National Institute for Public Health
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Ministry of Health, Welfare and Sport

Diet of community-dwelling older adults

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Dutch National Food Consumption Survey Older Adults 2010-2012

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Abstract

Diet of community-dwelling older adults
Dutch National Food Consumption Survey Older adults 2010-2012

Community-dwelling Dutch adults over the age of 70 consume more unhealthy saturated fatty acids and more salt than recommended, and less wholemeal products, fruit and fish than recommended. This group is therefore advised to comply with the same recommendations for diet improvement as the general Dutch population. One in five older adults has serious overweight. A healthy diet and sufficient physical exercise are important for all ages to prevent chronic diseases and disabilities. One in four Dutch adults over the age of 70 complies with the recommendation to take vitamin D supplements. A sufficient intake of vitamin D reduces the risk of falling and fractures.

These are some of the results of a diet survey conducted by the Dutch National Institute for Public Health and the Environment (RIVM) among some 700 community-dwelling adults over the age of 70. Most of the respondents were relatively vital.

Diet of adults over the age of 70
Community-dwelling adults over the age of 70 mostly consume food and drinks at home. Compared to people in their fifties and sixties, they consume less meat, sauces and cereal products and drink less alcohol. However, they consume more fruit, sugar, sweets, margarine, spreads and cooking fat.

Only a small number of older adults with functional disabilities took part in the survey. These adults have a lower energy intake, consume less protein, vegetables, alcohol, calcium and magnesium, and run a higher risk of undernutrition. Further research must be conducted into the quality of the diet of vulnerable older adults.

Use of food consumption data
This food consumption survey has produced detailed information on the diet of community-dwelling older adults, i.e. what products they eat and drink, and where and when they consume them. The survey was conducted as part of the national diet monitoring system. The data will contribute to the development of policy on healthy diet and food safety, and to product innovation, nutritional information and diet research.

Keywords: older adults, diet, vitamin D, dietary monitoring in the Netherlands

Rapport in het kort

De voeding van zelfstandig-wonende ouderen
Nederlandse Voedselconsumptiepeiling Ouderen 2010-2012

Zelfstandig-wonende 70-plussers eten meer ongezonde verzadigde vetzuren en zout en minder volkoren producten, fruit en vis dan aanbevolen. Daarmee gelden voor hen dezelfde aandachtspunten om het voedingspatroon te verbeteren als voor de rest van de bevolking. Eén op de vijf ouderen heeft ernstig overgewicht. Een gezonde voeding en voldoende lichaamsbeweging zijn voor jong en oud van belang om chronische ziekten en beperkingen tegen te gaan. Eén op de vier 70-plussers volgt het advies op om extra vitamine D te slikken. Voldoende vitamine D vermindert het risico op vallen en botbreuken.

Dit zijn de resultaten uit onderzoek van het RIVM naar de voeding onder ruim 700 zelfstandig-wonende 70-plussers. De meeste deelnemers waren relatief vitaal.

Voeding van 70-plussers
Zelfstandig-wonende ouderen eten en drinken vooral thuis. In vergelijking met vijftigers en zestigers eten ze minder vlees, sauzen en graanproducten en drinken ze minder alcoholische dranken. Fruit, suiker en zoetwaren, en smeer- en bereidingsvetten eten zij juist meer.

Aan dit onderzoek deden weinig ouderen met functionele beperkingen mee. Zij hebben een lagere inname van energie, eiwit, groente, alcohol, calcium en magnesium en een verhoogd risico op ondervoeding. Gericht onderzoek naar de kwaliteit van de voeding van kwetsbare ouderen is nodig.

Gebruik voedselconsumptiegegevens
Deze voedselconsumptiepeiling bevat gedetailleerde gegevens over wat, waar en wanneer zelfstandig-wonende ouderen eten en drinken en is onderdeel van het nationale voedingspeilingsysteem. De gegevens dragen bij aan de ontwikkeling van beleid voor gezonde voeding en veilig voedsel, productinnovatie, voorlichting en voedingsonderzoek.

Trefwoorden: ouderen, voeding, vitamine D, wat eet Nederland

Contents

Summary

Rationale and aim

To effectively develop and evaluate health, nutrition and food safety policy, national food consumption data is needed, together with data on the composition of foods and information on nutritional status.
The main aim of the Dutch National Food Consumption Survey-Older adults 2010-2012 (DNFCS-Older adults) was to gain insight into the diet of community-dwelling men and women aged 70 years and older in the Netherlands. These older adults represent about 10% of the total population of the Netherlands.

Study design

DNFCS-Older adults was a nationwide cross-sectional study. A two-stage cluster sampling technique was used to compile a representative national sample. Data were collected from October 2010 to February 2012 in 15 municipalities. The dietary assessment was based on two non-consecutive dietary record assisted 24-hour dietary recalls. The dietary recalls were carried out using the EPIC-Soft© program by means of face-to-face interviews during home visits. Background data were collected by means of a general questionnaire. Height, weight, and arm and waist circumference were measured. All interviews and the anthropometric measurements were carried out by dieticians who were specially trained in working with the EPIC-Soft program, the anthropometric measurements and specific procedures in this study.

Response rate and representativeness

Of the 2,848 invited eligible people, 739 (26%) participated in the study. Because of the low response rate, the possibility of selection bias was explored. The results indicated that the older adults in this Dutch National Food Consumption Survey were in better health and appeared to have less cognitive and physical impairments than the general population of community-dwelling older adults; furthermore, a smaller proportion of the women had a body mass index ≥30 kg/m^2. The study population thus represents a more vital population of older adults. Only a small number of older adults with functional disabilities took part in the survey. These adults had a lower energy intake, consumed less protein, vegetables, alcohol, calcium and magnesium.

