenia (ROSENBERG 1989, EVANS 1995, NAIR 2000). Sarcopenia is an important consequence of ageing, which is associated with loss of strength, decreased protein reserves, and increased disability. An estimated 50% of those

subjects over age 80 years are concerned (ROUBENOFF 2000). It is a component of normative ageing which may contribute to disability in terms of more falls and limited ambulation (SOLOMONS 2000).

Intra-abdominal fat (IAF) accumulates more rapidly than total fat, and this is true even in the absence of obesity. The simultaneous loss of lean body mass is more pronounced in peripheral than in central tissues. There is increasing evidence that the accumulation of IAF (without obesity) plays a major role in the metabolic changes observed with ageing, and particularly in the pathogenesis of insulin resistance, which is the basis of type II diabetes and which is linked to cardiovascular diseases (BEAUFRÈRE & MORIO 2000).

Thus, the use of anthropometry may well result in underestimation of body fat (WHO 1995), but also in overestimation of the calculated muscle area. Additionally, the accuracy and reproducibility of skinfold measurements can be reduced because of lax skin, atrophy of subcutaneous adipocytes contributing to increased tissue compression, dehydration or oedema (DELARUE et al. 1994, OMRAN & MORLEY 2000). In the present study, by recruitment of apparently healthy subjects and intensive attention to measurement techniques (intensive training of the interviewers) these latter difficulties were eliminated as far as possible.

In the following, anthropometric values of the very olds assessed in this thesis are compared with the data of the younger elderly in our study project, with the available data from previous European and American studies on the elderly, and with the proposed frame of reference values in the form of percentiles for mid-upper arm circumference (AC), arm muscle circumference (AMC), arm muscle area (AMA), and triceps skinfold thickness (TSF) for elderly people in Britain by BURR & PHILLIPS (1984) who analysed the data of 1,500 persons aged 65 years and older assessed in South Wales, United Kingdom (table V.6). However, this cited study sample included a small proportion of institutionalised persons: residents of old people's homes (4%) and long-stay hospital wards (3%). Moreover, BURR & PHILLIPS emphasise in their discussion in agreement with the WHO EXPERT COMMITTEE ON PHYSICAL STATUS (WHO 1995) that geographical differences must be borne in mind when individuals are compared against published norms. Alike for BMI, the WHO suggests the use of NHANES III data for comparisons if local reference data are not available, therefore these data are additionally presented in this thesis.

As shown in table V.6, for each measured anthropometric indicator (TSH and AC) and therefrom calculated indicators (AMC, AMA, corrected or bone-free arm muscle area [CAMA], and arm fat area [AFA]), values were lower for persons aged 85 years and older than for the younger participants of our project. However, these differences were significant only for TSH, AC and AFA between women of the two age groups and for AC between corresponding men.

Mean TSF value of the very old women in our study was comparable to that presented by DELARUE et al. (1994) of a French population aged 80 years and older, mean TSF value of men in our study was slightly higher than that of the French men in this study. Compared to the data of an American sample of 424 independently living 75-100 years old individuals, mean TSF value of men was similar to ours; for women KUBENA et al. (1991) observed about 3 mm more we did. Almost the same applies for the data of NHANES III (KUCZMARSKI et al. 2000).

In a community cross-sectional study in Belfast, Northern Ireland (REA et al. 1997) of people aged 90-94 years old no sex-dependent difference was found: 12.3 ± 4.1 mm (males) and 12.5 ± 4.5 mm (females) (not shown in table V.6). These data correspond only to those measured for high aged men in our study, and the missing sex-dependent difference in this Irish study seems be to also in contrast to the findings of the Euronut SENECA follow-up (DE GROOT et al. 1996). However, considering the age difference between the compared study samples, this difference goes in accordance with previous findings, since a decline in TSF values with advancing age was more marked in women than in men in the study of BURR & PHILIPS (1984); this finding also agrees with the data of the aforementioned elderly French population (DELARUE et al. 1994). Female bodies normally consist to greater parts of fat mass than male bodies, and thus women have thicker triceps skinfolds than men. However, if the decline in TSF is greater with age in women than in men, the sex-specific difference in TSF might be terminated to a certain very advanced age, thus explaining the results of REA et al. (1997). As far as our study population is concerned, however, sex-specific differences clearly exist in our group of 85-95 years old subjects.

The TSF values (median as well as mean values) of the very old men in our study were within the wide range of median TSF values assessed in the SENECA project of persons aged 75-80 years, whereas the corresponding data for women in our study were below the lowest values assessed in that project. Here again, the results of our study seem to confirm the sex-specific differences in the decline of TSF with age.

Means of mid-upper arm circumferences assessed in the regional part of our project were very similar to those assessed in other European studies for persons aged 80+ or 75-80 years, with ranges as follows: 28-30 mm (males) and 27-31 mm (females). Thus, AC was the anthropometric variable with the least sex-dependent differences between the quoted studies. Compared to the data of RAVAGLIA et al. (1997) based on a sample of North-Italian nonagenarians our data were clearly higher, and in comparison to the reference values supposed by BURR & PHILLIPS (1984) our data exceeded their 95th percentile.

Similar findings were made with respect to the arm muscle circumferences. Mean AMC by RAVAGLIA et al. (1997) and the median by BURR & PHILLIPS (1984) were almost identically low: 20-21 cm (males) and 18 cm (females), whereas our data resembled better those as-

sessed by DELARUE et al. (1994) for French elderly: 24.9 cm for men and 22.4 cm for women. Both average AC and AMC values in our project were nearly identical to those values assessed by KUBENA et al. (1991) and in NHANES III (KUCZMARSKI et al. 2000).

Comparison of calculated arm-muscle areas showed alike results: our data were remarkably higher than those assessed by both RAVAGLIA ET AL. (1997) and BURR & PHILLIPS (1984). The prognostic value of the corrected arm-muscle area has been described by BANNERMAN & GHOSH (2000) for patients referred for gastrostomy. Individuals with a CAMA of below 16.0 cm² (males) respectively below 16.9 cm² (females) had a significantly poorer clinical course. Further analysis showed increased risk of mortality also for patients with CAMA of below 21.4 cm² in males and below 21.6 cm² in females (BANNERMAN & GHOSH 2000). Our data clearly exceeded these critical prognostic values, comparable data of healthy high aged subjects are not available.

Arm fat area could only be compared to the data by RAVAGLIA ET AL (1997). However, analogous to the differences between our study sample and the nonagenarians in this study in all other anthropometric variables, differences in arm fat area were strikingly high, too: mean arm fat area among the very old Italians were about 12 cm² lower (both sexes) than among our participants.

Summarising, the anthropometric measurements of the upper arm indicate that our study sample consisted of rather “well-nourished” high aged persons. This conclusion goes in agreement with the already presented findings by the data of weight and BMI. Assessed by anthropometric values, no signs for malnutrition as there are low muscle mass indicating low somatic protein content or insufficient fat reserves were found concerning the whole group of very old elderly in our project, keeping in mind the restrictions for the interpretation of anthropometric markers in the elderly broadly discussed in this chapter. Our anthropometric data cannot be considered as reference values, because the sample size was too small. According to the WHO, at least 200 subjects of the each age group and gender need to be measured to get reliable reference ranges (WHO 1995). Nevertheless, our data provide useful information for further measurements in high aged individuals that should include measurements of body components to elucidate normal body composition and changes with age (HEYMSFIELD ET AL. 2000). The described data are partly comparable to those assessed in recently run local European and American studies and also to the American data of HNANES III (recommended by the WHO for comparable purposes), but they clearly exceed those former values published by BURR & PHILLIPS in 1984.

Table V.6 Comparison of arm-anthropometry assessed in different European and American studies

Author / region Age-group	sex	n	TSH [mm]: Triceps skinfold thickness mean	 SD	AC [cm]: Mid upper arm circumference mean	 SD	AMC [cm]:Arm muscle circumference mean	 SD	AMA [cm²]: Arm muscle area mean	 SD	CAMA [cm²]: corr. arm-muscle area mean	 SD	AFA [cm²]: Arm fat area mean	 SD
Regional study part														
≥ 85 years	men	14	12.7	4.6	28.9	3.3	25.1	2.3	50.4	9.0	40.4	9.0	17.5	8.0
	women	37	15.8	5.2	28.1	5.2	23.2	4.6	44.3	18.2	37.8	18.2	20.6	8.6
65-84 years	men	103	15.7	6.7	31.4	3.9	26.5	3.7	56.9	17.0	46.9	17.0	22.9	10.7
	women	144	21.9	7.3	31.4	5.0	24.1	4.3	47.8	17.8	41.3	17.8	30.5	11.6
DELARUE et al. (1994) France														
	men	62	9.7	3.2	28.0	2.4	24.9	1.3	–	–	–	–	–	–
≥ 80 years	women	62	17.1	6.2	27.8	3.6	22.4	2.3	–	–	–	–	–	–
RAVAGLIA et al. (1997) Italy														
	men	24	6.8	2.8	22.1	2.6	20.0	1.9	32.0	5.9	–	–	6.1	2.3
90-99 years	women	33	10.7	5.2	20.9	3.1	18.3	2.2	26.8	7.0	–	–	8.3	4.9
BURR & PHILLIPS (1984)			P5 / median / P95		P5 / median / P95		P5 / median / P95		P5 / median / P95					
United Kingdom	men	31	3.4 / 6.5 / 12.2		18.9 / 23.0 / 27.1		17.2 / 20.8 / 24.4		22.7 / 34.7 / 46.7		–	–	–	–
≥ 85 years	women	75	6.0 / 11.5 / 21.8		16.4 / 22.1 / 27.8		14.1 / 18.2 / 22.3		14.3 / 26.9 / 39.5		–	–	–	–
SENECA (1996)			n / median / #		n / mean / SD / #									
'Minimum mean' 75-80 years	men		62 / 8.9 / B		32 / 28.2 / 2.7 / E		–	–	–	–	–	–	–	–
	women		45 / 17.2 / F		66 / 27.3 / 3.1 / I		–	–	–	–	–	–	–	–
'Maximum mean' 75-80 years	men		49 / 19.0 / DK		52 / 30.4 / 2.5 / NL		–	–	–	–	–	–	–	–
	women		52 / 25.6 / DK		58 / 30.8 / 3.5 / B		–	–	–	–	–	–	–	–
KUBENA (1991)			n / mean / SE		n / mean / SE		n / mean / SE							
75-100 years	men		40 / 13.5 / 1.0		41 / 28.9 / 0.6		41 / 24.8 / 0.6		–	–	–	–	–	–
	women		87 / 19.2 / 0.8		91 / 28.0 / 0.4		87 / 21.9 / 0.4		–	–	–	–	–	–
NHANES III KUCZMARSKI et al. (2000)														
	men		641	12.0	0.28	642	29.5	0.19	639	25.7	0.16	–	–	–	–	–	–
≥ 80 years	women		705	18.6	0.42	712	28.5	0.25	703	22.7	0.16	–	–	–	–	–	–

region concerned in the Euronut SENECA study; SE standard error

Energy and nutrient intake

Methodological problems

Methods traditionally used in the collection and analysis of nutrient intake data and dietary patterns pose a variety of problems. No method has ever been devised for collecting completely reliable and comprehensive dietary information from members of the general public (McCormack 1997). Limitations involving validity, reliability, inter- and intra-individual variability, sampling techniques, data processing, and interpretation of results have been evident (St. Jeor et al. 1983). In selecting a method for a dietary survey not only the target group but also the purpose of the study and some practical issues, such as the availability of skilled personnel, computer facilities and financial resources have to be taken into consideration (van Staveren et al. 1994). Hence, there is no overall "ideal" method but the way of getting dietary intake data has to be defined for each specific study (Wahrburg & Bender 1985).

In our study, sampling techniques and data processing were highly standardised, intensively supervised and controlled, and the interviewer of both parts of the project were schooled for topics. This is very important, because lack of motivation can be a potential source of error in both subjects and interviewers. It is critical that the interviewers who introduce the study to the subjects be enthusiastic about the study and able to convey this enthusiasm to the participants (Buzzard 1998).

In contrast to retrospective methods (like 24 hour recalls or food frequencies), the estimated dietary record used in this study profits by being independent from a participants memory. As confirmed by the high rate of memory problems in our population (cp. table IV.2), this aspect becomes very important in high-aged subjects (van Staveren et al. 1994). In contrast to weighed dietary records, the use of estimated dietary records is much less complicated and thus enhances the co-operation of participants. Additionally, the estimated record has less influence on nutritional habits (Dwyer 1994, Nelson & Bingham 1998).

There is an extensive literature investigating the variability of nutrient intake, and also the number of days required at various level of precision for various nutrients in different populations (Buzzard 1998). The number of days of food intake data needed to estimate "true" average intakes has found to be smaller for analysis on group levels than for those on individual levels (Basiotis et al. 1987). Besides, the degree of random variation differs according to nutrient (Guthrie & Crocetti 1985). Total energy (caloric) intake is quite well regulated by physiologic mechanisms and thus has the least day-to-day variation among nutrients. For macronutrients, because of their large contribution to total caloric intake, there is a somewhat constrained possibility for large degrees of variation. As micronutrients tend to be concentrated in certain foods, intake can be very low or very high, depending on food choices for that day (Willett 1998). Especially for vitamin A, day-to-day variability is known to be substantially high (Basiotis et al. 1987). Several investigators have found three days to be an

acceptable, e.g., practical and feasible compromise in a given situation with limited resources (FREUDENHEIM et al. 1987, LAMBE et al. 2000). The use of either three random-day or three consecutive-day records seems to be acceptable for describing large groups (LARKIN et al. 1991). The latter was used in this project, obeying to the known effect that the intake of energy and nutrients on weekdays has found to be different from the intake on weekends (WINKLER et al. 1991), especially on Sundays (MAISEY et al. 1995), by fixing the record period Sunday to Tuesday.

The effect of "atypical" days in dietary records, which means intakes "less-than-usual" or "more-than-usual" has also been examined (CRAIG et al. 2000). The most frequent reasons found for "atypical" intake as there were vacation, travel, dining-out, celebrations for "more-than-usual" intake and acute illness for "less-than-usual" intake were mostly eliminated in our study because participants should not keep the records in such unusual circumstances (cp. chapter III.4.1). The second main reason for intake "less-than-usual", keeping the record itself (CRAIG et al. 2000), is a well known main problem of dietary records which cannot be totally excluded. Besides, the accuracy of self-reported intakes varies considerably among individuals, e.g., a number of studies have shown that obese individuals tend to underreport (energy) intake to a greater extent than lean individuals (BUZZARD 1998, LÜHRMANN et al. 1999, ZHANG et al. 2000), and show lower levels of education (LÜHRMANN 2001). However, nutrient intakes expressed as a percentage of total energy intake have not been found to be biased, even when energy intake itself was underreported (BUZZARD 1998, LÜHRMANN 2001).

In our project, regional data was obtained from may to January, national data from May-June. This could have resulted in a "seasonal bias". However, it has been claimed that nutrient intake remains remarkably consistent from one week to the next (ST. JEOR et al. 1983). In addition, since there is a great variety of available foods all over the year in industrialised societies the sources of nutrients vary but the overall intake apparently does not significantly change, so seasons make a relatively small contribution to variation in nutrient intake (VAN STAVEREN 1986).

The intake of nutrient supplements was not analysed for this thesis. As reported elsewhere, 20% of the all participants aged 65 years and older in the regional study part reported to use supplements (above all magnesium, calcium, vitamin E, and multivitamins), but less of the high aged participants (JUNK et al. 2000, STEHLE et al. 2000). In agreement with previous findings, the use of supplements was found to be not nutrition oriented (RANNO et al. 1988, MCINTOSH et al. 1990, AMORIM CRUZ et al. 1995). Regular supplement users have on average a more nutrient rich dietary pattern with a higher vitamin and mineral content (MENSINK & STRÖBEL 1999). Consequently, findings concerning inadequate nutrient intake are not affected by omitting supplement intake.

To summarise, there are well known limitations in the use of dietary records in nutritional epidemiology. However, these restrictions are not specific to the present project and were controlled as far as possible. In large population studies as well as studies in the elderly different kinds of dietary records or dietary histories combined with food check lists have also been used and the detailed review of specific problems of dietary assessment given in this chapter confirms that the 3-day estimated records used in this project can provide an applicable description of the nutritional intake of the group of high aged participants.

Participation bias

As regards a possible participation bias, only for the characteristics “financial problems” (females) and “living status: alone” (males) statistically significant differences for found between participants and non-participants on dietary records in the national survey (table VIII.3). These two topics have often been cited as important risk factors for inadequate nutrient intake in the elderly. However, as has already been discussed in context with nutritional status (see above), in recent time there are hints that “living alone” does not adversely effect nutrient intake while the economical situation has a very strong impact for the quality of nutrition (RYAN & BOWER 1989, SCHLETTWEIN-GSELL et al. 1999). This result might indicate that participants (at least females) with complete dietary data represent a somehow selected group of the high aged elderly. It remains an important issue for ageing research to get data of those economically disadvantaged persons who are very difficult to approach.

Adequacy of dietary intake

Studies conducted to estimate the adequacy of dietary intake require the collection of food consumption data at the individual level of assessment. Classification of the adequacy of intakes is made by comparison with a reference value, usually based on recommended intakes or allowances. Recommended intakes of protein, minerals, and vitamins, however, are customarily set above the average requirement to cover the needs of almost all healthy people in the population. For many nutrients the recommended intake represents the average requirement plus two standard deviations, on the assumption that the individual requirements are normally distributed. Since the recommended intake is greater than the requirement of nearly all persons in the population, the prevalence of inadequacy is overestimated if the recommended level is used as the criterion of dietary adequacy. For this reason it has been customary to use cut-off points, often set at two thirds or three quarters of the recommended intake, to estimate the proportion of a population with inadequate intakes (SABRY 1988). Therefore, in this thesis proportions below and above cut-off points (1/2, 2/3, 1/1) are given besides the description of the average intake.