BMI, undernutrition, physical activity

A BMI below 20 kg/m^2 was observed in a small proportion of the older community-dwelling population (about 1%). Undernutrition according to the screening instrument Short Nutritional Assessment Questionnaire 65+ (SNAQ^{65+}) was present in one in eight older adults. On the other side of the spectrum, 20% of the study population had a BMI of 30 kg/m^2 or more. Although the majority of the population had one or more chronic diseases, a large proportion was norm-active and regularly went outside.

General characteristics of the diet

Older adults consumed most food at home; for many food groups less than 15% of total consumption took place not at home. More than half of the older women and about one fifth of the older men prepared their own hot meals each day. For most of the other men, someone else in the household usually prepared the meal. Home-delivered meals were rarely consumed by this study population of relatively vital community-dwelling older adults. Two to three in ten older adults were on a specific diet, such as a diet for diabetes or hypertension.

Consumption of foods

Overall older men on average consumed greater or similar amounts of food compared to older women, although the mean consumption of fruit and beverages was higher for women. The average fruit consumption in this older adult population (about 1.5 pieces of fruit a day) was lower than the recommended two pieces a day. The mean consumption of vegetables just equalled the recommended amount of three serving spoons per day. At least 40% of the older adults did not consume oily fish on a weekly basis as recommended. Median consumption of beverages (1.4 litres) was just below the guideline of 1.5 to 2.0 litres per day. About 70% of older adults consumed fortified foods on one or both of the survey days, in particular in the subgroup 'Margarines'. Forty-five percent of the survey group used dietary supplements. Dietary supplements were more often consumed in the winter than during the rest of the year, and more women than men took them. Compared to people in their fifties and sixties, community-dwelling adults over the age of 70 consumed less meat, sauces and

cereal products and drank less alcohol. However, they consumed more fruit, sugar, sweets, margarine, spreads and cooking fat.

Intake of energy and macronutrients

Average energy intake was slightly below the average requirement for this group of relatively vital older adults. This might be explained by an underestimation of energy intake. Protein intake was sufficient for the majority in this population. On average, total carbohydrate intake was below the reference intake range and total fat intake was just within the reference intake range for sedentary populations. Moreover, for one fifth of the women and two-fifths of the men, alcohol intake was too high. In addition, intake of dietary fibre was much lower than recommended. With regard to the fatty acid composition of the diet, intake of trans-fatty acids, linoleic acid and alpha-linolenic acid was appropriate, whereas the intake of saturated fatty acids was too high and intake of n-3 fish fatty acids was low. These suboptimal macronutrient intakes are similar to what was observed for adults below the age of 70.

Intake of vitamins

In this study, only the intake of vitamin D was clearly inadequate, the results supporting the need for supplementation of vitamin D for all older adults. The recommendation to take dietary supplements containing vitamin D daily was followed only by a small part of the population: about 25% of the women and 20% of the men.
For the vitamins A, B_2, B_6, folate and vitamin C (men only), potentially inadequate intakes were observed for subgroups of older adults. The proportions of older adults with potentially inadequate intakes were below 15% for each of these vitamins, and intake levels were not very low. There are no indications of problems with excessively high intakes of vitamins among older adults.

Intake of minerals and trace elements

Selenium intake was potentially inadequate for about 10% of older adults and for calcium, potassium, and magnesium (men only) adequacy was unclear. The intake of other minerals and trace elements was sufficient and no related public health problems are expected among older adults. Sodium or salt intake was too high, particularly in men. There were no indications of excessively high intakes of other minerals and trace elements by older adults.

Usefulness of food consumption data

This food consumption survey has produced detailed information on the diet of community-dwelling older adults, i.e. what products they eat and drink, and where and when they consume them. The survey was conducted as part of the national diet monitoring system. The data will contribute to the development of policy on healthy diet and food safety, and to product innovation, nutritional information and diet research.

Conclusions

DNFCS-Older adults 2010-2012 provides insight into the food consumption of relatively vital community-dwelling older adults. We conclude that overall the same issues for improvement of the diet apply to vital community-dwelling adults aged 70 years and older, as to the rest of the Dutch population. The older adults consumed more saturated fatty acids and sodium, and less whole grain products, fruit and fish, than the amounts recommended in the dietary guidelines.
A high vitamin D requirement is specific to older adults. In this study, intake of vitamin D was clearly inadequate; this supports the need for supplementation of vitamin D for all older adults. Dietary supplements containing vitamin D were taken by about 25% of the women and 20% of the men.
Older adults with functional impairments and multimorbidity were not represented adequately in this study. The group of older adults with the greatest functional impairments had a lower intake of energy, protein and various dietary components than well-functioning older adults. This underpins the problem of undernutrition among some older adults. Intake of vitamin D is inadequate for most of these older adults, but even more so for those not going outside daily.
Monitoring the diet and supplement use of older adults can contribute to adequate food policies and recommendations. Given the growing population of older adults in the next decades it is recommended not to wait too long to collect new food consumption data. New data collection should be representative of groups of older adults that are most at risk of acquiring nutritional problems.

1 Introduction

1.1 Dutch National Food Consumption Surveys

The aim of the Dutch policy on health and diet is to facilitate a healthy lifestyle in society. A healthy diet contributes to the prevention of morbidity from conditions such as cardiovascular diseases and obesity. A healthy diet also includes foods free of harmful micro-organisms, residuals and contamination risks.

Monitoring of food consumption forms the basis of nutrition and food policy.[1] Food consumption surveys provide insight into the consumption of foods, the intake of energy, macronutrients and micronutrients, exposure to potentially harmful chemical substances and also into dietary trends of a population. To effectively develop and evaluate health, nutrition and food safety policy, data from food consumption surveys are needed, together with data on the composition of foods and information on nutritional status. Furthermore, food consumption surveys provide information that is useful for nutrition education programmes, scientific research in the field of nutrition and health, and the promotion of healthier food development.

Data on food consumption and nutritional status of the general Dutch population and of specific groups in that population have been collected periodically since 1987. In 2003, the Dutch National Food Consumption Surveys (DNFCS) were redesigned for several reasons: to meet changing policy requirements, to be able to reflect socio-demographic developments and trends in dietary habits and due to developments in dietary assessment methods.[2,3] Because of the differences in survey design and methods before and after 2003, a direct comparison of survey results cannot be made.

A detailed description of the system of dietary monitoring in the Netherlands was published in 2005.[4] Recently, some revisions to this system were made due to changes in policy priorities and the limited budgets and capacity available.[5]
The current dietary monitoring system consists of three modules.

- Module 1 is the core food consumption survey among the general population.
- Module 2 focuses on the nutritional status of the general population by measuring specific vitamins and minerals in blood and urine.
- Module 3 includes additional research on specific topics. Depending on the policy needs, specific dietary issues can be studied. Examples are the monitoring of dietary habits or biomarkers in specific groups such as infants or pregnant women and the monitoring of the consumption of specific foods such as energy drinks.

The present report concerns a food consumption survey in community-dwelling older adults living in the Netherlands. The survey is part of Module 3 and was conducted from 2010 to 2012. These older adults represent about 10% of the total population of the Netherlands. On January 1, 2012, 1.84 million inhabitants of the Netherlands were aged 70 years and older; most of them (94%) lived independently. Of these 1.72 million older adults, about 743,000 were men and about 981,000 were women.[71]

1.2 DNFCS-Older adults survey 2010-2012

The main aim of DNFCS-Older adults 2010-2012 was to gain insight into the diet of community-dwelling men and women aged 70 years and older in the Netherlands. More specifically the goals were to establish:

- the consumption of food groups, including fruits, vegetables, fish, and beverages and the percentage of older adults that meet the dietary guidelines for these food groups. Specific attention was given to the intake of fluid;
- the intake of energy and nutrients from food and the percentage of older adults that meet the recommendations on energy and nutrients. Specific attention was given to a too high or too low energy intake and to the intake of vitamin B_2, B_6, B_{12}, C, D, folic acid, iron and calcium;
- the use of dietary supplements and the intake of micronutrients from food and dietary supplements;
- the contribution of food groups to the intake of energy and nutrients;
- place and time of consumption of foods, energy and nutrients;
- anthropometric values, prevalences for eating difficulties and the percentage of older adults that may be at risk of undernutrition;
- the consumption of various food groups and the intake of energy and specific nutrients of interest for older adults (see above) presented for different characteristics like health status.

In addition, the dataset of DNFCS-Older adults needed to be suitable for research questions on food safety as well as for nutrition education programmes, development of healthier food products and scientific research in the field of nutrition and health.

DNFCS-Older adults was authorised by the Dutch Ministry of Health, Welfare and Sport (VWS) and coordinated by the Dutch National Institute for Public Health and the Environment (RIVM). Part of the work was subcontracted to other organisations:

- data were collected by the market research agency GfK Panel Services (Dongen, the Netherlands);
- software for 24-hour dietary recalls was updated by the International Agency for Research on Cancer (Lyon, France).

An Expert Committee (see Appendix A) advised VWS on the survey during planning, data collection, data analyses and reporting of the results.

This report presents the survey results with regard to the study population characteristics and objectives given above. More detailed reports and analyses on energy, nutrients and foods for different subgroups will be published on the DNFCS website.[6] This website also includes more information on the DNFCS in general as well as on the conditions and procedure for obtaining the DNFCS database. It is also possible to receive newsletters by e-mail in which the reader is notified of new topics appearing on the website.

2 Methods

2.1 Study population

2.1.1 Target population

The target population consisted of community-dwelling men and women aged 70 years and older and living in the Netherlands. The targeted sample size was 720, including 360 men and 360 women.

2.1.2 Sampling design and sampling frame

DNFCS-Older adults was a nationwide cross-sectional study, designed to be representative for region, address density and age. A two-stage cluster sampling technique was used to draw the representative national sample.

- To ensure that all geographic regions were represented, the Netherlands was divided into five geographic regions of approximately equal population size. Within each of the five geographic regions, all municipalities were divided into three region-specific groups with the highest, intermediate, and lowest address density - again with approximately equal population sizes. For each of the 15 combinations of region and address density class, one municipality was sampled with a probability proportional to the municipality size. Data on municipality population characteristics were based on data from Statistics Netherlands (CBS).[7] Three municipalities rejected the request for sampling from the municipality population register. Reasons mentioned were a lack of qualified personnel and too many survey requests among older adults. Within similar region/address density classes, adjacent municipalities were selected (Groesbeek, Uden, Leudal). Table 2.1 shows the municipalities that were included in the survey.
- Within each municipality a sex and age-stratified sample of 500 individuals was randomly drawn from the population register of the municipality. A sufficient size to allow for non-response. Defined age groups were 'born before 1926', and born between 1927-1931, 1932-1936, and 1937-1941.
  In the second half of the study period the sampling in the municipality of Velsen appeared not to have been drawn randomly, but selectively based on the alphabetical order of the street names. A new random sample from the population register was drawn and further embedded in the procedure. The first sample, from which 44 participants were recruited, had a mean socio-economic status score according to the Netherlands Institute of Social Research (In Dutch: SCP) [8] of 0.5 SD above the national average, whereas the second sample, from which three participants were recruited, had a mean socio-economic status score of 0.1 SD above the national average. The difference was statistically significant, indicating that the sample from which most participants in Velsen were recruited appeared to be somewhat biased towards older adults with a higher socio-economic status.