In the following, all analysed nutrients are discussed in detail for the national study part and afterwards compared to the data of the regional study part, to data in literature and to the data of younger elderly in this project. The intake of water (fluids) is described and judged in detail below.

National study part: energy intake

The median energy intake of the high aged men almost reached 100% of the recommended value, that of the old women was just above it (tables IV.8 and IV.9). Thus, energy intake of our population was just in the middle of the energy intake ranges of (younger) European elderly reported in the Euronut SENECA follow-up. There, mean energy intake reached from 7.9-12.1 MJ (males) and 6.3-10.2 MJ (females) (MOREIRAS et al. 1996).

Physical activity is the most variable component of daily energy expenditure, and is therefore an important determinant of energy needs (STARLING & POEHLMAN 2000). The recommendation assumes a PAL (physical activity level) of 1.6 for individuals aged 65 years and older (DGE et al. 2000). The usual range of PAL in the reasonably healthy elderly is 1.5-1.8 (BEAUFRÈRE et al. 2000). As the participants in our project did not practice much sports (table IV.2), the average energy intake might be adequate. In general however, it is difficult to judge the energy intake of very old persons because this age group is very heterogeneous. Concerning our project, only fairly healthy and independent elderly participated, however co-morbidity was widespread (table IV.2), which might affect energy requirements (STARLING & POEHLMAN 2000). In addition, short-term physiologic variations in the elderly can complicate a qualified judgement as well as physiological differences in the content of body fat.

As regards an “optimal” energy intake, over a period of seven decades it has been consistently shown that reduced energy intake (providing adequate levels of micronutrients) is the only reliable environmental manipulation that slows ageing and extends both life span and health span in mammals (ROTH et al. 2000). However, extrapolation of these results to humans must be done with caution, if humans could profit by the same beneficial anti-disease effects observed in primates (lower levels of circulation triglycerides, decreased central obesity, lower systolic and diastolic blood pressure, elevated concentration of HDL, delayed decline in circulating levels of steroid hormone [DHEA], higher levels of locomotor activity, enhanced sensitivity to insulin) is not clear. As demonstrated by MOREIRAS et al. (1996), it is hard to obtain an adequate supply of essential nutrients when energy intake merely reaches very low levels.

Protein

To date, the protein requirement or, more precisely, the requirement of amino acids of elderly people is still part of scientific discussion (MORSE et al. 2001, RITZ 2001). Some experimental data suggest that it is slightly increased in comparison to younger adults (CAMPBELL & EVANS 1996, KURPAD & VAZ 2000). However, as there is not enough reliable data, recommendation is the same as for younger adults: 0.8 g protein/kg body weight (i.e., reference body weight) and day. On the other hand, more than 2 g protein/kg body weight and day should not be ingested to avoid unfavourable effects described in literature as there are: increased urinary excretion of calcium (ITOH 1998), risk of synthesis of calcium oxalates in the kidneys (HOLMES 1993), slight metabolic acidosis (BALL 1997) including a potential risk of a gradual depletion of skeletal muscle to maintain acid-base balance (BAILEY 1998) (thus possibly contributing to sarcopenia), increased insulin resistance (LINN 1996), and decreased plasma concentration of amino acids which normally is observed under catabolic conditions only.

Current research suggests that the source of protein is equally important because of effects on calcium excretion and acid-base metabolism, as animal food provide predominantly acid precursors. An increase in vegetable protein intake and/or a decrease in animal protein intake may decrease bone loss and the risk of hip fracture (in postmenopausal women) (ABELOW et al. 1992, FRASSETTO et al. 2000, SELLMEYER et al. 2001), but these results are also doubted (HANNAN 2000, HEANEY 2001). In any case increased ingestion of animal protein normally goes along with rather unfavourable higher ingestion of fat, cholesterol, and purine. Not analysed separately for this thesis, but given elsewhere, the consumption of meat and sausages was higher than recommended and that of vegetables and fruits lower than recommended in our study population (STEHLE et al. 2000).

According to the recommendation, the percentage intake of protein can be considered as adequate (17% of energy). The great majority (79%) of the study group ingested 0.8 up to 2 g protein per kg reference body weight and day, however, 15% of the elderly ingested more than 2 g protein per kg reference body weight and day, and might therefore be at risk for unfavourable effects as aforementioned. In return, the risk of protein malnutrition seems to be restricted to exceptional cases: only 7% of the study group ingested less than the recommended 0.8 g protein per kg reference body weight, and only 1% of all participants ingested less than half of the recommended amount (figures IV.7-IV.8).

Mean daily protein intake of our female population (86 g) was higher than reported for all other European females in the SENECA follow-up study (52-78 g), and that of our male population was equal to highest intakes of the SENECA follow-up (range: 66-94 g) which were observed in Poland (MOREIRAS et al. 1996). Our values are markedly higher, too, than those of the free-living people aged ≥ 65 years described in the nationally representative British National Diet and Nutrition Survey (NDNS) (69 g men, 55 g women) (GAY 2000).

In conclusion, on average protein consumption of the elderly in our study was higher than among other European elderly populations and resembles that of younger adults in industrialised countries. It would be interesting to further analyse the sources of protein and high protein intake itself, respectively, and their associations with bone and muscle metabolism in the high aged population.

Carbohydrates

The recommendation for carbohydrate intake is based on epidemiological findings in consideration of limiting the intake of fat. Therefore, the recommendation is related to the proportion of energy supplied by carbohydrates which should exceed 50% (DGE et al. 2000). On the other hand, there are hints that a diet with very high intake of carbohydrates (more than 50% of total energy) seems to worsen the blood profile by raising plasma triglycerides and lowering HDL cholesterol more than total cholesterol, despite the potential beneficial of its high dietary fibre content (MACDONALD 1999). In addition, a diet very high in carbohydrates could produce substantial reductions in blood pressure after meals in the elderly (MACDONALD 1999).

The participants aged 85 years and older in our project are not affected by these potential hazards because they ingested on the average 44 energy-% as carbohydrates (range: 28-64 energy-%) and thus did not met the DGE-recommendation (table IV.12). Only 13%, (mostly females) met or exceeded the recommended standard. As regards the absolute intake, at least 200 g carbohydrates are considered to be necessary to sustain normal brain metabolism and muscle function (MACDONALD 1999). Women in this project just reached this amount.

Dietary fibre

The average daily intake of dietary fibre of both men (24 g) and women (20 g) did not met the recommendation (tables IV.8-IV.9). A notable percentage (15% men, 21% women) did not even reach half of the recommended 30 g per day, indicating a diet low in whole grain products (containing above all insoluble polysaccharides) and/or low vegetable and fruit intake (containing above all soluble polysaccharides that can be metabolised by bacteria).

Dietary fibres are considered to have potential positive effects on the development of obstipation, adipositas, diverticulosis, hypercholesterinemia, colon cancer, gall-stones, diabetes mellitus, and arteriosclerosis (RIMM et al. 1996, BROWN et al. 1999, WOLK et al. 1999). However, reaching the recommendation for dietary fibre is quite difficult with increasing age: because of their lower energy requirements, elderly subjects have to ingest more than the recommended 12.5 g (females) respectively 10 g (males) dietary fibre per 1000 kcal for adults:

exactly 13.0 g per 1000 kcal (males) and even 16.7 g per 1000 kcal (females), respectively. This can only be realised with very nutrient-dense foods. In case of problems in chewing (which concerned approximately 1/3 of the participants “in case of hard or sticky foods”, cp. table IV.2), special preparation techniques like mashing foods are helpful. Whole grain bread can consist of well-ground flour instead of meal grain, but unfortunately such a bread is often not available.

Our data indicating too low dietary fibre intake are in agreement with the results of the GISELA study of free-living subjects aged 60-80 years. Both women in our national survey and in the GISELA study reached 75% of the recommendation, while men of our survey reached 82%, and men in the GISELA study 87% (NEUHÄUSER-BERTOLD et al. 2000). According to the German Nutrition Survey (GeNuS), mean dietary fibre intake of adults aged 18-79 years without age differentiation was higher than among our high aged subjects (28 g men and 25 g women). However, according to our findings, women had a higher nutrient density by dietary fibre indicating a better food choice in this context (MENSINK et al. 1999).

Fat/cholesterol

Epidemiological research and interventional studies on human beings suggest that a fat intake 30 energy-% along with a well-balanced composition of the fatty acids can decrease the risk of cardiac infarction when combined with a well-balanced diet and sufficient physical activity (DGE et al. 2000).

In this project, proportion of fat on overall energy intake was higher than recommended (36 energy-% women, 34 energy-% men; range 17-58 energy-%) and presumably reflects the same existing dietary intake patterns like earlier observed on adult populations in Germany (MENSINK et al. 1999). The mean daily total fat intake in our project (91 g men, 84 g women) is within the regionally quite different ranges of the SENECA follow-up study (70-119 g men, 41-101 g women), and equals at most the total intake (and the percentage of energy by fat) of the elderly in The Netherlands and in France (MOREIRAS et al. 1996).

In comparison to saturated fatty acids, ingested cholesterol increases LDL-concentrations only to minor parts, however, exogenous cholesterol can enhance the unfavourable effects of saturated fatty acids. Therefore it is recommended that the intake of cholesterol should not substantially exceed 300 mg per day (DGE et al. 2000). According to their high intake of fat, the elderly subjects in this project clearly exceeded this limit (tables IV.8-IV.9). The intake of cholesterol is higher than observed among younger German adults (403 g men and 304 g women), but this comparison is restricted because of different nutrient data bases (MENSINK et al. 1999). The newly calculated fat and cholesterol contests of foods in the BLS version II.3 which was used by MENSINK et al. are lower than in the BLS version II.2 which was used for

this investigation. Thus, the intake of our population fat might actually be a bit lower than calculated by the old nutrient data base.

Alcohol

It is well known that it is very hard to get reliable data on alcohol consumption, at least in countries where regular drinking much alcohol is not socially acceptable and therefore often underreported (MIDANIK 1982, MOREIRAS et al. 1991). As regards our investigation, alcohol was the food component with the greatest variability and greatest sex-dependent differences, including subjects who confessed high consumption of alcohol while we do not know if other subjects held back their real consumption (11% of men and 26% of women reported of no alcohol intake at all).

Mean energy percentage derived from alcohol was 6% (males) and 2% (females) (table IV.12). Thus, our percentages are just in the middle of the considerably varied values which were investigated in the SENECA follow-up study: 1-10% (males) and 1-4% (females) (MOREIRAS et al. 1996). 20 g alcohol per day are considered as tolerable for healthy men but this amount should not be ingested daily (DGE et al. 2000). For healthy women, alcohol intake should not exceed 10 g per day. 49% of men vs. 26% of women in our study exceed those cut-off points.

Thus, alcohol intake of half of the very old men and of 75% of the corresponding women, respectively, could be considered as acceptable, keeping in mind a great variety of alcohol intake among individuals and a remarkable proportion of high aged persons (men) who might be at risk for unfavourable consequences of high alcohol intake as there are displacement of essential nutrients, impaired absorption of nutrients, diuretic effects with subsequent disturbances in the distribution of the electrolytes, organic damage (liver, pancreas, heart muscle), psychic disturbances, and increased risk of development of certain kinds of cancer (FERRO-LUZZI et al. 1988, BODE & BODE 1999).

Vitamins

70% of women vs. 53% of men met or exceeded the recommendations of 1.0 mg and 0.8 mg retinol equivalents (RE) per day (figures IV.7-IV.8). Though standard deviation was high, percentage of supply below half the recommendations was only 9% (caused by low energy intake). In contrast, in the SENECA study vitamin A intake was low in many study centres, but the calculated high deficits were not accompanied by suboptimal nutritional blood values (SCHLETTWEIN-GSELL et al. 1999). As mentioned above, especially for vitamin A day-to-day variability is known to be high (BASIOTIS et al. 1987), and therefore judgement by 3-day observation has to be judged carefully. Our results (at least for females) do not support litera-

ture considering elderly to be at risk for inadequate supply of vitamin A because of monotonous food habits (DGE et al. 2000).

In contrast to most of the other vitamins, the intake of vitamin D was very low. Only 18% of men vs. 8% of women met or exceeded the recommended intake of 10 µg per day; 61% of men and even 76% of women did not even reach half of this recommended value (figures VI.7-VI.8).

These findings are not astonishing, as it is hard to reach the recommendation for vitamin D intake by an usual Mid-European diet, because for only few foods like fatty sea fishes content of vitamin D is worth mentioning. On the other side, synthesis of vitamin D in the skin seems to be clearly reduced in elderly persons (NEED et al. 1993), and insufficient UV-exposition additionally reduces this synthesis making the intake of vitamin D more important for elderly persons. In addition, in recent years sunlight exposure or the ultraviolet irradiation are limited by concern about skin cancer and skin diseases (GENNARI 2001). There are well known changes in bone composition caused by marginal vitamin D deficiency (osteoporosis) as well as marked vitamin D deficiency (osteomalacia) resulting in high rates of hip fractures. Medicines like barbiturates or disturbances in the digestion of fat additionally increase vitamin D requirements.

The vitamin D intake cannot be sufficiently judged without regarding the intake of calcium at the same time because the effect of vitamin D is dependent on an adequate intake of calcium and vice versa. As described below, in comparison with the recommended value the average intake of calcium is also too low. With regard to the serious consequences of bones fractures (especially hip and vertebral fractures) for old persons both for their quality of life as well as for the enormous total care costs in the health care system (GENNARI 2001), these two nutrients (vitamin D and calcium) demand special concern. To date, general supplementation of vitamin D in the elderly is extensively under discussion (MAWER & DAVIES 2001). There are many hints for vitamin D deficiency in elderly populations, mostly for institutionalised or housebound subjects who get little sunshine exposure (GLOTH et al. 1995, SAHOTA & HOSKING 2001). Similar to the data of the present project, in the GISELA study on free-living elderly the mean intake of vitamin D (and also the intake of calcium) was markedly below the recommendation (NEUHÄUSER-BERTOLD et al. 2000).

The recommended intake of 12 mg (men) and 11 mg (women) tocopherol equivalents were met by more than half the women and 40% of the man. On fifth of men vs. 13 % of women did not meet half of the recommendation (figures IV.7-IV.8). In conclusion, vitamin E does not seem to be critical in high aged subjects unless disturbances in digestion or absorption in-

crease the requirements (DGE et al. 2000). In the GISELA study, too, vitamin E was not considered as critical nutrient (NEUHÄUSER-BERTOLD et al. 2000).

Vitamin B complex: Recent research has highlighted the potential impact of folate, vitamin B_6, and B_{12} on cognitive performance. Both cross-sectional and longitudinal studies have provided evidence that even subclinical differences in nutritional status may have a subtle influence on aspects of cognitive performance in older adults (CALVARESI & BRYAN 2001). Previous research in elderly populations has revealed low intakes of all B vitamins, especially for vitamin B_6 and folate (STEINMETZ 1976/1986, BELLIN et al. 1986, HORWATH 1989, AMORIM CRUZ et al. 1996).

In our investigation, the average supply of the analysed vitamins thiamine, riboflavin, and pyridoxine seems to be adequate, the respective recommendations were met or exceeded to 70% (riboflavin), 80% (thiamine), and 90% (pyridoxine). The proportions the of elderly not reaching half the respective recommendation merely counted for 3% each (figures IV.7-IV.8). The requirement for thiamine and riboflavin are dependent on the energy intake, whereas the requirement for pyridoxine is increased with increased protein intake (DGE et al. 2000). As the protein intake among the elderly was high on the average, the requirement for pyridoxine might also be higher and thus correct the relatively high supply.

There is evidence that lack of folic acid (as well as lack of vitamin B_6 and vitamin B_{12}) is accompanied with the common finding of increased levels of homocysteine in the elderly which are associated with an increased risk of arterosclerotic vascular diseases (RUSSELL & SUTER 1993, MASON & MILLER 1996, VENTURA et al. 2001) and probably with cognitive disorders like dementia and Alzheimer's disease (RIEDEL & JORISSEN 1998, GONZALEZ-GROSS et al. 2001, VENTURA et al. 2001, SESHADRI et al. 2002). The intake of folic acid is too low (according to the old definition of folat-equivalents). However, the calculation was based on data of mixed vegetables, while content of folic acid in some specific vegetables is higher. Thus the intake of folic acid might be underestimated. Nevertheless, on the basis of the actual knowledge about the association of arteriosclerosis with dementia and stroke – both topics with increasing importance in elderly populations –, senior citizens should be advised to eat more green (leafy) vegetables and whole grain products.

The average daily intake of vitamin C (ascorbic acid) clearly exceeded the recommended value of 100 mg per day. Only 8% of the elderly had mean intakes of less than half the recommendation (figures VI.7-VI.8). Vitamin C is sometimes used as "indicator vitamin" (i.e., indicating poor food choice), the findings in this project give no hints for a restricted food choice in general. In agreement with former studies in free-living more-than-60-year-olds in western societies (VAN DER WIELEN et al. 1994) and current studies in elderly populations in

Germany and France, the intake of vitamin C is not critical (NEUHÄUSER-BERTOLD et al. 2000, NICOLAS et al. 2001). Unless multiple medications and/or (acute) diseases increase the requirement, the intake of vitamin C can be judged as good, keeping in mind that the current recommendation (DGE et al. 2000) was lifted up from 75 mg to 100 mg ascorbic acid per day among other things to ensure sufficient storage capacity in the individual.

Minerals

The mean daily intake of calcium was low (table IV.8-IV.9). Only one fourth of the very aged individuals met or exceeded the recommended value of 1000 mg calcium per day; another fourth did not even reach half this value (figures IV.7-IV.8). These data confirm the finding of low calcium intake in several current and previous investigations in the elderly (HORWARTH 1989, JOHNSON et al. 1992, SMALL et al. 1994, CID-RUZAFA et al. 1999, SCHLETTWEIN-GSELL et al. 1999, NEUHÄUSER-BERTOLD et al. 2000, NICOLAS et al. 2001, MARTINS et al. 2002).

As already discussed, adequate absorption of calcium goes along with adequate vitamin D status. Renal excretion of calcium is increased by salt and proteins with high portions of sulfurated amino acids (BALL 1997, ITOH 1998). The intake of salt was not analysed in this thesis while the intake of protein was high in 15% of participants (see above). Moreover, the bone status is also dependent on an adequate estrogen status as well as sufficient physical activity (DGE et al. 2000), the latter was rather low among the participants (cp. table IV.2). In general, a higher ingestion of milk, milk products, mineral waters with high content of calcium, and calcified juices should be recommended.

In agreement with current findings (NEUHÄUSER-BERTOLD et al. 2000), too, the supply of magnesium does not seem to be critical in the elderly: about 60% of the elderly met or exceeded the recommendation of 350 mg (men) and 300 mg (women) per day. Only 3% of them had intakes below half the recommendation (figures IV.7-IV.8). Yet, because nutrient density of magnesium was on the average too low (both sexes), a higher intake of wholegrain products, milk and milk products, liver, a great variety of vegetable and fruits, and magnesium-rich mineral waters should be recommended.

Presumably because of high intake of animal foods, elderly persons do not seem to be at risk for iron or zinc deficiency at all (tables IV.8-IV.9). For both minerals, intake below half the recommendation were quite rare: 1-2%, exclusively among women who were characterised by very low energy intakes. The average potassium intake clearly exceeded the recommended minimal intake of 2000 mg per day and exceeds the amount described by the DGE

as average intake in Mid-European adults which is not problematic in healthy subjects (DEG et al. 2000).

Regional study part

The energy and nutrient intake of the high aged participants in the study regional study part seems to be a bit poorer (tables IV.10-11 and figures IV.9-IV.10). In addition to the low average intake of calcium, vitamin D, folate, and dietary fibre described for the nation-wide survey, energy intake of men was remarkably low (1984 kcal) and went along with a low average intake for several other nutrients (magnesium, vitamin A, vitamin E, and vitamin C). Except for the lower average intake of vitamin A and vitamin E, data of women was comparable to the findings of the national study part.

Intake of vitamin B_{12} (which was only analysed in the regional study part) was adequate for both sexes, yet it has to be taken into account that for older populations lack of intrinsic factor which is necessary for absorption of vitamin B_{12} seems to be wide-spread (VAN ASSELT et al. 1998).

Sex-dependent differences

In general, women of both study parts showed a better food choice than corresponding men: on an absolute scale, women ingested lower amounts of most nutrients than men, due to their lower intake of energy. When relating to the reference values, and also, when taking the nutrient density into account, women did better for many minerals and vitamins (tables IV.8-IV.11). That means, the lower energy content of the female diets went along with a higher nutrient density for almost all analysed micronutrients and dietary fibre. This finding goes in agreement with findings in literature (MOREIRAS et al.1996).

Overall interpretation and judgement of nutrient intake of elderly subjects is as difficult as an overall interpretation of the nutritional situation. In 1989, HORWATH reviewed data on more than 90 international studies on the energy and nutrient intake of free-living elderly. She indicated that of all nutrients the intake of calcium, magnesium, zinc, vitamin B6, and folic acid was the worst, while the fat intake was to high and the intake of (complex) carbohydrates was too low. As described above, in the more recently conducted Euronut SENECA study on the nutrient intake of elderly people in eleven European countries enormous differences were found in the average intake of all analysed nutrients between the study centres (AMORIM CRUZ et al. 1991, MOREIRAS et al. 1991, SCHLETTWEIN-GSELL 1991). Some former German studies on the nutrient intake in the elderly from the 1970ies and 1980ies also revealed low

intakes of calcium, but also of B vitamins including folic acid, zinc, and iodine, while intake of protein and fat was high (STEINMETZ 1976/1986, BELLIN et al. 1986).

As discussed above, nutrient intake of the analysed group of healthy high aged Germans partly corresponds to that of the (younger) elderly in the cited studies and also to that of younger adults in our society (ADOLF et al. 1995). This implies the same unfavourable intake patterns observed in the NVS (national consumption study) as there are high intake of fat, protein and cholesterol, relatively low intake of carbohydrates and dietary fibre and high intake of alcohol (men), relatively low intake of calcium and folic acid.

As often described in scientific research (AMORIM CRUZ et al. 1996, MOREIRAS et al. 1996, MARTINS et al. 2002), there is an decrease in the intake of energy and some nutrients with increasing age in our project (STEHLE et al. 2000), but this decrease is not unequivocal. As shown in table V.7, compared to younger elderly aged 65-84 years in whole Germany the percentages of achieving the reference values used in this project (DGE et al. 2000) are quite similar, critical nutrients (judged by not achieving 100% of the reference value) are the same as for the younger age-group (calcium, vitamin D, folic acid, dietary fibre, and energy and vitamin E for men only).

Table V.7 Nutrient intake in percentages of reference values * – comparison of study participants with younger elderly (national study part)

	man		women	
	85+ years (n=89)	**65-84 years (n=494)**	**85+ years (n=198)**	**65-84 years (n=591)**
Energy	97	95	107	110
Protein	168	167	178	187
Fibre	79	72	66	76
Potassium	166	166	146	162
Calcium	72	83	73	81
Magnesium	111	111	110	121
Iron	133	135	126	132
Zinc	125	129	172	172
Vitamin A	104	106	138	148
Vitamin D	38	36	27	30
Vitamin E	88	98	103	118
Vitamin B1	149	153	130	138
Vitamin B2	134	133	119	126
Vitamin B6	155	152	156	167
Folic acid	82	82	76	70
Vitamin C	114	120	129	146

*basis: median daily intake

Risk groups

Diet quality indexes and nutrient intake scores, respectively, may be defined in quite different ways. In any case they have the advantage of taking dietary patterns into account (which comprise multiple interdependent dietary factors) in contrast to just analysing single nutrients or foods, respectively (KANT ET AL. 2000). In this thesis, analysis of risk groups was based on participants with two or more nutrients (vitamins and minerals) below two thirds of the recommendation vs. those with intakes above this level. Keeping in mind the origin of recommended values (see above) a low nutrient intake score does not equate with inadequate nutrient intake for an individual but increases the risk for nutrient deficits. A further differentiation of the nutrient intake score (subjects with mean intake of several nutrients below half the recommendation) showed that only a low proportion of participants was affected by such very unfavourable intake patterns (7%).

Nevertheless, as many studies show beneficial effects of marginal supply of vitamins and minerals, the present analysis may give helpful hints for further public health programs. Variables involved in a higher diet adequacy were mainly associated with education, nutritional knowledge (males) and mental capacity (women) (table IV.13). As regards the latter, the meaning of adequate nutrient intake for cognitive function has been already discussed above. The association of nutrient intake (and thus food choices) with educational level and nutritional knowledge probably embodies benefits of further nutritional education programs (WARDLE et al. 2000), preferably on younger adults and elderly subjects.

In conclusion, for energy and most nutrients the average intake of the high aged study participants (national study part) met the current recommendation for persons aged 65 years and older (DGE et al. 2000). There is no general risk for malnutrition, however, there is an obvious risk for osteoporosis (low intake of calcium and vitamin D) and probably for arteriosclerotic alterations (low intake of folic acid and dietary fibre, relatively high intake of fat). According to current findings, a higher intake of antioxidants (beta-carotine, alpha-tocopherol, vitamin C), and folate can probably be beneficial to cognitive function in the elderly (RIEDEL & JORISSEN 1998, STÄHELIN 1999, GONZALEZ-GROSS et al. 2001), an important issue for our study group (cp. table IV.2) as well as for our whole society. The low average daily intake of dietary fibre in combination with low physical activity (cp. table IV.2) and low fluid intake (see below) favours obstipation.

The necessity of a general supplementation of vitamin D, calcium, folic acid and antioxidants demands further nutritional research including biochemical parameters. The same applies for the supplementation of other vitamins and trace minerals as suggested by some scientists to prevent infection and maintain cognitive function in the elderly (CHANDRA 2001, HIGH 2001).

On the basis of these data follows the advise to regular expose to ultraviolet sunlight, for an increased consumption of nutrient-dense foods, especially of milk products, whole-grain products and green (leafy) vegetable, and for a lower proportions of (fatty) meat and sausages. Thereby, encouragement of variety (that allows individuals to meet their nutrients while adopting eating patterns consistent with their lifestyle), moderation and balance may lend itself to an increased perception of quality of life in high aged individuals (WAHLQVIST & SAVIGE 2000, DREWNOWSKI & WARREN-MEARS 2001).

In this context the meaning of increased physical activity (e.g. progressive resistance training) as far as it is possible for high aged individuals becomes apparent, this issue has often been outlined in literature (AMORIM CRUZ et al. 1996, VOLKERT 2000, WAKIMOTO & BLOCK 2001). As already mentioned, it is hard to obtain an adequate supply of essential nutrients when energy intake merely reaches very low levels. Apart from its positive effects on muscle strength, bone density, agility, and prevention of sarcopenia (ROUBENOFF 2000), physical activity increases energy requirements (and thus normally energy intake) and can consequently contribute to an higher intake of nutrients when nutrient-dense foods are chosen.

Fluid intake

Fluid balance is determined by various factors, both physical (homeostasis, renal capacity, specific diseases, level of activity, etc.), as well as environmental influences (climate, temperature, etc.). In addition, especially in elderly populations it is hard to seize short-term physiological variations. Unless well-known methodical problems concerning the accuracy of assessment (see above), 3- to 7-day dietary records have been proved to be reliable and adequate instruments to examine the nutritional and drinking behaviour of population groups (FREUDENHEIM et al. 1987, LÜHRMANN et al. 1999, LAMBE et al. 2000) which supports the use of 3-day estimated records to analyse fluid intake.

Recommendations for fluid intake are derived from water balance, especially regarding (minimal) output determined by evaporation and renal capacity to eliminate substances that are under obligation of urinary excretion. The minimal water requirement of adult persons amounts to about 1.5 litre per day (at least 0.9 L/day evaporation and at least 0.5 L/day urinary volume) (THEWS et al. 1980). As aforementioned, physical activity levels, climate and seasonal vacillations (temperature) have to be taken into account. The GERMAN NUTRITION SOCIETY (DGE et al. 2000) suggests in its newly published and revised recommendations for people aged 65 years and older to ingest 1310 ml fluids by beverages and another 680 ml by foods per day, or 35 ml/kg body weight and day (by beverages and foods), respectively.

Some authors advise elderly persons to drink at least 1.5-2 litres per day to be sure of avoiding dehydration (VOLKERT 1997).

"Low fluid intake" may be defined in different ways. For this thesis, the recommendations of the DGE were chosen as basis: firstly, the cut-off value 1310 ml per day as the reliable newly advised one, and secondly, the former recommended value 1000 ml per day, which offered a clearer cut-off point and calculation value, and which is comparable to data in literature. The new recommendation of the DGE results from the following calculation for subjects aged 65 years and older: fluid intake by beverages (1310 ml) = overall/total water intake (2250 ml) – water of oxidation (260 ml) – fluid intake by solid foods (680 ml). These values are valid for the climatic circumstances given in Mid-Europe, they assume adequate energy intake and only light physical activity (DGE et al. 2000). Furthermore, the cut-off value 1990 ml total fluid intake (by beverages and foods) was also chosen in dependence on the DGE recommendation to check if too low intake by beverages was compensated by higher intake of foods rich in fluids. The division into drinking fluids and solid foods which was also used in this thesis is some kind of arbitrary, because e.g., soups and fruits containing relatively high amounts of fluids belong to solid foods. Nevertheless, this division makes sense because beverages cater for the biggest part of fluid intake, and thus it is more important (and also rather possible) to exert influence on drinking amounts.

The present analysis provides detailed fluid intake data of a large group of high aged German elderly. For half the elderly (figures IV.11 and IV.12), fluid intake was adequate on average, i.e. met the respective current recommendation for beverage intake (1310 ml per day) and total fluid intake (1990 ml per day) for people aged 65 years and older (DGE et al. 2000). Low fluid intakes by beverages were mostly not compensated by (higher) intake of foods containing high amounts of water, for example soups or fruits. Only in the national study part, one forth of those individuals with beverage intake below 1310 ml per day met the recommended 1990 ml total fluid intake. Yet, the supply of fluids by solid foods among our participants was slightly higher than suggested by the DGE, that of the water of oxidation slightly lower than the recommended one (tables IV.14-IV.15). The present results emphasise that the observation of fluid intake by just beverages is sufficient to distinguish persons (by their intake) at risk for dehydration; information on total water intake seems to provide only optional information.

In comparison to our results, earlier investigations including data on fluid intake in the elderly mostly assessed a lower fluid intake. Unfortunately, the study groups consisted almost exclusively of younger elderly. In the NVS/VERA beverage intake data of the 102 male and 115 female participants aged 65-88 years was assessed by 7-day dietary records, milk drinks were not included (HESEKER et al. 1994). After subtraction of milk drinks from our results

(87±149 ml per day for men, 94±129 ml per day for women), daily beverage intakes in our study remained slightly higher than those assessed for males (1267 ml) and females (1121 ml) in the NVS. Already in 1986, with the use of 7-day dietary records, too, an average daily beverage intake of 1211 ml (males) and 979 ml (females), respectively, was examined in a study group of 400 subjects aged 65-74 years from three German towns Heidelberg, Michelstadt, and Berlin (milk drinks also not included) (BELLIN et al. 1986). In a regional study in the German federal state Baden-Württemberg, an average fluid intake from beverages of only 1140 ml per day was examined in 82 free-living seniors aged 65-75 years, covering a period of 2 x 6 weeks within one year (PFAU & PIEKARSKI 2000).

It could be argued that the remarkably higher intakes in our study might be due to the shorter record period. However, in a recently published thesis examining the situation of 152 institutionalised persons aged 60-92 years in selected regions of Germany, higher fluid intakes were found, though the use of 7-day dietary records. There, median beverage intake amounted to 1698 ml (men) and 1567 ml (women), respectively (MÜLLER 1998). Our beverage intake data are also slightly lower than those of 346 subjects aged 60-87 years in Gießen, Germany. There, mean beverage intake was 1567 ml for males and 1468 ml for females (LÜHRMANN et al. 2001a).

The comparison with the younger elderly of our project showed that in both study parts subjects aged 65-84 years ingested significantly greater amounts of beverages than their older counterparts ($p<0.000$): 1500 ml (medium) for the whole national study group aged 65-84 years. Between the sexes, similar differences could be stated as for the oldest old ($p<0.000$): 1583 ml for men vs. 1450 ml for women in the national study part.

As regards the total fluid intake (by beverages and solid foods), both sex- and age-dependent persisted: the median of total fluid intake of the younger elderly was 2417 ml (men) and 2269 ml (women), respectively, against 2289 ml (men) and 2069 ml (women) among the very old participants. In the regional study part, fluid intake by beverages (median) was even higher than in the national study part: 1574 ml for people aged 65-84 years, corresponding total fluid intake (by beverages and solid foods) was 2384 ml.

In conclusion, it has been shown by our study that although thirst decreases with increasing age fluid intake remains adequate in half the free-living elderly. Fluid intake of the oldest olds was remarkably lower compared to that of the younger participants in our study. Women generally have lower fluid intakes than men (except for the high-aged regional participants). Provided that the survey data was not underreported, these findings confirm that the group of very old people as a whole and especially women seem to have a higher risk for dehydration.

These findings raise the question if recommendations for subjects aged 65 years and older are actually applicable to high aged individuals. On the basis of the present data and evalua-

tion basis, fluid intake indeed remains a “matter of special interest” at least as to very old individuals. In 1999, RUSSELL et al. suggested the use of a special “food guide pyramid”’ for healthy people over 70 years of age which takes into account the special needs of elderly persons. The basis of this pyramid is composed of symbols for water (8 glasses or portions equivalent to about 2 litres of fluid), and thus emphasises the importance of adequate fluid intake. However, there are also critical notions against encouraging the fluid intake above a level that is comfortable for the elderly individual (LINDEMAN et al. 2000). Yet, the target group of the suggested “food guide pyramid” are healthy elderly individuals as were those observed in this project. It goes without saying that patients with congestive heart failure, hypoproteinemia, and liver or renal disease would be at increased risk if they did not limit their water intake (LINDEMAN et al. 2000). According to MORLEY (2000), the appropriate care of older persons required the wisdom of Solomon, rarely it was a case of one fits all. Since specified illustrative recommendations for the elderly in Germany are absent, the proposed food guide pyramid could yet be of value for public health purposes unless other methods are developed on our part. Thereby, the recommendation of 8 glasses might be modified to 5-6 glasses, and adjustments for special conditions (higher physical activity etc.) should be made.

Beverage types

The ranking of beverage types examined in our project (tables IV.16-IV.17) is in accordance with or very similar to those found in previous studies – as far as data are comparable. In the NVS/VERA, too, non-alcoholic beverages (excluding coffee) and coffee counted for the highest portions of beverages ingested. Ranges of coffee intake in our study are similar to those described by HESEKER et al. (1994) and BELLIN et al. (1986). Unfortunately, no further comparisons of beverage types are possible, because of lacking beverage specification in these publications. The remarkably higher intake of alcoholic beverages of men in comparison to women was observed by these earlier investigations (BELLIN et al. 1986, HESEKER et al. 1994), too, and the ranges of these intakes are very similar to our present ranges. In the investigation of PFAU AND PIEKARSKI (2000), coffee was followed by water/mineral water as the mostly drunken beverages, that means compared to present investigation the order of these two beverages was inverse.