Table 2.1 Municipalities that were included in DNFCS-Older adults 2010-2012.

	Relative address Density Classes of Municipalities		
Region	High	Middle	Low
North	Groningen	Hoogeveen	Westerveld
Middle	Utrecht	Zutphen	Groesbeek
North-west	Amsterdam	Velsen	Wieringen
South-west	Rotterdam	Zoetermeer	Borsele
South-east	Breda	Uden	Leudal

Data were collected from October 2010 to February 2012. Per period of four weeks, municipality, age and sex-stratified samples were drawn from the samples obtained from the Municipal Personal Records Database (GBA). In this periodic sampling the targeted number of participants, the number of participants already recruited, response rate and the number of periods still to cover were taken into account. Prior to recruitment, the addresses of the selected people in the period sample were updated through the GBA to prevent the contacting of relocated or deceased persons (RIVM GBA authorisation number 601201). The addresses were supplemented with telephone numbers if possible. Addresses of nursing homes were removed from the sample (see Section 2.1.4).

2.1.3 Recruitment

At the start of the study, the market research agency informed selected people by letter and invited them to participate in the study. Those who did not respond within two weeks were phoned if a telephone number was available. If not, a reminder letter was sent. A list of people willing to participate was sent to the interviewers every four weeks.

Because the response rates were initially low, the method to recruit participants was reconsidered. Between mid-January and the end of February a recruitment pilot was carried out and in April the recruitment method was changed to face-to face visiting. The participants received written information on DNFCS-Older adults and were informed that within a few days a survey employee would visit them. To reassure respondents and to increase recognition when opening the door, photographs of the survey employees in the region concerned were printed on the invitation letter. At least three recruitment attempts on different days and times had to be done before a participant was classified as non-contactable. With this face-to-face recruitment method the response rate increased (see Chapter 3). From April 2011 onwards the face-to-face recruitment method was implemented in all municipalities.

The number of people invited and the response rates are presented in Section 3.1.

2.1.4 Exclusion criteria

Various exclusion criteria were applied. Firstly, institutionalised people were excluded. In addition, tube-fed or parenterally fed people, people with a high-intensity care package (in Dutch: 'Zorgzwaartepakket 5 of hoger'; similar to 18 hours of care or more per week) and people who were terminally ill were excluded. For practical reasons, only people with sufficient cognitive abilities, an adequate command of the Dutch language, and who were otherwise capable to participate or who were in the position to ask the help of a proxy person were included in the study.

The exclusion of institutionalised people was partly done based on an address list of nursing homes that was purchased by the market research agency for an earlier study among older adults in nursing homes[7] and was further updated based on web research for the current study. Exclusions were additionally based on assessment of the interviewers, self-report of participants or partners/relatives (exclusion questions were asked when the invited person agreed to participate), and the Mini Mental State Examination (MMSE) test (see Section 2.2.2).

2.2 Data collection and data handling

2.2.1 Overview of data collection

The dietary assessment was based on two non-consecutive dietary record assisted 24-hour recalls, carried out by means of face-to-face interviews during home visits. The interviewer made appointments for the home visits and provided the participant with a food diary and instructions. The food diary (used as memory aid, see Section 2.2.4) was meant to be filled in during the day prior to the day of the 24-hour recall. Background data were collected through a general questionnaire. Height, weight, and arm and waist circumference were measured during one of the two home visits. All interviews and the

anthropometric measurements were carried out by 25 dieticians who were specially trained for working with the EPIC-Soft program, the anthropometric measurements and specific procedures in this study.

The study was conducted according to the guidelines of the Helsinki Declaration. The Ethics Committee of University Medical Centre Utrecht approved the study protocol (METC protocol number 10-155/O, NL32079.041.10). Participants signed an informed consent form at the first home visit and received an incentive bonus, a €30 gift voucher, during the second home visit.

2.2.2 Questionnaire

During the first home visit the interviewer asked the questions of a general questionnaire and recorded the answers in the questionnaire. A copy of the questionnaire (in Dutch) can be downloaded from the DNFCS website.[6] Answers were digitalised by the market research agency. Data were checked for impossible values, inconsistencies and missing values.