With regard to the sex-dependent differences, women showed a somewhat better choice of beverage types (tables IV.16-IV.17): they ingested more mineral water, more juices, and less alcoholic drinks than men. Fruit and vegetable juices (preferably diluted by water) can supplementary improve vitamin intake and enlarge the variety of beverages. Beverages high in antioxidant capacity (red wine, green tea, black tea) only were ingested to minor parts in our study population.

The consumption of milk drinks (about 100 ml) was also quite low. Buttermilk, which is an alternative in case of incompatibility and disgust of milk, was not accepted by the elderly, its intake was extremely lower than that of milk (data not shown). BARR et al. (2000) recently showed that older adults can successfully increase milk intake, thereby meaningfully improving their nutrient intakes. Their advice to increase skim or 1% milk intake by 3 cups per day for 12 weeks was well tolerated by the 101 healthy, free-living American participants aged 55-85 years and easily incorporated in their usual diet.

The diuretic effect of alcohol is well known: it depresses production of the antidiuretic hormone (ADH or vasopressin) by the pituitary gland in the brain (KLEINER 1999). This effect is certainly known by half the men in the present investigation with high alcohol consumption (see above).

Some guidelines for elderly persons emphasise not to include the intake of coffee and tea in the calculation of total fluid intake because of their diuretic effects. It is controversial or at least not proven, respectively, if caffeine (methylxanthines) leads to excess water losses as some scientists argue (NEUHÄUSER-BERTOLD et al. 1997). There seems to be a certain adaptation preventing from excess water losses when xanthines are consumed regularly about a longer period (MARTOF & KNOX 1997). Potential negative effects of caffeine intake on bone density and bone loss have also been discussed in literature (COOPER et al. 1992, HARRIS & DAWSON-HUGHES 1994). A recently published study in healthy postmenopausal women with statistical adjustment for calcium intake did not support the idea that caffeine intake is a risk factor for bone loss (LLOYD et al. 2000). These findings do not indicate the restriction of the favoured beverage coffee.

In practical advises for the elderly and caregivers respectively, varied supply of beverage types is often emphasised. However, whether increasing variety of supplied beverages can increase the total amount of fluid intake remains questionable and deserves further investigation. A previous study showed that young subjects consumed more fluids with increased variety of drinks than with just one drink (ROLLS 1992). Unfortunately, it is not mentioned of which beverage types this variety consisted. However, in a study of PHILLIPS et al. (1991), elderly persons seemed to be insensitive to the stimulatory effect of variety on fluid intake. Yet, in this study, the “variety” of supplied beverages consisted of four beverages (water, mineral water, cola, and orange juice) in comparison to just water after a dehydration period of 24 hours. Both groups of the elderly subjects (66-78 years) drank similar amounts, a younger control group was missing. The interpretation of this study is somehow dubious, because a defacto variety of beverages did not exist (e.g. water vs. mineral water). Moreover, cola belongs to those refreshments which are less often consumed by the elderly (DE CASTRO 1992) – this finding was confirmed by our results, too. Nevertheless, the finding that elderly are somehow insensitive to the stimulatory effect of variety on fluid intake corre-

sponds to a decreased taste-specific satiation observed among old people. This means a lack of decrease in pleasantness of a food as it is consumed, thus decreasing the impulse of shifting to other foods (or beverages) (ROLLS 1992).

In conclusion, a variety of drunken beverages types existed to some extent in our investigation, with an obvious preference of coffee and mineral water. A higher ingestion of (low fat) milk drinks and also fruit or vegetable juices could be beneficial, at least for a better nutrient intake, if this resulted in a higher fluid intake should be examined in further investigations.

One fifth of the oldest old participants tended to avoid frequent trips to the toilet by drinking little amounts (figure IV.13). Both the corresponding percentage of younger elderly in our project and also the percentage of them drinking little amounts to avoid frequent toilet visits at night were significantly lower than among the very old participants (7 vs. 19% and 9 vs. 17%, respectively). This result proposes increased arthritic pain resulting from numerous trips to the toilet as one main reason for restricted fluid intake (cp. tables IV.2 and V.1) (DREWNOWSKI & WARREN-MEARS 2001). However, this finding also leads attention to the problems of urinary incontinence and nocturia, which both are of special interest among elderly people, especially among women. Innocence of remedial measures, sense of shame, and feeling of discomfort are some of the particular reasons which can lead to insufficient fluid intake among these people concerned. Even if those participants who agreed with the cited statement were not (yet) directly afflicted with urinary incontinence, the importance of this topic remains clear.

Risk groups (national study part)

Within the scope of performed analyses, only few of the specific factors which are often taken into account in view of malnutrition could be identified to be related to fluid intake (table IV.18). Educational level seems to support a higher fluid intake in men. As regards women, the degree of both self-perceived appetite and cognitive function as well as aspects linked with functional independence (ability to cut with knife, ability to cook without help) showed statistically significant differences.

The results of these mono-factorial analysis do not permit well founded conclusions, but may give hints for practical advice targeted at elderly subjects. With regard to the present sex-specific differences, appetite seems to be more important for women than for men, consequently, particular attention should be paid to the fluid intake of women with poor appetite. The association of appetite with fluid intake goes conform with the result of a former study indicating that the strongest predictor of the amount of fluid ingested was the amount of solid

ingested. In other words: older persons obtained most of their fluids by coingestion of solids at mealtimes (DE CASTRO et al. 1992).

The association with functional capacity in women probably shows how important it is that caregivers (who do the cooking) provide sufficient drinking possibilities. Encouragement and close observation are required to substantial support (WEINBERG et al. 1995). In women, also cognitive functioning is a significant reason for decreased fluid intake. Vice versa, it is important to realise that dizziness and dementia can be even enhanced by low fluid intakes. As already mentioned, dementia is a serious problem in high aged populations with increasing dimensions. Consequently, public health education should emphasise the importance of easy behavioural measures (drinking schedules, provision of full glasses within reach, etc.) to eliminate this cause of dementive conditions.

Our findings concerning women go in agreement with the SENECA follow-up, where women were found to be at higher risk for dehydration not only because of much lower water intakes than men but also because of the overall relationship between a low fluid intake and a poor mental state and ADL problems (HAVEMAN-NIES et al. 1997).

Attitudes towards drinking (regional study part)

The proportions of agreement and disagreement with the five statements concerning attitudes towards drinking showed some contradictions which might be explained by lack of knowledge of the physical changes in the elderly (figure IV.13): 60% confessed to pay attention to sufficiently drinking, but another 64% confessed to drink little because of lack of thirst.

A comparison with the results of the younger study participants in our project shows that with increasing age the proportion of aged persons who stated “to pay attention to sufficiently drinking” decreased, on the other side the proportion of participants who declaimed to drink only when they were thirsty increased.

Although DE CASTRO et al. (1992) found no indications in their study that healthy elderly people (aged 65 to 80 years) had any impairment in subjective thirst or its relationship to fluid intake under ad libitum conditions, most authors agree to the effect that the perception of thirst seems to be clearly reduced in the elderly, even among healthy persons (PHILLIPS et al. 1984) because of changes in homeostasis. These physical changes make it more important for elderly to establish “conscious” drinking habits independent from the perception of thirst (so-called “secondary drinking”, THEWS 1980).

The findings of our study confirm the importance of consciously controlled drinking behaviour among elderly persons. Adequate fluid intake was examined to go along with rather rationally controlled and conscious attitudes towards drinking: a higher proportion of the elderly with fluid intake above the recommendation ingested fluids without the perception of thirst (table

IV.19). In this context, for people with rather consciously controlled drinking habits, a great variety of supplied beverages might have positive effects with regard to adequate fluid intake (cp. paragraph “beverage types”).

Fluid intake assessed by questionnaire vs. fluid intake assessed by dietary records

Retrospective estimation of fluid intake is susceptible to inaccuracy; the comparison of the two divergent methods of inquiring fluid intake used in this project brings to light a bit of the nature of this bias. In the regional study part, the elderly had to specify all beverages they normally drink in course of a day (e.g. yesterday). The total amount of fluid intake was calculated later on by the interviewer, using standardised portion sizes. In the national study part, the participants should tell the average amount of fluid intake only, without specifying single beverages normally consumed (chapter III.5.1). This method presumably caused the higher percentages of overestimation of self-estimated fluid intake in this study part. It is difficult to estimate the real amount of beverages consumed, if someone is not highly involved and interested in nutritional issues. Moreover, social desirable answers are more likely this way.

Nevertheless, in previous studies examining the drinking behaviour of free-living elderly, the amount of total fluid intake (ingested by beverages) was inquired with the same or very similar method used in the national part of the study (MENDEN et al. 1989/BRODHAGEN 1993, BELLIN 1986, SOMMER et al. 1998), however these data were declared as actual (real) fluid intake in place of missing dietary intake data.

Above all, in the SIMA-project (SOMMER et al. 1998) estimated fluid intakes resembled those assessed by questionnaire in the national part of our project (table V.8). According to the findings in our study, the actual fluid intake of these persons might have been lower. In the Bethanien study (VOLKERT 1997), fluid intake of geriatric patients was assessed with almost the same method as in the regional part of this project (questionnaire). As table V.8 shows, these data resemble those assessed by dietary records in our project (with the exception of the relatively high percentage of fluid intakes above 2 litres per day in the regional study part).

The accuracy of the estimations does not seem to be dependent on age: there were no statistically significant differences between the younger and the older participants in the national study part. However, the findings of the regional study part showed a slight “increase” in overestimation as well as a slight “decrease” in both nearly correct estimation and underestimation of fluid intake with age (data not shown).

Table V.8 Comparison of classified fluid intake assessed in different studies								
Authors/study		MENDEN et al. (1989)	SOMMER et al. (1998)	VOLKERT (1997)	National study part		Regional study part	
Methods		Q	Q	Q	Q	DR	Q	DR
Age of participants		80-100y	75-93y	75-97y	85-95y	85-95y	85-96y	85-96y
n		216	375	300	286	287	36	36
fluid intake [%]	**< 0.5 litre**	1	6 *	2	0	4	6	6
	0.5 - 1 litre	24		29	9	25	14	28
	1 - 1.5 litres	47	76 *	40	30	33	47	28
	1.5 - 2 litres	24		19	40	25	28	17
	>= 2 litres	4	18	10	21	13	6	22

Q = questionnaire, DR = dietary record; * data available for "< 1L" and "1-2 L" only

Conclusion

The present analyses provides comprehensive information about the nutritional situation of high-aged free-living elderly and outlines issues for further research. In the following, the specific questions linked to our study aims are answered.

Is there an obvious general risk for malnutrition in this population group?

Altogether the nutritional situation of healthy high-aged subjects is not critical in general, but there are hints for unfavourable factors which could trigger malnutrition. A very low proportion of study participants was classified as underweight (4-9%), whereas BMI of 11% (national) and 14% (regional), respectively was classified as high (≥ 30 kg/m²). Unintended weight loss indicating nutritional risk refers only to a minor portion, too (9-13%). Anthropometric data of our study groups was to a high extent comparable to that of NHANES III which is recommended for comparison by the WHO. Further investigations that include measurements of body components are essential to elucidate normal body composition and changes with age. Based on the analysis of estimated dietary records, for energy and most nutrients the average daily intake of the high aged study participants met the current German recommendation for persons aged 65 years and older. There is, however, an obvious risk for osteoporosis (low intake of calcium and vitamin D) and probably for arteriosclerotic alterations (low intake of folic acid and dietary fibre, relatively high intake of fat).

Is it necessary to recommend energy and/or nutrient supplements for high aged subjects?

The necessity of a general supplementation of vitamin D, calcium, folic acid, and antioxidants for the elderly demands further nutritional research including biochemical parameters. Based on the present data, elderly subjects should pay attention to regular exposure to ultraviolet sunlight. They should consume more nutrient-dense foods, especially milk products, whole-grain products, green (leafy) vegetables and fruits, and less (fatty) meat and sausages. A higher intake of antioxidants (beta-carotine, alpha-tocopherol, vitamin C), and folate could probably be beneficial to cognitive function in the elderly.

Is it necessary to encourage high aged subjects to increase their fluid intake in avoidance of dehydration? If so, is it possible to identify points of contact?

It has been shown by our study that although thirst decreases with increasing age fluid intake remains adequate in half the free-living elderly. Our findings confirm that the group of very old people as a whole and especially women seem to have a higher risk for dehydration than younger elderly. The observation of fluid intake by just beverages is sufficient to distinguish persons (by their intake) at risk for dehydration, information on total water intake only pro-

vides optional information. High-aged elderly clearly prefer coffee and mineral water. If a greater beverage variety could increase fluid intake is unclear. In any case, a higher ingestion of (low fat) milk drinks and also fruit or vegetable juices could be beneficial, at least for a better nutrient intake. The findings of our study confirm the importance of emphasising adequate fluid intake and of (introducing) consciously controlled drinking behaviour among elderly persons. Adequate fluid intake was examined to go along with rather rationally controlled and conscious attitudes towards drinking (drinking without the perception of thirst).

Is it possible to identify a gender-dependence and/or subgroups with higher risk for malnutrition, inadequate nutrient intake, and dehydration?

In our two study groups, no obviously malnourished subjects were found. In agreement with some previous findings, living alone does not adversely affect nutritional status and nutrient intake, while financial restrictions show an association with nutritional status in women. Some factors associated with BMI seem also to be gender-dependent (self-perceived health status, appetite). There are hints for educational level and nutritional knowledge to be positively associated with adequate nutrient intake for both sexes and for fluid intake in men. Thus, further nutritional education programs might be beneficial. Furthermore, such programs should emphasise the importance of easy behavioural measures (drinking schedules, provision of full glasses within reach, etc.) to eliminate dehydration as cause of dementive conditions.

Do high aged subjects reliably report their own body weight and height? Is it possible to dispense with measurements of body height and weight in studies on high aged populations?

Our findings support the use of self-reports of weight as a reliable data source in high aged population groups on group level. The use of self-reported height data is somehow more restricted and calls for a certain correction factor. When using BMI by self-reported data, it has be to corrected (raised) by 1-2 units. This is especially important when BMI ranges are used for classification of elderly population groups.

Is it possible to rely on estimated drinking fluids and to dispense with measurements of fluid intake in studies on high aged populations?

The use of self-reports of fluid intake provide reliable data for most high-aged subjects (about 75-80%). However, when drinking amounts are only asked for as a whole instead of specifying all beverages usually drunken, a considerable proportion of overestimation is possible.

It should be noted that these study results pertain only to high aged citizens that are mostly independent and mobile with an interest in nutrition issues. Participation rates of high aged elderly are lower than among younger elderly, mostly due to illness which can be am important source of bias. Intensive efforts (repeated efforts to meet people not at home, individual dates) can be useful to reach higher participation rates. Our findings do not allow similar conclusions for institutionalised elderly, geriatric patients and elderly living in private households that are in need of care.

It is so far unknown, in how far life-style factors can actually contribute to overall health, independence and quality of life of older people. According to the recommendations for “successful ageing”, nutrition (adequate nutrient and fluid intake) as well as physical activity are modifiable factors that might a least partly avoid some of the nutritional and health problems in old ages. In view of the described dramatic demographic changes in our society, further research that considers the involvement of nutritional status with socio-economics, health, functional status, and activity with health and quality of life of high aged subjects are necessary. Thereby, clinical measurements (blood values, body composition) might be useful for a better judgement and completion of our knowledge. The present data especially stresses the need for research in economically disadvantaged and ill persons living at home who are very difficult to approach. Especially longitudinal studies can elucidate the effects of risk factors as well as the influence and possibilities of nutritional measures.

VI Summary

The present analyses provides detailed information about the nutritional situation of high-aged (85 years and older) free-living elderly in Germany. It was mainly aimed at exploring if there is an obvious risk for malnutrition in this population group judged by nutritional status and dietary intake, to identify subgroups with higher risk for malnutrition, and to check the reliability of self-reported data on body height and weight as well as on fluid intake.

The underlying representatively designed cross-sectional study that included ≥ 65-year-old Germans citizens living in private households – that could handle every day tasks independently – was structured into a regional survey (in the small town Euskirchen near Bonn) and a nation-wide survey. By the means of an age-stratified random sample it was possible to gain a large group of high aged elderly for participation (320 national, 66 regional) that are subject of this thesis.

Analyses are based on a standardised comprehensive questionnaire which covers socio-demographics, living situation, health and functional status, activities, smoking habits, and nutrition aspects as well as anthropometric measurements, and a dietary record over three consecutive days.

Participation rates of subjects aged 85 years and older have shown to be lower (30% both study parts) than among younger elderly, mostly due to illness which can be am important source of bias. Intensive efforts (repeated efforts to meet people not at home, individual dates) can be useful to reach higher participation rates.

Both survey groups are distinguished by the high proportion of women (68%). Markedly more women than men were widowed (85% vs. 55% national, 87% vs. 52% regional) and single living (77% vs. 45% national, 67% vs. 43% regional). In general, men had experienced a better education and professional status than women. Two thirds of participants (both parts) were satisfied with their financial situation.

About half the regional participants and one third of the national ones reported to be in good or very good health. Multi-morbidity was widespread: only 8% (nation-wide) and 11% (regional) did not suffer from any chronic disease at study-time. Most participants reported to have one up to three chronic diseases, in the first place orthopaedic problems and cardiac diseases. Judged by 16 items covering the activities of daily living (ADL), the functional status of the participants was fairly good, however, women came off worse than men in most activities. Most problems appeared in “carrying heavy objects“, „cutting one’s toenails“, and “doing heavy housework“. A memory test revealed that restricted short time memory was frequent (66% national, 77% regional). Two thirds of both study parts reported to have a good or even very good appetite. The majority of participants was free from disabilities which

might hamper adequate nutrient intake as there are chewing disabilities (63% national, 47% regional), swallowing disabilities (89% both parts) or loss of appetite (90% national, 84% regional). Only few participants were subject to the risk of poor nutrition because of inadequate supply of nutritional services (e.g., merely occasionally consumed warm meals) or missing social networks (as regards doing the cooking, help in case of illness). The importance of a well balanced diet for health and well-being was well known (78% national, 80% regional). A sedentary lifestyle was predominant (no sports: 76% national, 93% regional). The great majority were non-smokers (81% national, 72% regional), in both surveys significantly less women.

Mean BMI was 25 kg/m² for both men and women in the national study part; corresponding values were 27 kg/m² for men and 25 kg/m² for women in the regional study part. Proportions of very low BMI values (<18.5 kg/m²) were rarely examined in our study (0-4%). In return, prevalence of obesity defined as BMI above 30 kg/m² was about 9-14%.

Unintended weight loss of more than 5 kg initial body weight in recent time was rarely examined in our study population (13% national, 9% regional). Of the analysed risk-factors for adequate nutritional intake, swallow difficulties and appetite were the only topics associated with BMI for men, whereas for women self-perceived health status, self-perceived relative activity and financial problems showed statistically significant associations.

Body weight was slightly under-estimated (about 1 kg national, 0.4 kg regional) by self-reports, whereas body height was over-estimated about 1.6 cm national and even 4-6 cm regional, resulting in an under-estimation of BMI values about 0.7 kg/m² (national) and 1.8 kg/m (regional). These findings support the use of self-reports of weight as a reliable data source in high aged population groups on group level. The use of self-reported height data is somehow more restricted and calls for a certain correction factor (95% limits of agreement were rather poor). When using BMI by self-reported data, it has be to corrected (raised) by 1-2 units. This is especially important when BMI ranges are used for classification of elderly population groups.

There were no hints for malnutrition by the arm anthropometry (regional study part). On average, while there was no sex-dependent difference concerning upper arm circumference (about 28.5 cm), women had higher values in triceps skinfold thickness than corresponding men (15.7 *vs.* 12.7 cm), in return men had greater muscle areas (50.4 *vs.* 44.3 cm²) and arm muscle circumferences (25.1 *vs.* 23.2 cm).

The given anthropometric data are comparable to several recently run local Europe studies in (high aged) elderly and also to the American data of HNANES III which was suggested by the WHO (1995) for comparison between different population groups, but data of arm an-

thropometry clearly exceed those reference values for elderly people (in Britain) published by BURR & PHILLIPS in 1984.

Analysed by the dietary records on the basis of the Official German nutrient data base (BLS version II.2), median energy intake was 9.3 MJ (men) and 8.6 MJ (women) in the national study part and 8.3 MJ (men) and 7.9 MJ (women) in the regional one. Mean carbohydrate intake was around 44-46% of energy intake, fat provided 35-37% of energy, protein 17-18%, and percentage of energy intake from alcohol ranged between 1-2% (females) and 4-6% (males). The lower energy content of the female diets went along with a higher nutrient density for almost all analysed micronutrients and dietary fibre.
In conclusion, for energy and most nutrients the average intake of the high aged study participants (national study part) met the current recommendation for persons aged 65 years and older. There is no general risk for malnutrition, however, there is an obvious risk for osteoporosis (low intake of calcium and vitamin D) and probably for arteriosclerotic alterations (low intake of folic acid and dietary fibre, relatively high intake of fat). The low average daily intake of dietary fibre in combination with low physical activity favours obstipation.
A low nutrient intake score (two or more vitamins and minerals below two thirds of the recommendation) was positively associated with mental capacity (women), education and nutritional knowledge (males). The latter probably embodies the benefits of further nutritional education programs, preferably on younger adults and elderly subjects. The association of B vitamins and antioxidants with cognitive performance is under discussion in literature.
On the basis of these data follows the advise to regular expose to ultraviolet sunlight, for an increased consumption of nutrient dense foods, especially of milk products, whole-grain products, green (leafy) vegetables and fruits, and for a lower proportions of (fatty) meat and sausages. The necessity of a general supplementation of vitamin D, calcium and folic acid (and antioxidants) demands further nutritional research including biochemical parameters.

Although thirst decreases with increasing age, fluid intake remained adequate in half the free-living elderly. However, about one third drank less than 1 litre per day. Compared to younger elderly, the group of very old people as a whole and especially women seem to have a higher risk for dehydration. The observation of fluid intake by just beverages is sufficient to distinguish persons (by their intake) at risk for dehydration, information on total water intake only provides optional information. With regard to beverage types, there was an obvious preference of coffee and mineral water, and a rather low consumption of milk drinks and also fruit/vegetable juices.

Adequate fluid intake was examined to go along with rather rationally controlled and conscious attitudes towards drinking. However, one fifth of the oldest old participants tended to

avoid frequent trips to the toilet by drinking little amounts. Particular attention should be paid to the fluid intake of women with poor appetite. There are hints for educational level and nutritional knowledge to be positively associated with fluid intake in men. Nutritional education programs should emphasise the importance of easy behavioural measures (drinking schedules, provision of full glasses within reach, etc.) to eliminate dehydration as cause of dementive conditions.

The use of self-reports of fluid intake provide reliable data for most high-aged subjects (about 75-80%). However, when drinking amounts are only asked for as a whole instead of specifying all beverages usually drunken a considerably proportion of overestimation is possible.

These study results pertain only to high aged citizens that are mostly independent and mobile with an interest in nutrition issues. Our findings do not allow similar conclusions for institutionalised elderly, geriatric patients and elderly living in private households that are in need of care. There is still a great need for research in these populations as well as in economically disadvantaged and ill persons living at home who are very difficult to approach.

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VIII Annex

VIII.1 Questionnaires

In the following, the German wording of the original questions used for the characterisation of the participants are given in the order presented in chapter III. Special questions used in the other chapters of this thesis (anthropometry, fluid intake) and the dietary records are given thereafter.

Additional instructions for the interviewer have been retained unchanged. As apparent by the consecutive numbering of the original questions, many questions of the project have not been used in this thesis and therefore are not given here. The original order of the regional questionnaire was as follows: social-demographic data (S), nutritional relevant issues (E), health status (G), physical capacities (L), and finally activities and smoking behaviour (AR). The original order of the national questionnaire can be easily seen by the numbers of the questions.

Regional study part

Socio-demographics

S1. Geschlecht **?**

- ❍ Männlich
- ❍ Weiblich

S3. Wie ist Ihr Familienstand **?**
☞ *offene Frage, nur eine Antwort möglich*

- ❍ Ledig
- ❍ Verheiratet
- ❍ Geschieden, getrennt
- ❍ Verwitwet
- ❍ Weiß nicht / keine Angabe

S4. a) Was war Ihr höchster erreichter Schulabschluß
☞ *offene Frage, nur eine Antwort möglich*

- ❍ Volksschule / Hauptschule
- ❍ Realschule
- ❍ Gymnasium
- ❍ Kein Abschluß
- ❍ Weiß nicht / keine Angabe

b) Was war Ihr höchster erreichter Bildungsabschluß
☞ *offene Frage, nur eine Antwort möglich*

- ❍ Berufsschulabschluß
- ❍ Fachschulabschluß
- ❍ Meisterprüfung
- ❍ Fachhochschulabschluß
- ❍ Universitätsabschluß
- ❍ Kein Abschluß
- ❍ Weiß nicht / keine Angabe

S5. b) Wie ist / war Ihre berufliche Position
☞ *offene Frage, nur eine Antwort möglich*

- ❍ Selbständig
- ❍ Beamter
- ❍ Angestellter
- ❍ Arbeiter
- ❍ Hausfrau
- ❍ Mithelfender Familienangehöriger
- ❍ Weiß nicht / Keine Angabe

S9. Kommen Sie mit Ihrem Geld gut über die Runden?
☞ *offene Frage, nur eine Antwort möglich*

- ❍ Ja, ohne Probleme
- ❍ Ja, es geht so
- ❍ Nein, schlecht
- ❍ Weiß nicht / keine Angabe

S13. Wer wohnt mit Ihnen zusammen (in der gleichen Wohnung)? ☞ *offene Frage, jede Zeile 1 Antwort*
➔ *weiter mit **S15.***

Ja	Nein	Wn / kA	
❍	❍	❍	Partner
❍	❍	❍	Kinder
❍	❍	❍	Enkel
❍	❍	❍	Verwandte der gleichen Generation
❍	❍	❍	Andere (z.B. Untermieter) _____

S27. Haben Sie Personen (auch professionelle Helfer), die Ihnen helfen können, wenn Sie krank sind? Wenn ja, welche?

- ❍ Ja, und zwar _____
- ❍ Nein
- ❍ Weiß nicht / keine Angabe

Health and functional status, activities, smoking behaviour

G1. Wie würden Sie Ihren momentanen Gesundheitszustand insgesamt einschätzen?
☞ *offene Frage, nur eine Antwort möglich*

- ❍ Sehr gut
- ❍ Gut
- ❍ Mittel
- ❍ Weniger gut
- ❍ Schlecht
- ❍ Weiß nicht / keine Angabe

G17. Wie ist Ihr Appetit? ☞ *offene Frage, nur eine Antwort möglich*

- ❍ Sehr gut
- ❍ Gut
- ❍ Mäßig
- ❍ Schlecht
- ❍ Weiß nicht / keine Angabe

G18. a) Hat sich Ihr Appetit in den letzten Wochen verschlechtert?

- ❍ Ja
- ❍ Nein
- ❍ Weiß nicht / keine Angabe

G21. Haben Sie Schwierigkeiten beim Kauen?

- ❍ Ja, immer
- ❍ Ja, bei harten / zähen Lebensmitteln
- ❍ Nein
- ❍ Weiß nicht / keine Angabe

	Ja	Nein	Wn / kA
G13. Leiden Sie unter <u>Schluckbeschwerden</u>?	❍	❍	❍
G15. Haben Sie Probleme, ein Stück Fleisch kleinzu<u>schneiden</u>?	❍	❍	❍

G22 a) Jetzt kommt ein kleiner Gedächtnistest. Ich nenne Ihnen 3 Begriffe: Apfel - Pfennig - Tisch. Bitte wiederholen Sie die Begriffe. Bitte merken Sie sich die Begriffe.

G22. b) Fragen Sie den Teilnehmer nach den 3 Begriffen, die vorhin genannt wurden.

- ❍ Richtig
- ❍ Falsch
- ❍ Weiß nicht / keine Angabe

G23. An welchen chronischen Krankheiten leiden Sie? ☞ *einzeln abfragen, jede Zeile 1 Antwort*

	Ja	Nein	Wn/kA
Zuckerkrankheit (Diabetes mellitus).....	❍	❍	❍
Bluthochdruck.....	❍	❍	❍
Herzschwäche (Herzinsuffizienz)	❍	❍	❍
Andere Herzkrankheit _____	❍	❍	❍
Schlaganfall.....	❍	❍	❍
Bösartiger Tumor / Krebs.....	❍	❍	❍
Schilddrüsenüberfunktion (Hyperthyreose).....	❍	❍	❍
Schilddrüsenunterfunktion (Hypothyreose).....	❍	❍	❍
Erkrankungen der Atemwege.....	❍	❍	❍
Gastritis, Magenerkrankung.....	❍	❍	❍
Entzündliche Darmkrankheiten.....	❍	❍	❍
Chronische Leberkrankheit.....	❍	❍	❍
Chronische Nierenerkrankung.....	❍	❍	❍
Gelenkserkrankungen (Arthritis, Arthrose).....	❍	❍	❍
Osteoporose.....	❍	❍	❍
Andere	❍	❍	❍

_____

G24. a) Wie häufig hatten Sie in der letzten Woche Schmerzen?

- ❍ Keine
- ❍ 1 mal
- ❍ Mehrmals
- ❍ Täglich
- ❍ Weiß nicht / keine Angabe

Activities of daily living (ADL's)

L1. Sind Sie zu folgenden Tätigkeiten in der Lage? *Vorlage aushändigen, Tätigkeiten vorlesen, jede Zeile 1 Antwort*

	Ja, ohne Probleme	Ja, mit Mühe, aber ohne Hilfe	Ja, aber nur mit Hilfs-person	Nein	wn / kA
Von Zimmer zu Zimmer gehen	❍	❍	❍	❍	❍
Treppensteigen	❍	❍	❍	❍	❍
Das Haus verlassen	❍	❍	❍	❍	❍
Mindestens 400 m gehen	❍	❍	❍	❍	❍
Schwere Sachen tragen (z.B. Einkäufe von 5 kg 100 m)	❍	❍	❍	❍	❍
Toilettenbenutzung	❍	❍	❍	❍	❍
Waschen	❍	❍	❍	❍	❍
Baden	❍	❍	❍	❍	❍
Anziehen	❍	❍	❍	❍	❍
Aufstehen aus dem Bett	❍	❍	❍	❍	❍
Fußnägel schneiden	❍	❍	❍	❍	❍
Medikamente nehmen	❍	❍	❍	❍	❍
Finanzgeschäfte erledigen	❍	❍	❍	❍	❍
Essen	❍	❍	❍	❍	❍
Leichte Hausarbeit (abspülen, Staub wischen)	❍	❍	❍	❍	❍
Schwere Hausarbeit (Fenster putzen, Boden putzen)	❍	❍	❍	❍	❍
Über Nacht allein bleiben	❍	❍	❍	❍	❍

A20. Gibt es bestimmte sportliche Aktivitäten, die Sie regelmäßig durchführen?

- ❍ Ja
- ❍ Nein
- ❍ Weiß nicht / keine Angabe

A21. a) Welche Sportart machen Sie am häufigsten? _____

b) Wie häufig üben Sie diese Sportart aus und in welcher Jahreszeit? _____

- ❍ Irrel. ❍ <1 ❍ 1-2 ❍ 2-3 ❍ 3-4 ❍ >4 Std./Woche
- ❍ Irrel. ❍ <1 ❍ 1-3 ❍ 4-6 ❍ 7-9 ❍ >9 Mon./Jahr

A29. Fühlen Sie sich im Vergleich zu Gleichaltrigen viel weniger aktiv / weniger aktiv / gleich aktiv / aktiver / viel aktiver ? ☛*Vorlage aushändigen, nur eine Antwort möglich*

- ❍ Viel weniger aktiv
- ❍ Weniger aktiv
- ❍ Gleich aktiv
- ❍ Aktiver
- ❍ Viel aktiver
- ❍ Weiß nicht / keine Angabe

Smoking habits

R1. Sind Sie

- ❍ Raucher
- ❍ Ehemaliger Raucher
- ❍ Nichtraucher?
- ❍ Weiß nicht / keine Angabe

Nutritional aspects

A10 a) Bereiten Sie Ihre warmen Mahlzeiten selbst zu (oder helfen Sie bei der Zubereitung)?

b) Bereiten Sie Ihre anderen Mahlzeiten selbst zu (oder helfen Sie bei der Zubereitung)?

☞ *offene Frage, nur eine Antwort pro Mahlzeit*

	Warme Mahlzeit	Andere Mahlzeiten
Ja, immer (>5x / Woche)	❍	❍
Ja, meistens (3-5x / Woche)	❍	❍
Ja, manchmal (1-2x / Woche)	❍	❍
Seltener oder nie	❍	❍
Weiß nicht / keine Angabe	❍	❍

A11. a) Wenn Sie es nicht selbst tun, wer bereitet die warmen Mahlzeiten gewöhnlich für Sie zu?
b) Wer bereitet die anderen Mahlzeiten gewöhnlich für Sie zu?
☞ *offene Frage, nur eine Antwort pro Mahlzeit*

	Warme Mahlzeit	Andere Mahlzeiten
Partner	❍	❍
Kinder, Angehörige	❍	❍
Bekannte, Freunde	❍	❍
Essen auf Rädern	❍	❍
Restaurant	❍	❍
Sonstige Person _____	❍	❍
Weiß nicht / keine Angabe	❍	❍
Frage irrelevant	❍	❍

A13. Wären Sie in der Lage, ohne Probleme eine warme Mahlzeit (Fleisch mit 2 Beilagen) zu kochen, auch wenn Sie es zur Zeit nicht tun? ☞ *offene Frage, nur eine Antwort möglich*

❍ Ja, ohne Probleme
❍ Ja, es ginge / mit Schwierigkeiten
❍ Nein
❍ Weiß nicht / keine Angabe

E3. Wie oft essen Sie normalerweise eine warme Mahlzeit?
*offene Frage, nur eine Antwort möglich*

Mehrmals täglich
(Fast) täglich
Mehrmals pro Woche (3-4 mal pro Woche)
Gelegentlich
Nie
Weiß nicht / keine Antwort

E26. Für wie wichtig halten Sie eine richtige / ausgewogene Ernährung für Gesundheit und Wohlbefinden im Alter?
☞ *offene Frage, nur eine Antwort möglich*

❍ (Sehr) wichtig
❍ Weniger wichtig (mittel)
❍ Unwichtig
❍ Weiß nicht / keine Angabe

National study part

Socio-demographics

38. ☞ ***Bitte markieren:***

Männlich ..... ☐
Weiblich ..... ☐

29. Wie ist Ihr Familienstand?

Ledig ..... ☐
Verheiratet ..... ☐
Geschieden, getrennt lebend ..... ☐
Verwitwet ..... ☐

34A Welchen höchsten Schulabschluß haben Sie?
☞ ***Liste 34A vorlegen!***

A Volksschule / Hauptschule ..... ☐
B Mittlere Reife oder Abschluß der polytechnischen Oberschule ..... ☐
C Abitur, Fachhochschulreife (Gymnasium oder erweiterte Oberschule EOS) ..... ☐
D Keinen Abschluß ..... ☐

34B Welchen beruflichen Ausbildungsabschluß haben Sie?