The questionnaire covered:

- demographic factors: marital status, type of housing, composition of the household, education level, income and native country;
- lifestyle factors: physical activity, smoking and alcohol consumption;
- general characteristics of the diet: the person that cooks the hot meals, use of salt, and frequency of consumption of specific foods and beverages (e.g. fruit, vegetables, alcoholic drinks, fish);
- health factors, i.e. chronic diseases and possible eating difficulties;
- the use of dietary supplements during winter and during the rest of the year;
- the use of calcium-containing medicines;
- unintended weight changes during the last six months, appetite and functionality as part of the Short Nutritional Assessment Questionnaire (SNAQ^{65+}) screening tool for undernutrition;[9]
- standardised questions from the Mini Mental State Examination (MMSE).[10]

The MMSE is a globally used screening method to test the cognitive functions of older adults by means of a few questions. The MMSE was originally developed in 1975 by Folstein.[11] For DNFCS-Older adults the Dutch-translated standardised MMSE with instructions as developed by Kok and Verhey in 2002 was used.[10]
The test consists of 11 questions with regard to: orientation in time and place, concentration, memory, language, calculations and practical actions, resulting in a score of 0 to 30. In DNFCS-Older adults there was one modification in the instructions compared to those provided by Kok and Verhey. Based on the first five questions an initial score was calculated and participants having a score of 20 or 21 (one or zero errors) did not have to answer the remaining questions of the test. It was assumed that these participants had no cognitive impairment, equal to participants with a total score of above 24. Participants with a total score of below 18 were excluded from the study, assuming that their answers to the study could be unreliable, unless an appropriate proxy person was available.

With regard to the *type of housing*, *composition of the household, education level*, *income* and *native country*, the information from the questionnaire was combined and/or aggregated into fewer categories. The 'type of housing' and 'living together' were both aggregated into two categories: respectively living fully independently or a home especially intended for older people and living alone or with a housemate. The 'highest education level' and 'income' of the respondent were defined. Four categories of education level were distinguished: primary education, lower, intermediate or higher vocational education (see Table 3.7 for specific categories). If participants did not know their income, they could indicate whether they received old-age pension only or old-age pension and a supplementary pension. Taking into account the number of household members participants with old-age pension only were classified as 'low income', participants with a supplementary pension as 'moderate income'. 'Native country' was bifurcated into 'Of Dutch origin' and 'Not of Dutch origin'.

With regard to *physical activity,* respondents were asked how many days per week they were doing at least 30 minutes of moderately intense physical activity, both in summer and during the rest of the year. This question was the last question of the SQUASH (Short QUestionnaire to ASsess Health enhancing physical activity) for adults.[12] The activity level of the participants was classified based on the average number of days with at least 30 minutes of moderately intense physical activity. Distinguished categories were inactive (0 days), semi-active (0.5-4.5 days) or norm-active (5.0 of more days). The guideline on healthy physical activity for older adults recommends 30 minutes of moderately intense physical activity at least five days a week.[13, 14]

The information on consumption of *alcoholic drinks* was aggregated into the following categories: 'No alcohol' and the habitual number of days a week when alcoholic drinks were consumed.

The variable *smoking* was divided into three categories: 'currently smoking', 'use of tobacco in the past' and 'never-smokers'.

The consumption frequency of *fish* was aggregated into four categories: 'two days a week or more', 'one day a week', 'less than once a week, and 'never'.

The questions on the consumption frequency of *dietary supplements* distinguished the use of different supplements during winter time and during the rest of the year. The frequencies of all supplements containing vitamin D (vitamin D, vitamin A/D, and multivitamin/multimineral supplements) were taken together as an indicator for supplements containing vitamin D. Multivitamin supplements were not included in this definition because they were hardly used and overall two-thirds of the multivitamin supplements did not contain vitamin D.

2.2.3 Height, body weight, arm and waist circumference, undernutrition

The body weight, height, and arm and waist circumference were measured during one of both home visits. Waist circumference was measured twice. Data were recorded to an accuracy of 0.1 kg for body weight and 0.1 cm for the other measurements. In case the respondents were not able to stand upright or had kyphosis or scoliosis, no measurements were taken. If applicable, height and weight were adjusted for wearing shoes, and arm and waist circumference were adjusted for wearing clothes.

The body mass index (BMI) was determined as the body weight (in kg) divided by the height (in m) squared (kg/m^2). For older adults, there are no age and sex specific cut-off values for the BMI. Some authors suggest a higher cut-off value for underweight compared to adults. A recent report of the Dutch Health Council on undernutrition among elderly people concluded that there was not enough evidence to indicate a specific cut-off value for underweight for older adults.[15] The BMI is therefore presented in four classes, as in the report of the Dutch Health Council[15] and the WHO[16].

The report of the Dutch Health Council also concluded that there is no unambiguous definition of undernutrition and a gold standard to determine undernutrition is lacking.[15] In DNFCS-Older adults, criteria from the Short Nutritional Assessment Questionnaire 65+ (SNAQ^{65+}) were included in the general questionnaire and anthropometric measurements. The SNAQ^{65+} is a screening tool for identifying people that may be at risk of undernutrition and has been especially developed for community-dwelling older adults by the Dutch Malnutrition Steering Group ('Stuurgroep Ondervoeding')[9, 17]. The criteria to classify persons into the categories 'No undernutrition', 'At risk of undernutrition' and 'Undernutrition' according to the SNAQ^{65+} are given in Table 2.2. The mid-upper arm circumference was used as an indicator for thinness instead of the BMI, because this indicator is more strongly associated with mortality than the BMI.[18] In addition, the mid-upper arm circumference is a valid anthropometric measure to observe body compositional changes in older adults.[19]

At the end of the second home visit, participants received information depending on the outcome of the SNAQ^{65+} criteria. Participants who were not at risk of undernutrition received a brochure about healthy nutrition, developed by the Dutch Nutrition Centre. Participants who were at risk of undernutrition received a brochure about undernutrition, based on information from the website of the Dutch Malnutrition Steering Group[17] and participants who may have undernutrition received the same brochure about undernutrition with the advice to contact their general practitioner. All participants received written information on the advice of the Dutch Health Council on vitamin D supplementation.