☞ ***Liste 34B vorlegen! Nur eine Nennung!***

A Betriebliche Ausbildung (Lehre) bzw. beruflich-schulische Ausbildung Berufsfachschule, Handelsschule) ..... ☐

B Ausbildung an einer Fach-, Meister-, Technikerschule, Berufs- oder Fachakademie ☐

C Fachhochschulabschluß ..... ☐

D Universitätsabschluß ..... ☐

E Keinen Abschluß ..... ☐

35. Wie ist / war Ihre berufliche Position?

☞ ***Nur eine Nennung möglich!***

Selbständig, Freiberufler ..... ☐

Beamter (auch Berufssoldat, Richter) ..... ☐

Angestellter ..... ☐

Arbeiter ..... ☐

Hausfrau ..... ☐

Mithelfender Familienangehöriger ..... ☐

Sonstige, und zwar: .... ☐

36. Kommen Sie mit Ihrem Geld gut über die Runden -

☞ ***Vorgaben bitte vorlesen!***

- ja, ohne Probleme? ..... ☐
- ja, es geht so? ..... ☐
- oder nein, schlecht? ..... ☐

30. Wer wohnt mit Ihnen zusammen in der gleichen Wohnung?

☞ ***Mehrfachnennungen möglich!***

Niemand ..... ☐

(Ehe-) Partner ..... ☐

Kinder ..... ☐

Enkel ..... ☐

Verwandte der gleichen Generation ..... ☐

Sonstiges, und zwar (z.B. Untermieter) ..... ☐

_____

31A Haben Sie Personen (auch professionelle Helfer), die Ihnen helfen können und die Ihnen helfen können, wenn Sie z.B. krank sind?

Ja ..... ☐

Nein ..... ☐

Health, mental and functional status, activities, smoking behaviour

1. Wie würden Sie Ihren momentanen Gesundheitszustand insgesamt einschätzen -

☞ ***Vorgaben bitte vorlesen! Nur eine Nennung möglich!***

- sehr gut? ..... ☐
- gut? ..... ☐
- mittel? ..... ☐
- weniger gut? ..... ☐
- oder schlecht? ..... ☐

15. Wie ist Ihr Appetit?

☞ ***Vorgaben bitte vorlesen!***

- sehr gut? ..... ☐
- gut? ..... ☐
- mäßig? ..... ☐
- oder schlecht? ..... ☐

16A Hat sich Ihr Appetit in den letzten Wochen verschlechtert?

Ja ..... ☐

Nein ..... ☐

20. Haben Sie Schwierigkeiten beim Kauen?

☞ ***Bei „Nein“ bitte nachfragen, wie es bei harten Lebensmitteln, wie z.B. Brotrinde, Apfel ist!***

Ja, immer ..... ☐
Ja, bei harten, zähen Lebensmitteln ..... ☐
Nein ..... ☐

19. Leiden Sie unter **Schluckbeschwerden**?

Ja, immer ..... ☐
Ja, manchmal ..... ☐
Nein ..... ☐

21. Haben Sie Probleme, ein Stück Fleisch kleinzuschneiden?

Ja, immer ..... ☐
Ja, manchmal ..... ☐
Nein ..... ☐

22. Jetzt kommt ein kleiner Gedächtnistest. Ich nenne Ihnen 3 Begriffe: Apfel – Pfennig – Tisch. Bitte wiederholen Sie die Begriffe. Bitte merken Sie sich die Begriffe.

22. Können Sie sich noch an die 3 Begriffe erinnern, die ich Ihnen vorhin – in Frage 22 – genannt habe? Bitte nennen Sie die Begriffe.

Alle 3 Begriffe richtig ..... ☐
2 Begriffe richtig ..... ☐
1 Begriff richtig ..... ☐
Kein Begriff richtig ..... ☐

23. An welchen chronischen Krankheiten leiden Sie?

☞ ***Vorgaben bitte vorlesen und einzeln abfragen!***
Wenn bereits eine Krebsoperation erfolgt ist, momentan aber kein akutes Krebsleiden besteht, bitte trotzdem „bösartiger Tumor/Krebs“ als chronische Krankheit entsprechend eintragen.
Bei Vorhandensein eines künstlichen Darmausganges bitte bei „entzündlichen Darmerkrankungen“ entsprechend eintragen. Gallensteine unter „Sonstiges“ eintragen. Schilddrüsen-Operation/Kropf-Operation ist keine chronische Krankheit, sondern ein Akutereignis. Unter „Durchblutungsstörungen am Herzen“ fallen z.B. Herzinfarkt, Angina pectoris, Bypass- oder Katheter-Operationen!

- Zuckerkrankheit (Diabetes mellitus) ..... ☐
- Bluthochdruck ..... ☐
- Durchblutungsstörung am Herzen ..... ☐
- Herzinsuffizienz ..... ☐
- Herzrhythmusstörungen ..... ☐
- Schlaganfall ..... ☐
- Bösartiger Tumor / Krebs ..... ☐
- Erkrankungen der Atemwege ..... ☐
- Gastritis, Magenerkrankung ..... ☐
- Entzündliche Darmerkrankungen ..... ☐
- Chronische Leberkrankheit ..... ☐
- Chronische Nierenerkrankung ..... ☐
- Gelenkerkrankungen (Arthritis, Arthrose) ..... ☐
- Osteoporose ..... ☐
- Sonstige Erkrankungen des Bewegungsapparates (z.B. Knieprobleme) ..... ☐
- Schilddrüsenfunktionsstörungen ..... ☐
- Sonstiges, und zwar: ..... ☐

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26. Wie häufig hatten Sie in der letzten Woche körperliche Schmerzen -

☞ ***Vorgaben bitte vorlesen!***

- nie? ..... ☐
- einmal? ..... ☐
- mehrmals? ..... ☐
- oder täglich? ..... ☐

Activities of daily living (ADL's)

27. Sind Sie zu den folgenden Tätigkeiten in der Lage?

☞ ***Liste 27 vorlegen! Punkte der Reihe nach abfragen, eine Antwort pro Zeile!***

		Ja, ohne Probleme	**Ja, mit Mühe, aber ohne Hilfe**	**Ja, aber nur mit Hilfs-person**	**Nein**
A	Von Zimmer zu Zimmer gehen	☐	☐	☐	☐
B	Treppensteigen	☐	☐	☐	☐
C	Das Haus verlassen	☐	☐	☐	☐
D	Mindestens 400 m gehen	☐	☐	☐	☐
E	Schwere Sachen tragen (z.B. Einkäufe von 5 kg 100 m)	☐	☐	☐	☐
F	Toilettenbenutzung	☐	☐	☐	☐
G	Waschen	☐	☐	☐	☐
H	Baden	☐	☐	☐	☐
J	Anziehen	☐	☐	☐	☐
K	Aufstehen aus dem Bett	☐	☐	☐	☐
L	Fußnägel schneiden	☐	☐	☐	☐
M	Medikamente nehmen	☐	☐	☐	☐
N	Bankgeschäfte erledigen	☐	☐	☐	☐
O	Essen	☐	☐	☐	☐
P	Leichte Hausarbeit (abspülen, Staub wischen)	☐	☐	☐	☐
Q	Schwere Hausarbeit (Fenster putzen, Boden putzen)	☐	☐	☐	☐
R	Über Nacht allein bleiben	☐	☐	☐	☐

28A Wie oft treiben Sie Sport, z.B. Gymnastik, Schwimmen, Radfahren?

☞ ***Liste 28A vorlegen! Nur eine Nennung möglich!***

A Regelmäßig. insgesamt mehr als 5 Stunden in der Woche ☐
B Regelmäßig. insgesamt 3-5 Stunden in der Woche ☐
C Regelmäßig. insgesamt 1-3 Stunden in der Woche ☐
D Weniger als 1 Stunde pro Woche ☐
E Keine sportliche Betätigung ☐

28B Fühlen Sie sich im Vergleich zu gleichaltrigen Personen -

☞ ***Vorgaben bitte vorlesen!***

- weniger aktiv? ☐
- gleich aktiv? ☐
- oder aktiver? ☐

Smoking habits

9A Sind Sie –

☞ ***Vorgaben bitte vorlesen!***

- Raucher? ☐
- ehemaliger Raucher? ☐
- oder Nichtraucher? ☐

Nutritional aspects

4A Wer bereite Ihre warmen Mahlzeiten zu?

☞ ***Mehrfachnennungen möglich!***

Selbst ☐
Partner ☐
Kinder ☐
Koch/Köchin (Restaurant) ☐
Koch/Köchin (Betriebskantine) ☐
Essen auf Rädern ☐
Sonstiges, und zwar: ☐

_____

4B Wer bereite Ihre **nicht** warmen Mahlzeiten zu?

☞ ***Mehrfachnennungen möglich!***

Selbst ..... ☐
Partner ..... ☐
Kinder ..... ☐
Sonstiges, und zwar: ..... ☐
_____

5 Wären Sie in der Lage, ohne Probleme eine warme Mahlzeit, z.B. Fleisch mit 2 Beilagen, zuzubereiten, auch wenn Sie es zur Zeit nicht tun?

☞ ***Nur eine Nennung möglich!***

Ja, ohne Probleme ..... ☐
Ja, es ginge mit Schwierigkeiten ..... ☐
Nein ..... ☐

3. Wie oft essen Sie normalerweise eine warme Mahlzeit?

☞ ***Liste 28A vorlegen! Nur eine Nennung möglich!***

A Mehrmals täglich ..... ☐
B (Fast) täglich ..... ☐
C Mehrmals pro Woche (3-4 mal pro Woche) ..... ☐
D Gelegentlich ..... ☐
E Nie ..... ☐

10. Für wie wichtig halten Sie eine richtige / ausgewogene Ernährung für die Gesundheit und das Wohlbefinden im Alter, für -

☞ ***Vorgaben bitte vorlesen! Nur eine Nennung möglich!***

- sehr wichtig? ..... ☐
- weniger wichtig? ..... ☐
- oder unwichtig? ..... ☐

Anthropometry

40. Jetzt würde ich noch gerne Ihr aktuelles Körpergewicht und Ihre Körpergröße messen; haben Sie die Möglichkeit sich zu wiegen?

Ja, Messung _____ kg (inklusive leichter Kleidung)

Was wiegen Sie?
(Selbstangabe) _____ kg (ohne Kleidung)

41. Jetzt habe ich noch eine Frage zu Ihrer aktuellen Körpergröße; darf ich Sie messen?

Ja, Messung _____ cm

Wie groß sind Sie?
(Selbstangabe) _____ cm

Fluid intake

7 Wieviel Liter Flüssigkeit trinken Sie täglich? Denken Sie bitte an alle Getränke, z.B. Kaffee, Tee, Mineralwasser, Limonaden, Saft, alkoholische Getränke etc., die Sie im Laufe eines Tages zu sich nehmen.

☞ ***Liste 7 vorlegen! Nur eine Nennung möglich!***

A Weniger als ½ Liter ..... ☐
B ½ bis unter 1 Liter ..... ☐
C 1 bis unter 1,5 Liter ..... ☐
D 1,5 bis unter 2 Liter..... ☐
E 2 Liter und mehr ..... ☐
Weiß nicht ..... ☐

VIII.2 Dietary records

Regional study part (reduced in size)

Verzehr über 3 Tage	**Anzahl am:**		
	Sonntag	**Montag**	**Dienstag**
Brot	**in Scheiben**		
Weißbrot, Toastbrot			
Mischbrot, Graubrot, Roggenbrot			
Vollkornbrot (z. B. Roggen-, Weizenvollkorn)			
Mehrkornbrot (z. B. Sechskorn-, Vierkorn)			
Knäckebrot, Zwieback			
Sonstiges Brot (z. B. Pumpernickel, Graham)			
Brötchen	**in Stück**		
Roggenbrötchen			
Vollkornbrötchen, Mehrkornbrötchen			
Sonstige Brötchen (z. B. Rosinen-, Laugenbrötchen)			
Hörnchen, Croissant			
Brotaufstrich, Butter, Margarine, Öl	**in Teelöffeln**		
Marmelade, Konfitüre, Gelee			
Honig			
Nußnougatcreme			
Butter (auch zum Kochen / Braten) **Sorte / Name**			
Margarine (auch zum Kochen / Braten) **Sorte / Name**			
Öl (zum Kochen / Braten) **Sorte / Name**			
Müsli, Getreidebrei	**in Eßlöffeln**		
Haferflocken **(trocken)**			
Gemischtes Müsli **(trocken)**			
Cornflakes **(trocken)**			
Kuchen und Gebäck	**in Stück**		
Sahnetorte, Crèmetorte			
Kuchen ohne Füllung/ohne Belag (z. B. Marmor-, Hefekuchen)			
Kuchen mit Füllung/mit Belag (z. B. Käsekuchen)			
Obstkuchen (z. B. Apfelkuchen)			
Stückchen, Teilchen (z. B. Plunder, Blätterteiggebäck)			
Kekse, Plätzchen			
Käse, Milchprodukte, Milch (eine Portion entspricht dem Belag einer Scheibe Brot)	**in Portionen, Bechern oder Tassen**		
Fettgehalt in %			
Quark, Frischkäse **(in Portionen)**			
Hartkäse (z. B. Emmentaler, Gouda) **(in Portionen)**			
Weichkäse (z. B. Camembert) **(in Portionen)**			
Joghurt, Kefir **(im Becher à 150 g)**			
Buttermilch **(in Tassen à 150 ml)**			
Milch **(in Tassen à 150 ml)**			
Saure Sahne, Dickmilch **(im Becher à 150 g)**			
Süße Sahne/Schlagsahne **(im Becher à 150 g)**			
Wurst (eine Portion entspricht dem Belag einer Scheibe Brot)	**in Portionen oder Stück**		
Fettreiche Wurst (z. B. Salami, Cervelatwurst) **(in Portionen)**			
Fettarme Wurst (z. B. Geflügelwurst, Bierschinken), gekochter Schinken **(in Portionen)**			
Roher Schinken, Lyoner, Gelbwurst **(in Portionen)**			
Wienerle, Frankfurter, Fleischwurst **(in Stück)**			
Fleisch, Fisch, Eier	**in Portionen oder Stück**		
Zubereitung / Sorte			
Rindfleisch, Kalbfleisch **(in Portionen)**			
Schweinefleisch **(in Portionen)**			
Geflügelfleisch **(in Portionen)**			
Schaffleisch **(in Portionen)**			
Wild **(in Portionen)**			
Frikadelle **(in Stück)**			
Innereien (z. B. Leber, Niere) **(in Portionen)**			
Fisch **(in Portionen)**			
Eier **(in Stück)**			

Suppe, Eintopf		**in Tellern**		
Klare Suppe				
Gebundene Suppe/Crèmesuppe				
Eintopf mit Fleisch/Wurst				
Eintopf ohne Fleisch, Gemüseeintopf				
Kartoffeln, Nudeln, Reis, Pizza		**in Portionen oder Stück**		
Pellkartoffeln, Salzkartoffeln **(in Portionen)**				
Kartoffelbrei **(in Portionen)**				
Bratkartoffeln **(in Portionen)**				
Kartoffelklöße **(in Stück)**				
Nudeln ohne Füllung **(in Portionen)**				
Nudeln mit Füllung (z. B. Ravioli) **(in Portionen)**				
Reis **(in Portionen)**				
Getreide (z. B. Hirse, Polenta) **(in Portionen)**				
Pfannkuchen **(in Stück)**				
Pizza **(in Stück)**				
Gemüse, Salat		**in Portionen**		
	Sorte			
Erbsen, Linsen, Bohnen	.....			
Sonstiges Gemüse, gedünstet	.....			
Gemüserohkost (z. B. Karotten, Tomaten, Gurke)	.....			
Grüner Salat/Blattsalat	.....			
Kartoffelsalat				
Fleischsalat				
Obst		**in Stück oder Portionen**		
	Sorte			
Apfel, Birne **(in Stück)**	.....			
Banane **(in Stück)**				
Trauben, Beeren, Kirschen **(in Portionen)**	.....			
Zitrusfrüchte (z. B. Orange) **(in Stück)**	.....			
Südfrüchte (z. B. Ananas, Mango) **(in Stück)**	.....			
Konservenobst **(in Stück)**	.....			
Soßen, Salatsoßen		**in Portionen**		
Bratensoße				
Hackfleischsoße				
Tomatensoße				
Salatsoße (Essig/Öl)				
Süßwaren, Knabbereien, Nachspeisen		**in Stück, Tassen, Eßlöffeln oder Portionen**		
Schokolade, Pralinen **(in Stück)**				
Sonstige Süßwaren (Bonbons, Lakritz) **(in Stück)**				
Knabbergebäck **(in Tassen à 150 ml)**				
Nüsse, Pistazien **(in Eßlöffeln)**				
Pudding **(in Portionen)**				
Eis **(in Portionen)**				
Trockenfrüchte **(in Stück)**				

Kaffee, Tee, Kondensmilch, Zucker	**in Tassen à 150 ml oder Teelöffeln**		
Kaffee (coffeinhaltig) **(in Tassen à 150 ml)**			
Kaffee (entcoffeiniert) **(in Tassen à 150 ml)**			
Malzkaffee/Zichorienkaffee **(in Tassen à 150 ml)**			
Schwarzer Tee **(in Tassen à 150 ml)**			
Kräutertee, Früchtetee **(in Tassen à 150 ml)**			
Zucker **(in Teelöffeln)**			
Kaffeesahne, Kondensmilch **(in Teelöffeln)**			
Bier	**in Flaschen à 500 ml**		
Bier (z. B. Pils, Alt, Kölsch)			
Alkoholfreies Bier			
Malzbier			
Wein, Sekt, Spirituosen	**in Gläsern**		
Weißwein **(in Gläsern à 250 ml)**			
Rotwein **(in Gläsern à 250 ml)**			
Sekt **(in Gläsern à 100 ml)**			
Schnaps, Likör **(in Gläsern à 2 cl)**			

Säfte, Wasser, sonstige Getränke		**in Gläsern à 200 ml**		
	Sorte			
Fruchtsaft, 100 % Frucht	.....			
Fruchtnektar, 50 % Frucht	.....			
Gemüsesaft	.....			
Multivitaminsaft				
Erfrischungsgetränke (z. B. Limonaden, Cola)				
Diätgetränke (mit Süßstoff)				
Mineralwasser				
Leitungswasser				
Lebensmittel, die nicht aufgeführt sind		**Menge**		

National study part (reduced in size)

Verzehr über 3 Tage	**Anzahl am:**		
	Sonntag	**Montag**	**Dienstag**
Brot	**in Scheiben**		
Weißbrot, Toastbrot			
Mischbrot, Graubrot, Roggenbrot			
Vollkornbrot (z. B. Roggen-, Weizenvollkorn)			
Mehrkornbrot (z. B. Sechskorn-, Vierkorn)			
Knäckebrot, Zwieback			
Brötchen	**in Stück**		
Brötchen, Semmel (aus Weißmehl)			
Roggenbrötchen			
Vollkornbrötchen, Mehrkornbrötchen			
Hörnchen, Croissant			
Brotaufstrich, Butter, Margarine, Öl	**in Teelöffeln**		
Marmelade, Konfitüre, Gelee			
Honig			
Nußnougatcreme			
Sorte / Name			
Butter (auch zum Kochen / Braten)			
Margarine (auch zum Kochen / Braten)			
Öl (auch zum Kochen / Braten)			
Müsli, Getreidebrei	**in Eßlöffeln oder Portionen**		
Haferflocken **(trocken, in Eßlöffeln)**			
Gemischtes Müsli **(trocken, in Eßlöffeln)**			
Cornflakes **(trocken, in Eßlöffeln)**			
Milchbrei (z.B. Grieß-, Hafer-, Reisbrei) (**in Portionen**)			

Kuchen und Gebäck		**in Stück**		
Sahnetorte, Crèmetorte				
Kuchen ohne Füllung/ohne Belag (z. B. Marmor-, Hefekuchen)				
Kuchen mit Füllung/mit Belag (z. B. Käsekuchen)				
Obstkuchen (z. B. Apfelkuchen)				
Stückchen, Teilchen (z. B. Plunder, Blätterteiggebäck)				
Kekse, Plätzchen				
Käse, Milchprodukte, Milch (eine Portion entspricht dem Belag einer Scheibe Brot)		**in Portionen oder Tassen**		
	Fettgehalt in %			
Quark **(in Portionen)**	.....			
Frischkäse **(in Portionen)**	.....			
Hartkäse (z. B. Emmentaler, Gouda) **(in Portionen)**	.....			
Weichkäse (z. B. Brie, Camembert) **(in Portionen)**	.....			
Joghurt natur **(im Becher à 150 g)**	.....			
Joghurt mit Früchten **(im Becher à 150 g)**	.....			
Milch **(in Tassen à 150 ml)**	.....			
Kakaogetränk **(in Tassen à 150 ml)**				
Buttermilch **(in Tassen à 150 ml)**				
Saure Sahne **(im Becher à 150 g)**				
Süße Sahne/Schlagsahne **(im Becher à 150 g)**				
Wurst (eine Portion entspricht dem Belag einer Scheibe Brot)		**in Portionen oder Stück**		
Fettreiche Wurst (z. B. Salami, Cervelat, Streichwurst) **(in Port.)**				
Fettarme Wurst (z. B. Geflügelwurst, Bierschinken) **(in Portionen)**				
Lyoner, Gelbwurst, Fleischwurst **(in Portionen)**				
Fleischkäse, Bratwurst, Wienerle **(in Stück)**				
Roher Schinken **(in Portionen)**				
Gekochter Schinken **(in Portionen)**				
Speck **(in Portionen)**				
Fleisch, Fisch, Eier		**in Portionen oder Stück**		
	Zubereitung / Sorte			
Rindfleisch, Kalbfleisch **(in Portionen)**	.....			
Schweinefleisch **(in Portionen)**	.....			
Geflügelfleisch **(in Portionen)**	.....			
Lamm-, Schaffleisch **(in Portionen)**	.....			
Wild **(in Portionen)**	.....			
Innereien (z. B. Leber, Niere) **(in Portionen)**	.....			
Frikadelle **(in Stück)**				
Fisch **(in Portionen)**	.....			
Eier **(in Stück)**				
Suppe, Eintopf		**in Tellern**		
Klare Suppe				
Gebundene Suppe/Crèmesuppe				
Eintopf mit Fleisch/Wurst				
Eintopf ohne Fleisch, Gemüseeintopf				
Kartoffeln, Nudeln, Reis, Pizza		**in Portionen oder Stück**		
Pellkartoffeln, Salzkartoffeln **(in Portionen)**				
Kartoffelbrei **(in Portionen)**				
Bratkartoffeln **(in Portionen)**				
Kartoffelklöße **(in Stück)**				
Pommes frites, Kroketten **(in Stück)**				
Nudeln ohne Füllung **(in Portionen)**				
Nudeln mit Füllung (z. B. Ravioli) **(in Portionen)**				
Reis **(in Portionen)**				
Getreide (z. B. Hirse, Polenta) **(in Portionen)**				
Pfannkuchen **(in Stück)**				
Pizza **(in Stück)**				
Gemüse, Salat		**in Portionen**		
	Sorte			
Erbsen, Linsen, Bohnen	.....			
Sonstiges Gemüse, gedünstet	.....			
Gemüserohkost (z. B. Karotten, Tomaten, Gurke)	.....			
Sauer eingelegtes Gemüse (z. B. Sauerkraut)	.....			
Grüner Salat / Blattsalat	.....			
Kartoffelsalat, Nudelsalat				
Fleischsalat				

Obst		**in Stück oder Portionen**		
	Sorte			
Apfel, Birne **(in Stück)**	.....			
Banane **(in Stück)**				
Trauben, Beeren, Kirschen **(in Portionen)**	.....			
Pfirsich, Nektarine **(in Stück)**	.....			
Zitrusfrüchte (z. B. Orange) **(in Stück)**	.....			
Südfrüchte (z. B. Ananas, Mango) **(in Stück)**	.....			
Kiwi **(in Stück)**	.....			
Konservenobst **(in Stück)**	.....			
Soßen, Salatsoßen		**in Portionen**		
Bratensoße				
Butter-, Sahnesoße				
Hackfleischsoße				
Tomatensoße				
Salatsoße (Essig/Öl)				
Süßwaren, Knabbereien, Nachspeisen		**in Stück, Tassen, Eßlöffeln oder Portionen**		
Schokolade, Pralinen **(in Stück)**				
Sonstige Süßwaren (Bonbons, Lakritz) **(in Stück)**				
Knabbergebäck **(in Tassen à 150 ml)**				
Nüsse, Pistazien **(in Eßlöffeln)**				
Pudding **(in Portionen)**				
Eis **(in Portionen)**				
Trockenfrüchte **(in Stück)**				
Kaffee, Tee, Kondensmilch, Zucker		**in Tassen à 150 ml oder Teelöffeln**		
Kaffee (coffeinhaltig) **(in Tassen à 150 ml)**				
Kaffee (entcoffeiniert) **(in Tassen à 150 ml)**				
Malzkaffee/Zichorienkaffee **(in Tassen à 150 ml)**				
Schwarzer Tee **(in Tassen à 150 ml)**				
Kräutertee, Früchtetee **(in Tassen à 150 ml)**				
Zucker **(in Teelöffeln)**				
Kaffeesahne, Kondensmilch **(in Teelöffeln)**				
Bier		**in Flaschen à 500 ml**		
Bier (z. B. Pils, Alt, Kölsch)				
Alkoholfreies Bier				
Malzbier				
Wein, Sekt, Spirituosen		**in Gläsern**		
Weißwein **(in Gläsern à 250 ml)**				
Rotwein **(in Gläsern à 250 ml)**				
Sekt **(in Gläsern à 100 ml)**				
Schnaps, Likör **(in Gläsern à 2 cl)**				
Säfte, Wasser, sonstige Getränke		**in Gläsern à 200 ml**		
	Sorte			
Fruchtsaft, 100 % Frucht	.....			
Fruchtnektar, 50 % Frucht	.....			
Gemüsesaft	.....			
Multivitaminsaft				
Erfrischungsgetränke (z. B. Limonaden, Cola)				
Diätgetränke (mit Süßstoff)				
Mineralwasser				
Leitungswasser				
Lebensmittel, die nicht aufgeführt sind		**Menge**		

VIII.3 Tables

Table VIII.1 Testing for bias concerning non-participation – regional study part

study participation	men yes (n=21) mean	SD	men no (n=11) mean	SD	p	women yes (n=45) mean	SD	women no (n=51) mean	SD	p
age in years	88	1.3	89	3.0	1.000	88	3.0	88	1.9	0.952
	n	**%**	**n**	**%**		**n**	**%**	**n**	**%**	
Family status										
& unmarried	0	0.0	0	0.0	#0.359	2	4.4	3	5.9	#0.706
married	8	38.1	7	63.6	0.266	4	8.9	7	13.7	0.534
& living in divorce / separated	2	9.5	1	9.1		0	0.0	0	0.0	
& widowed	11	52.4	3	27.3		39	86.7	41	80.4	
Living situation										
alone	9	42.9	2	18.2	0.248	30	66.7	28	54.9	0.297
not alone	12	57.1	9	81.8		15	33.3	23	45.1	
School graduation										
& no graduation	1	4.8	0	0.0	#0.275	0	0.0	0	0.0	#0.136
& elementary/secondary education	16	76.2	6	66.7	0.640	33	73.3	37	78.7	0.628
§ O-level or comparable	1	4.8	1	11.1		10	22.2	6	12.8	
§ techn. college -/ high school grad.	3	14.3	2	22.2		2	4.4	4	8.5	
Educational level										
no educational attainment	10	47.6	3	27.3	#0.685	31	68.9	30	58.8	#0.754
& vocational training / foreman	10	47.6	5	45.5	0.691	13	28.9	16	31.4	0.663
& technical college / university degree	1	4.8	1	9.1		1	2.2	2	3.9	
no data	0	0.0	2	18.2		0	0.0	3	5.9	
Self-perception of health *										
good – very good	11	64.7	2	18.2	#0.034	21	52.5	15	29.4	0.022
& fair	2	11.8	3	27.3	0.018	11	27.5	13	25.5	
& less good – poor	3	17.6	6	54.5		6	15.0	20	39.2	
no data	1	5.9	0	0.0		2	5.0	3	5.9	
Index of mobility *										
less mobile	8	47.1	8	72.7	0.218	25	62.5	38	74.5	0.175
mobile (4 ADL without problems)	8	47.1	2	18.2		15	37.5	12	23.5	
no data	1	5.9	1	9.1		0	0.0	1	2.0	
Smoking habits: are you ...? *										
& smoker	0	0.0	2	18.2	#0.021	1	2.5	0	0.0	#0.461
& former smoker	13	76.5	3	27.3	0.125	2	5.0	4	7.8	1.000
never smoked	4	23.5	6	54.5		37	92.5	47	92.2	
no data	0	0.0	0	0.0		4	8.9	0	0.0	
How often do you get a warm meal?										
& several times a day	2	9.5	0	0.0	#0.228	3	6.7	5	10.0	#0.842
& (almost) daily	19	90.5	10	90.9	0.534	41	91.1	44	88.0	0.718
several times a week/ occasionally	0	0.0	1	9.1		1	2.2	1	2.0	

no data: no data available/no answer; P: Chi²-test/Fisher's exact test; * Mann-Whitney-U-test

significance restricted because more than 20% of cross-tabled cells with expected frequency below, second p-value was calculated with &-marked (and §-marked) items classified

* participants: based on 57 subjects with complete second interview (17 men and 40 women)

Table VIII.2 Testing for bias concerning non-participation in anthropometry – national study part

anthropometric data at hand	men yes (n=54) mean	SD	men no (n=46) mean	SD	p	women yes (n=136) mean	SD	women no (n=84) mean	SD	p
age in years	87	2.0	87	2.1	0.070*	87	2.1	88	2.5	0.228*
	n	**%**	**n**	**%**		**n**	**%**	**n**	**%**	
Family status										
& unmarried	0	0.0	1	2.2	#0.565	8	5.9	2	2.4	#0.562
married	23	42.6	20	43.5	1.000	9	6.6	5	6.0	1.000
& living in divorce / separated	1	1.9	0	0.0		5	3.7	5	6.0	
& widowed	30	55.6	25	54.3		114	83.8	72	85.7	
Living situation										
alone	23	42.6	22	47.8	0.688	107	78.7	63	75.0	0.620
not alone	30	55.6	24	52.2		29	21.3	21	25.0	
no data	1	1.9	0	0.0		0	0.0	0	0.0	
School graduation										
& no graduation	1	1.9	0	0.0	#0.481	4	2.9	0	0.0	#0.306
& elementary/secondary education	37	68.5	27	58.7	0.293	99	72.8	68	81.0	0.408
§ O-level or comparable	7	13.0	10	21.7		28	20.6	14	16.7	
§ techn. college -/ high school grad.	9	16.7	9	19.6		5	3.7	2	2.4	
Educational level										
no educational attainment	2	3.7	6	13.0	#0.227	74	54.4	42	50.0	#0.689
& vocational training / foreman	41	75.9	31	67.4	0.140	58	42.6	38	45.2	0.579
& technical college / university degree	10	18.5	9	19.6		4	2.9	4	4.8	
no data	1	1.9	0	0.0		0	0.0	0	0.0	
Former professional status										
employee, clerk, self-employed	36	66.7	32	69.6	#0.270	56	41.2	38	45.2	0.056
& manual worker, family worker	17	31.5	12	26.1	1.000	43	31.6	15	17.9	
& housewife/homemaker	0	0.0	2	4.3		36	26.5	31	36.9	
no data	1	1.9	0	0.0		1	0.7	0	0.0	
Do you have enough money?										
yes, no problem	39	72.2	33	71.7	1.000	92	67.6	53	63.1	#0.273
& yes, fairly	15	27.8	13	28.3		38	27.9	29	34.5	0.659
& no, does not suffice	0	0.0	0	0.0		6	4.4	1	1.2	
no data	0	0.0	0	0.0		0	0.0	1	1.2	
Can you rely on s.o. who helps you if you were ill?										
yes	48	88.9	40	87.0	0.769	125	91.9	80	95.2	0.418
no	6	11.1	6	13.0		11	8.1	4	4.8	
Self-perception of health										
good – very good	20	37.0	14	30.4	0.754	41	30.1	31	36.9	0.340
fair	19	35.2	19	41.3		48	35.3	22	26.2	
less good – poor	15	27.8	13	28.3		47	34.6	31	36.9	
How is your appetite?										
good – very good	42	77.8	32	69.6	0.370	81	59.6	56	66.7	0.389
less good - poor	12	22.2	14	30.4		54	39.7	28	33.3	
no data	0	0.0	0	0.0		1	0.7	0	0.0	
Did you recently notice a loss of appetite?										
yes	1	1.9	3	6.5	0.331	15	11.0	12	14.3	0.529
no	53	98.1	43	93.5		120	88.2	72	85.7	
no data	0	0.0	0	0.0		1	0.0	0	0.0	
Do you have any difficulties in chewing?										
yes	18	33.3	14	30.4	0.831	49	36.0	35	41.7	0.394
no	36	66.7	32	69.6		86	63.2	48	571	
no data	0	0.0	0	0.0		1	0.7	1	1.2	
Do you have problems in swallowing?										
yes	6	11.1	6	13.0	0.769	13	9.6	8	9.5	1,000
no	48	88.9	40	87.0		122	89.7	76	90.5	
no data	0	0.0	0	0.0		1	0.7	0	0.0	
Do you have problems in cutting a piece of meat?										
yes	9	16.7	7	15.2	1.000	33	24.3	23	27.4	0.750
no	45	83.3	39	84.8		101	74.3	61	72.6	
no data	0	0.0	0	0.0		2	1.5	0	0.0	
Performance of the memory test										
good	21	38.9	18	39.1	1.000	46	33.8	23	27.4	0.372
poor	33	61.1	28	60.9		90	66.2	60	71.4	
no data	0	0.0	0	0.0		0	0.0	1	1.2	