As an indicator for overweight, the waist circumference was measured. In the absence of specific cut-off points for older adults, cut-off points for adults[20] were used to classify participants as having a low, moderate or high waist circumference. Because older adults may have aberrant fat distribution compared to younger adults, there are indications that the cut-off points should be higher, as suggested by a study of Heim et al.[21]

Table 2.2. Classification of nutritional status in community-dwelling older adults according to screening instrument SNAQ^{65+}.

Classification	Criteria
Undernutrition	Mid-upper arm circumference <25 cm **or** uninitended weight loss of 4 kg in last 6 months[a]
At risk of undernutrition	Loss of appetite in last week **and** difficulties in walking stairs of 15 steps[b]
No undernutrition	None of the above classes

[a] if this was unknown alternative questions were: Have clothes become too big?; Had the belt to be tightened recently?; Has the watch become looser around the wrist?
[b] if this was unknown, the alternative question was: Was the participant able to walk outside for 5 minutes without resting?

2.2.4 Dietary assessment

Data collection

Two non-consecutive food diary-assisted 24-hour dietary recalls were conducted per participant. Each person was interviewed twice by the same interviewer, with an interval of four weeks (two to six weeks). In order to gain insight into the habitual food consumption, recalls were spread equally over all days of the week and the four seasons. Interview days and record days were not planned on religious and national holidays, or during the vacation of the participant. Food consumption on Sunday to Friday was recalled the next day, while consumption on a Saturday was recalled on the following Monday.

Participants were asked to fill in a food diary on the day to be recalled. The completed diary was used as a memory aid during the 24-hour dietary recall, because impaired short-term memory is more likely to occur in old age.[22] During the home visits the diary was checked for incompleteness and for the use of household measures (like cups, mugs, glasses, and spoons) to indicate consumption amounts at home. The interviewer measured and registered the volume of the consumed content of these household measures by weighing them empty and filled with water.

The diary and 24-hour dietary recall covered the period from getting up in the morning of the recalled day until getting up on the next day (which was usually the day of the interview except when Saturday was recalled).

The 24-hour dietary recalls were conducted using the computer-directed interview program EPIC–Soft (IARC©). With the EPIC-Soft program the interviews were standardised and the answers could be entered directly into the computer.[23, 24] The average time taken to complete the dietary recall was 46 minutes. The EPIC-Soft interviews comprised the following parts:

- General information on the participant including date of birth, height and body weight, dietary rules or special diets on the day of the 24-hour recall and notable information on the day itself such as a holiday or any illnesses.
- Information on food consumption occasions – with time and place of consumption (quick list).
- Description and quantification of foods consumed. The food description consisted of a further specification of the food using facets and descriptors such as preparation method and fat content. Portion sizes of foods and meals could be quantified in several ways: by means of quantities as shown on photos in a picture booklet provided, in household measures, units (e.g. slices, pieces), by weight or volume.
- The possibility for entering free text remarks with further information.
- The intake of dietary supplements.

Quality assurance

For the purpose of quality assurance of the interviewers, regular updates of interview instructions and different controls were executed. After the initial three-day training period for new interviewers or the two-day training for experienced interviewers due to participation in former DNFCSs with the EPIC-Soft program, further training of the interviewers was given twice a year and a newsletter was sent every three months. Specified homework assignments were performed twice, and one interview was audio-recorded. The homework and recorded interviews were evaluated by RIVM staff and feedback was given to the interviewers both verbally and in writing.

In addition, various quality checks were carried out on the data entered. Free text remarks (notes) made by the interviewers during the recall were checked and processed. For example, if a new food was not available in the EPIC-Soft food list, a note was written during the interview. Based on additional information this new food was added to the EPIC-Soft databases. Several standardised quality checks were performed, such as a check on processing variables (e.g. correct raw/cooked factors used), missing quantities and correct use of the household measures (for example, not a heaped spoon for fluid food). Furthermore, extreme consumption data per food group and extremes in the energy and nutrient intake were checked. This check on extreme values was done using a statistical method, the Grubbs' method.[25] Finally, the energy intake was compared to the basal metabolic rate estimated with sex and age-specific equations by Henry[26] using body weight. Average underestimation and the number of low energy reporters[27] were assessed using an expected PAL-value of 1.6 for moderately active adults.[28] The average underestimation was also estimated by interviewer to assess any interviewer effects.

Food groups

In this report foods were classified in different ways: The EPIC-Soft classification of food groups, the food groups of the Dutch food based dietary guidelines, and the description of food based on fortification of foods.

EPIC-Soft food groups

The EPIC-Soft food group classification comprised 17 main groups and 77 subgroups.[24] Eight of these subgroups were additionally broken down into a total of 28 sub-subgroups.

For some results on food group consumption, foods were categorised into the food groups of the Dutch food based

dietary guidelines (see Appendix B).[29] Moreover, the energy intake from basic and non-basic food groups was calculated, according to the definition of the Dutch Nutrition Centre.[29] The basic food groups included 'Vegetables', 'Fruit', 'Bread', 'Potatoes (or rice, pasta or legumes)', 'Dairy products', 'Cheese', 'Meat (products), fish, chicken, egg or other meat replacement products', 'Spread', 'Cooking fat', and 'Drinks'. Other food groups were considered non-basic.

For the evaluation of the consumption of vegetables and fruit, the vegetable or fruit consumption was taken into account, including products with a considerable percentage of vegetables or fruit.[29] According to the food based dietary guidelines of the Dutch Nutrition Centre, these juices, soups and sauces could only contribute up to a maximum amount of 50% of the daily recommended consumption.