Table VIII.2 (continued)

anthropometric data at hand	men					women				
	yes (n=54)		no (n=46)			yes (n=136)		no (n=84)		
	n	%	n	%	p	n	%	n	%	p
Number of chronic diseases										
& none	4	7.4	3	6.5	#0.985	14	10.3	6	7.1	0.422
& 1-3	36	66.7	31	67.4	1.000	74	54.4	53	63.1	
more than 3	14	25.9	12	26.1		48	35.3	25	29.8	
How often have you been in pain the last week?										
never	19	35.2	17	37.0	1.000	40	29.4	21	25.0	0.443
one or more times	34	63.0	29	63.0		92	67.6	62	73.8	
no data	1	1.9	0	0.0		4	2.9	1	1.2	
Index of mobility										
less mobile	25	46.3	23	50.0	0.841	85	62.5	57	67.9	0.470
mobile (4 ADL without problems)	29	53.7	23	50.0		51	37.5	27	32.1	
Do you practice any kind of sports?										
no sports	37	68.5	34	73.9	#0.803	103	75.7	69	82.1	0.334
& regularly, less than 3 hours/week	15	27.8	11	23.9	0.660	26	19.1	10	11.9	
& regularly, more than 3 hours/week	2	3.7	1	2.2		7	5.1	3	3.6	
no data	0	0.0	0	0.0		0	0.0	2	2.4	
Compared to people of the same age, do you feel ...?										
less active	4	7.4	6	13.0	0.274	30	22.1	12	14.3	0.344
same active	19	35.2	10	21.7		46	33.8	33	39.3	
more active	31	57.4	30	65.2		60	44.1	39	46.4	
Smoking habits: are you ...?										
& smoker	4	7.4	2	4.3	#0.743	6	4.4	6	7.1	#0.655
& former smoker	18	33.3	14	30.4	0.680	8	5.9	4	4.8	0.824
never smoked	32	59.3	30	65.2		122	89.7	74	88.1	
How often do you get a warm meal?										
& several times a day	6	11.1	4	8.7	#0.579	9	6.6	2	2.4	#0.315
& (almost) daily	46	85.2	42	91.3	1.000	122	89.7	80	95.2	0.711
several times a week/ occasionally	1	1.9	0	0.0		5	3.7	2	2.4	
no data	1	1.9	0	0.0		0	0.0	0	0.0	
Are you able to prepare a complete meal, even if you actually don't do it?										
yes, without any problem	25	46.3	20	43.5	0.674	94	69.1	58	69.0	0.989
yes, with problems	12	22.2	14	30.4		25	18.4	15	17.9	
no	16	29.6	12	26.1		17	12.5	11	13.1	
no data	1	1.9	0	0.0		0	0.0	0	0.0	
What do you think, how important is a "right"/ balanced diet for health and feeling well?										
very important	42	77.8	30	65.2	#0.171	111	81.6	67	79.8	#0.025
& less important	12	22.2	14	30.4	0.186	24	17.6	11	13.1	0.728
& unimportant	0	0.0	2	4.3		1	0.7	6	7.1	

no data: no data available/no answer; P: Chi²-test/Fisher's exact test; * Mann-Whitney-U-test
significance restricted because more than 20% of cross-tabled cells with expected frequency below, second p-value was calculated with &-marked (and §-marked) items classified

Table VIII.3 Testing for bias concerning non-participation in anthropometry – regional study part

anthropometric data at hand (body weight, height, and BMI)	men yes (n=14) mean	SD	men no (n=7) mean	SD	p	women yes (n=33) mean	SD	women no (n=12) mean	SD	p
age in years	88	1.5	88	0.9	0.729*	89	3.2	88	2.6	0.592*
	n	**%**	**n**	**%**		**n**	**%**	**n**	**%**	
Family status										
& unmarried	0	0.0	0	0.0	#0.109	1	3.0	1	8.3	#0.747
married	6	42.9	2	28.6	0.656	3	9.1	1	8.3	1.000
& living in divorce / separated	0	0.0	2	28.6		0	0.0	0	0.0	
& widowed	8	57.1	3	42.9		29	87.9	10	83.3	
Living situation										
alone	5	35.7	4	57.1	0.397	24	72.7	6	50.0	0.174
not alone	9	64.3	3	42.9		9	27.3	6	50.0	
School graduation										
& no graduation	1	7.1	0	0.0	#0.350	0	0.0	0	0.0	#0.102
& elementary/secondary education	9	64.3	7	100.0	0.255	27	81.8	6	50.0	0.055
§ O-level or comparable	1	7.1	0	0.0		5	15.2	5	41.7	
§ techn. college -/ high school grad.	3	21.4	0	0.0		1	3.0	1	8.3	
Educational level										
no educational attainment	7	50.0	3	42.9	#0.687	24	72.7	7	58.3	#0.209
& vocational training / foreman	6	42.9	4	57.1	1.000	9	27.3	4	33.3	0.470
& technical college / university degree	1	7.1	0	0.0		0	0.0	1	8.3	
Former professional status										
employee, clerk, self-employed	12	85.7	5	71.4	#0.891	12	36.4	5	41.7	#0.672
& manual worker, family worker	2	14.3	1	14.3	1.000	1	3.0	1	8.3	0.743
& housewife/homemaker	0	0.0	0	0.0		20	60.6	6	50.0	
no data	0	0.0	1	14.3		0	0.0	0	0.0	
Do you have enough money?										
yes, no problem	10	71.4	3	42.9	1.000	25	75.8	6	50.0	0.147
yes, fairly / no does not suffice	4	28.6	2	28.6		8	24.2	6	50.0	
no data	0	0.0	2	28.6		0	0.0	0	0.0	
Can you rely on s.o. who helps you if you were ill?										
yes	12	85.7	5	71.4	1.000	33	100.0	11	91.7	–
no	2	14.3	1	14.3		0	0.0	0	0.0	
no data	0	0.0	1	14.3		0	0.0	1	8.3	
How often do you get a warm meal?										
daily - several times a day	14	100.0	7	100.0	–	32	97.0	12	100.0	1.000
less frequent	0	0.0	0	0.0		1	3.0	0	0.0	
What do you think, how important is a "right"/ balanced diet for health and feeling well?										
very important	12	85.7	6	85.7	#0.299	24	72.7	11	91.7	#0.417
& less important	0	0.0	1	14.3	1.000	2	6.1	0	0.0	0.309
& unimportant	1	7.1	0	0.0		2	6.1	0	0.0	
no data	1	7.1	0	0.0		5	15.2	1	8.3	

anthropometric data at hand	yes (n=14) mean	SD	no (n=3) mean	SD	p	yes (n=32) mean	SD	no (n=8) mean	SD	p
age in years	88	1.5	90	–	0.267*	89	3	88	2	0.942*
	n	**%**	**n**	**%**		**n**	**%**	**n**	**%**	
Self-perception of health										
good - very good	10	71.4	1	33.3	#0.059	17	53.1	4	50.0	#0.991
& fair	2	14.3	0	0.0	0.214	9	28.1	2	25.0	1.000
& less good - poor	1	7.1	2	66.7		5	15.6	1	12.5	
no data	1	7.1	0	0.0		1	3.1	1	12.5	
How is your appetite?										
good – very good	12	85.7	2	66.7	0.350	21	65.6	4	50.0	1.000
less good - poor	1	7.1	1	33.3		11	34.4	2	25.0	
no data	1	7.1	0	0.0		0	0.0	2	25.0	
Did you recently notice a loss of appetite?										
yes	1	7.1	1	33.3	0.350	4	12.5	0	0.0	1.000
no	12	85.7	2	66.7		28	87.5	6	75.0	
no data	1	7.1	0	0.0		0	0.0	2	25.0	

Table VIII.3 (continued)

anthropometric data at hand	men yes (n=14) mean	SD	men no (n=3) mean	SD	p	women yes (n=32) mean	SD	women no (n=8) mean	SD	p
age in years	88	1.5	90	–	0.267*	89	3	88	2	0.942*
	n	**%**	**n**	**%**		**n**	**%**	**n**	**%**	
Do you have any difficulties in chewing?										
yes	5	35.7	3	100.0	0.200	16	50.0	3	37.5	1.000
no	8	57.1	0	0.0		16	50.0	3	37.5	
no data	1	7.1	0	0.0		0	0.0	2	25.0	
Do you have problems in swallowing?										
yes	1	7.1	0	0.0	1.000	1	3.1	1	12.5	0.294
no	12	85.7	3	100.0		31	96.9	5	62.5	
no data	1	7.1	0	0.0		0	0.0	2	25.0	
Do you have problems in cutting a piece of meat?										
yes	1	7.1	0	0.0	1.000	7	21.9	3	37.5	0.310
no	12	85.7	3	100.0		25	78.1	3	37.5	
no data	1	7.1	0	0.0		0	0.0	2	25.0	
Are you able to prepare a complete meal, even if you actually don't do it?										
& yes, without any problem	7	50.0	1	33.3	#0.563	22	68.8	2	25.0	#0.008
& yes, with problems	2	14.3	0	0.0	0.537	5	15.6	0	0.0	0.007
no	5	35.7	2	66.7		5	15.6	5	62.5	
no data	0	0.0	0	0.0		0	0.0	1	12.5	
Performance of the memory test										
good	1	7.1	0	0.0	1.000	6	18.2	0	0.0	0.564
poor	11	78.6	3	42.9		25	75.8	5	41.7	
no data	2	14.3	4	57.1		2	6.1	7	58.3	
Number of chronic diseases										
& none	2	14.3	0	0.0	#0.657	4	12.5	0	0.0	#0.324
& 1-3	9	64.3	2	66.7	1.000	13	40.6	4	50.0	0.627
more than 3	2	14.3	0	0.0		12	37.5	1	12.5	
no data	1	7.1	1	33.3		3	9.4	3	37.5	
How often have you been in pain the last week?										
never	8	57.1	2	66.7	1.000	15	46.9	2	25.0	0.672
one or more times	5	35.7	1	33.3		17	53.1	4	50.0	
no data	1	7.1	0	0.0		0	0.0	2	25.0	
Index of mobility										
less mobile	5	35.7	3	100.0	0.200	18	56.3	7	87.5	0.219
mobile (4 ADL without problems)	8	57.1	0	0.0		14	43.8	1	12.5	
no data	1	7.1	0	0.0		0	0.0	0	0.0	
Do you practice any kind of sports?										
yes	2	14.3	0	0.0	1.000	1	3.1	0	0.0	1.000
no	12	85.7	3	100.0		31	96.9	7	87.5	
no data	0	0.0	0	0.0		0	0.0	1	12.5	
Compared to people of the same age, do you feel ...?										
& less active	2	14.3	0	0.0	#0.713	3	9.4	1	12.5	#0.840
& same active	3	21.4	0	0.0	1.000	7	21.9	1	12.5	1.000
more active	7	50.0	1	33.3		12	37.5	2	25.0	
no data	2	14.3	2	66.7		10	31.3	4	50.0	
Smoking habits: are you ...?										
& smoker	0	0.0	0	0.0	1.000	1	3.1	0	0.0	#0.496
& former smoker	11	78.6	2	66.7		1	3.1	1	12.5	0.498
never smoked	3	21.4	1	33.3		30	93.8	7	87.5	

no data: no data available/no answer; P: Chi²-test/Fisher's exact test; * Mann-Whitney-U-test
significance restricted because more than 20% of cross-tabled cells with expected frequency below, second p-value was calculated with &-marked (and §-marked) items classified

Table VIII.4 Testing for bias concerning non-participation in dietary records – national study part										
	men					women				
dietary records at hand	**yes (n=89)**		**no (n=11)**			**yes (n=198)**		**no (n=22)**		
	mean	**SD**	**mean**	**SD**	**p**	**mean**	**SD**	**mean**	**SD**	**p**
age in years	87	1.9	88	2.9	0.629*	87	2.3	88	2.4	0.475*
	n	**%**	**n**	**%**		**n**	**%**	**n**	**%**	
Family status										
& unmarried	1	1.1	0	0.0	#0.645	9	4.5	1	4.5	#0.739
married	40	44.9	3	27.3	0.342	13	6.6	1	4.5	1.000
& living in divorce / separated	1	1.1	0	0.0		8	4.0	2	9.1	
& widowed	47	52.8	8	72.7		168	84.8	18	81.8	
Living situation										
alone	36	40.4	9	81.8	0.011	150	75.8	20	90.9	0.177
not alone	53	59.6	2	18.2		48	24.2	2	9.1	
School graduation										
& no graduation	1	1.1	0	0.0	#0.209	4	2.0	0	0.0	#0.370
& elementary/secondary education	57	64.0	7	63.6	1.000	153	77.3	14	63.6	0.107
§ O-level or comparable	17	19.1	0	0.0		35	17.7	7	31.8	
§ techn. college -/ high school grad.	14	15.7	4	36.4		6	3.0	1	4.5	
Educational level										
no educational attainment	8	9.0	0	0.0	#0.491	103	52.0	13	59.1	0.226
& vocational training / foreman	64	71.9	8	72.7	0.592	89	44.9	7	31.8	
& technical college / university degree	16	18.0	3	27.3		6	3.0	2	9.1	
Former professional status										
employee, clerk, self-employed	60	67.4	8	72.7	#0.862	86	43.4	8	36.4	0.264
& manual worker, family worker	26	29.2	3	27.3	1.000	49	24.7	9	40.9	
& housewife/homemaker	2	2.2	0	0.0		62	31.3	5	22.7	
no data	1	1.1	0	0.0		1	0.5	0	0.0	
Do you have enough money?										
yes, no problem	66	74.2	6	54.5	0.283	136	68.7	9	40.9	0.008
& yes, fairly	23	25.8	5	45.5		54	27.3	13	59.1	
& no, does not suffice	0	0.0	0	0.0		7	3.5	0	0.0	
no data	0	0.0	0	0.0		1	0.5	0	0.0	
Can you rely on s.o. who helps you if you were ill?										
yes	80	89.9	8	72.7	0.125	184	92.9	21	95.5	1.000
no	9	10.1	3	27.3		14	7.1	1	4.5	
Self-perception of health										
good - very good	28	31.5	6	54.5	#0.245	62	31.3	10	45.5	0.267
& fair	36	40.4	2	18.2	0.177	66	33.3	4	18.2	
& less good - poor	25	28.1	3	27.3		70	35.4	8	36.4	
How is your appetite?										
good – very good	66	74.2	8	72.7	1.000	123	62.1	14	63.6	1.000
less good - poor	23	25.8	3	27.3		74	37.4	8	36.4	
no data	0	0.0	0	0.0		1	0.5	0	0.0	
Did you recently notice a loss of appetite?										
yes	4	4.5	0	0.0	1.000	25	12.6	2	9.1	1.000
no	85	95.5	11	100.0		172	86.9	20	90.9	
no data	0	0.0	0	0.0		1	0.5	0	0.0	
Do you have any difficulties in chewing?										
yes	27	30.3	5	45.5	0.322	74	37.4	10	45.5	0.480
no	62	69.7	6	54.5		123	62.1	11	50.0	
no data	0	0.0	0	0.0		1	0.5	1	4.5	
Do you have problems in swallowing?										
yes	10	11.2	2	18.2	0.618	21	10.6	0	0.0	0.141
no	79	88.8	9	81.8		176	88.9	22	100.0	
no data	0	0.0	0	0.0		1	0.5	0	0.0	
Do you have problems in cutting a piece of meat?										
yes	14	15.7	2	18.2	1.000	50	25.3	6	27.3	0.802
no	75	84.3	9	81.8		146	73.7	16	72.7	
no data	0	0.0	0	0.0		2	1.0	0	0.0	
Performance of the memory test										
good	36	40.4	3	27.3	0.521	66	33.3	3	13.6	0.088
poor	53	59.6	8	72.7		131	66.2	19	86.4	
no data	0	0.0	0	0.0		1	0.5	0	0.0	

Table VIII.4 (continued)

dietary records at hand	men yes (n=89) n	%	men no (n=11) n	%	p	women yes (n=198) n	%	women no (n=22) n	%	p
Number of chronic diseases										
& none	6	6.7	1	9.1	#0.948	17	8.6	3	13.6	0.663
& 1-3	60	67.4	7	63.6	1.000	114	57.6	13	59.1	
more than 3	23	25.8	3	27.3		67	33.8	6	27.3	
How often have you been in pain the last week?										
never	31	34.8	5	45.5	0.522	51	25.8	10	45.5	0.080
one or more times	57	64.0	6	54.5		142	71.7	12	54.5	
no data	1	1.1	0	0.0		5	2.5	0	0.0	
Index of mobility										
less mobile	43	48.3	5	45.5	1.000	129	65.2	13	59.1	0.640
mobile (4 ADL without problems)	46	51.7	6	54.5		69	34.8	9	40.9	
Do you practice any kind of sports?										
no sports	64	71.9	7	63.6	#0.614	155	78.3	17	77.3	#0.427
& regularly, less than 3 hours/week	22	24.7	4	36.4	0.726	31	15.7	5	22.7	0.788
& regularly, more than 3 hours/week	3	3.4	0	0.0		10	5.1	0	0.0	
no data	0	0.0	0	0.0		2	1.0	0	0.0	
Compared to people of the same age, do you feel ...?										
& less active	7	7.9	3	27.3	#0.068	37	18.7	5	22.7	0.666
& same active	28	31.5	1	9.1	1.000	73	36.9	6	27.3	
more active	54	60.7	7	63.6		88	44.4	11	50.0	
Smoking habits: are you ...?										
& smoker	5	5.6	1	9.1	#0.486	11	5.6	1	4.5	#0.959
& former smoker	27	30.3	5	45.5	0.324	11	5.6	1	4.5	1.000
never smoked	57	64.0	5	45.5		176	88.9	20	90.9	
How often do you get a warm meal?										
daily - several times a day	87	97.8	11	100.0	1.000	193	97.5	20	90.9	0.147
less frequent	1	1.1	0	0.0		5	2.5	2	9.1	
no data	1	1.1	0	0.0		0	0.0	0	0.0	
Are you able to prepare a complete meal, even if you actually don't do it?										
& yes, without any problem	39	43.8	6	54.5	#0.764	134	67.7	18	81.8	#0.379
& yes, with problems	24	27.0	2	18.2	1.000	38	19.2	2	9.1	0.748
no	25	28.1	3	27.3		26	13.1	2	9.1	
no data	1	1.1	0	0.0		0	0.0	0	0.0	
What do you think, how important is a "right"/ balanced diet for health and feeling well?										
very important	65	73.0	7	63.6	#0.645	160	80.8	18	81.8	#0.651
& less important	22	24.7	4	36.4	0.496	31	15.7	4	18.2	1.000
& unimportant	2	2.2	0	0.0		7	3.5	0	0.0	

no data: no data available/no answer; P: Chi²-test/Fisher's exact test; * Mann-Whitney-U-test
significance restricted because more than 20% of cross-tabled cells with expected frequency below 5, second p-value was calculated with &-marked (and §-marked) items classified