Fortified foods

Based on the information on fortification in the Dutch Food Composition Database (NEVO)[30] supplemented with information on new foods, all foods consumed were classified as either fortified or not fortified with a specific nutrient. Spreads enriched with vitamin A or vitamin D were not classified as fortified products for that nutrient. Information on enrichment of vitamin E in all spreads was incomplete and unclear. Therefore, spreads enriched with vitamin E were not classified as fortified either. This will lead to an underestimation of the contribution of fortified products to the vitamin E intake. Dietetic products (EPIC-Soft group 17 02) were classified as fortified.

Place of consumption and food occasions

The place and time of consumption and the food occasion were registered in the EPIC-Soft program. In this report the different categories for *place of consumption* were aggregated into two categories: 'At home' and 'Not at home'. This last group contained different categories like 'At the home of friends/family', 'On the street' or 'In a restaurant'. The *food consumption occasion* distinguished between three main meals (breakfast, lunch and dinner) and in between the main meals. The food consumption occasions in between the main meals have been combined in this report.

Based on the two 24-hour recalls, the number of food consumption occasions was defined as well. All foods and drinks consumed at the same place and the same hour of the day were defined as one food consumption occasion. Based on the two interviews, for each participant the mean number of food consumption occasions was calculated.

Energy and nutrient intake

The selection of nutrients of interest was based on the relevance for policy makers, availability of dietary reference intakes for these nutrients and the quality of the data.

Energy and nutrient intakes were calculated using an extended version of the Dutch Food Composition Database (NEVO table 2011)[30] and the Dutch Supplement Database (NES) dated 01 January 2011.[31] The definitions of the nutrients can be found on the NEVO website.[32] In total, 8904 different food items and 340 dietary supplement items were reported, which were linked to 1347 NEVO codes and 315 NES codes.

For all reported nutrients presented, the intake from foods was calculated; for micronutrients and fish fatty acid, the intake from both food and dietary supplements was calculated, for iodine and sodium the use of discretionary salt was taken into account. For several nutrients, the intake was calculated as a percentage of the total energy intake or intake per MJ, per kg of body weight.

2.3 Data analyses and evaluation

Most results are described for the total population, and separately by sex. P values below 0.05 were considered to be statistically significant. Most statistical analyses were done using SAS, version 9.3. Various survey procedures (proc surveymeans, proc surveyfreq, proc surveylogistic) available in SAS were used to take the survey design into account. Exceptions were the estimation of the habitual intake, which was done using SPADE version 2.28 (see Sections 2.3.4). More detailed reports and analyses on energy, nutrients and foods for different subgroups will be published on the DNFCS website.[6]

2.3.1 Dutch reference population

All results were weighted for small deviances in the distribution of participants across sex, age, region, level of urbanisation, day of the week, and season of data collection as compared to the community-dwelling older Dutch adults in this age group. For season the date of the first interview day was considered. For day of the week three classes were created: two week days, two weekend days, and one week day/one weekend day. Friday was considered a weekend day. Census data for 1 January, 2011 were used as reference population to derive the weights.[33] This weighting factor was created in an iterative process.

2.3.2 Socio-demographic and dietary characteristics, anthropometry, and lifestyle factors

Frequency distributions of socio-demographic and dietary characteristics and of lifestyle factors were calculated. In case of continuous variables, mean values and sometimes percentile values were calculated. Representativeness of the study population was evaluated by comparing the results to data from the nationwide Dutch population above 65 years of age from CBS and the Longitudinal Aging Study Amsterdam (LASA) (see Chapter 3).[34]
With regard to LASA data the same exclusion criteria as for DNFCS-Older adults were applied.

2.3.3 Food consumption

The DNFCS-Older adults provided 2-day dietary intake data, concerning observed intakes. The average food group consumption over two days was calculated for each participant. From this, the median consumption per food group was estimated for each sex, as well as the mean, 5th, 50th and 95th percentile of consumption. The percentage of consumption days of food (groups) was also calculated, i.e. the number of days on which a food (group) was consumed divided by all recalled days in the survey times 100. Subsequently the median consumption and 5th and 95th percentile on these consumption days were calculated. These calculations were conducted for all EPIC-Soft food groups and separately for all fortified foods. In addition, the proportions of the mean total consumption of food (groups) provided by fortified foods were calculated.

Consumption of foods, classified according to food groups mentioned in the Dutch food based dietary guidelines was also calculated (see Appendix B). These were the main food groups for which quantitative guidelines exist, as well as foods aggregated into basic foods and non-basic foods.[29]

2.3.4 Habitual intake of food groups and nutrients

The variance in intake comprised both the intra-individual (or day-to-day) variance and the inter-individual (or between subjects) variance.[35] However, for many purposes, it is not the observed intakes but the habitual (long-term mean) intake that is relevant. The habitual consumption distribution of food groups in the food based dietary guidelines and of nutrients was estimated from the observed daily intake by correction for the intra-individual (day-to-day) variance using SPADE (Statistical Program to Assess Dietary Exposure, RIVM).[36] With SPADE the habitual intake distribution was modelled age-dependently by sex. This resulted in habitual intake distributions by sex for each year of age separately. For the food groups and nutrients, the results of the habitual intake distribution mean, median and 5th, 25th, 75th, 95th percentile were presented by sex. Depending on the food group or nutrient different models were used in SPADE:

- For nutrients and food groups with no or few non-consumers, the SPADE one-part model was used.
- For food groups and nutrients with more non-consumers, the habitual intake was calculated using a two-part model in which the distribution of probability of consumption was modelled separately from the distribution of consumption amounts, before combining the two distributions. For the habitual alcohol and fish intake, the identification of people who never consume alcohol or fish, from the general questionnaire was included in the model.
- The habitual intake of micronutrients and fish fatty acids from both food and dietary supplements was calculated via SPADE using a three-part model.[37] Data from the additional questionnaire on the frequency of use of dietary supplements in winter and the rest of the year was used in combination with data from the 24-hour recall.
- The habitual intake of magnesium from dietary supplements only was modeled, with consideration of non-consumers.
- The habitual intake of iodine and sodium was modeled using a multi-part model with a first shrink and then add approach. For sodium, intake from foods and discretionary used salt at home was combined. For iodine, intake from iodine naturally present in foods, industrially added iodised salt to foods, discretionary added iodised salt, and dietary supplements were aggregated. The approach was slightly modified from Verkaik[69] and Van Rossum.[70]

2.3.5 Evaluation of dietary intake against dietary reference values

Dietary reference values

To evaluate the diet, the habitual intake distributions of nutrients were compared to dietary reference intakes. In principle, Dutch dietary reference values are used. However, in verbal communication the Dutch Health Council advised also using dietary reference values of EFSA and the Nordic reference values in case Dutch reference values were set more than ten years ago. Therefore, the habitual intake of macronutrients was compared to dietary reference values of EFSA,[28, 38-40] sometimes supplemented with dietary reference values of the Health Council of the Netherlands. [41-43] The average energy requirement as derived by EFSA was adjusted for body weights observed in the study population of Dutch older adults. See Chapter 5 for the specific reference values used and the authorities that have set these.

To assess micronutrient adequacy, the dietary reference values published by the Health Council of the Netherlands were applied if they had been set in the year 2000 or more recently.[42, 44-48] Otherwise, the Nordic dietary reference values 2004[49] were applied. In addition, the Nordic reference values are being updated. The draft recommendations published in 2012 were unchanged for those nutrients for which the Nordic reference values were applied in this report (see http://www.slv.se/en-gb/Startpage-NNR/Public-consultation/ accessed April 4, 2013). See Chapter 6 for the specific reference values used and the authorities that have set these.

To determine the proportion of the older Dutch population that may be potentially at risk of adverse effects due to excessive intake of a nutrient, the habitual intake distributions were compared to the tolerable upper intake level (UL) for micronutrients as set by EFSA.[50-52]

Evaluation methods

The approach towards evaluation of the diet differed according to the type of dietary reference value as recommended by the US Institute of Medicine (IOM) (see text box 2.1. for an explanation of these different types);[87] in other words, the evaluation of the intake was performed qualitatively or quantitatively depending on the type of dietary reference value:

- When an estimated average requirement (AR) of a nutrient was available, the habitual intake was evaluated using the AR cut point approach. The proportion of subjects with inadequate (insufficient) intake was estimated (see text box 2.2). When the 95% confidence limit of this proportion included 2.5% or less, the intake was considered adequate. For the energy intake the cut point approach is inappropriate, since the energy intake depends on energy requirement. Therefore, the proportion of the population with an inadequate energy intake cannot be estimated.
- When an adequate intake (AI) was available, the intake was evaluated qualitatively. If the median intake was above the adequate intake, the prevalence of inadequate intakes was stated as 'low'. When this was not the case, the adequacy of the diet could not be evaluated ('no statement').
- Reference intake ranges for macronutrient contributions to energy intake, sodium, dietary fibre, vegetables, fruit and fish are guidelines that refer to optimal intakes in the dietary circumstances applicable to the Netherlands. The reference intakes were based on the evaluation of knowledge on the impact of diet on health. Population median intakes were compared to the reference intakes. The proportion of the population with habitual intakes outside the reference intake ranges was monitored.
- When a tolerable upper intake level (UL) of a nutrient was available, proportion of the population potentially at risk of adverse effects due to excess intake was estimated. This does not mean that adverse health effects actually occur. For the proportions presented the modelling uncertainty is presented as a 95% confidence interval.

A comparison of consumption data with dietary reference values can never determine whether the intake is adequate or not. It can only indicate the probability of inadequate intake. Therefore, in order to find out whether an intake of a particular nutrient is adequate, biochemical measurements are needed.

The food based dietary guidelines[29, 34] describe a possible food pattern for meeting most of the nutrient requirements. However, it should be noted that requirements can also be achieved through other food patterns. The dietary guidelines have been developed for educational purposes and not for evaluation of food consumption at population level. In section 8.8 they are used to derive recommendations for food group consumption if the nutrient intake is not optimal.

2.3.6 Sources of nutrients

In order to gain insight into the main sources of nutrients, the contribution of each food group to the total energy and nutrient intake on each of the two recall days was calculated for each participant. Dietary supplements were also considered to be one of the sources. Subsequently, the mean contribution of the food groups and the supplements for each person was calculated over the two recall days. Finally, the group mean contribution was calculated averaging over all individual percentage contributions.

2.3.7 Consumption and intake by food consumption occasion and place of consumption

Food intake varies across place of consumption and occasion. Therefore, the averages of the individual contributions of intake at various food consumption occasions and places of consumption to the total intake of energy, nutrients and food groups were calculated.

2.3.8 Risk groups

In order to identify possible risk groups within the study population of older adults some specific nutrients of interest for older adults were described by several relevant factors. For these analyses the following dietary factors were selected: energy, protein, vitamin D, consumption of fluid. The sex-adjusted means for subgroups were

calculated. In addition, in order to gain insight into explanations for the differences found by subgroups, additional multivariate analyses were performed. Only the statistically significant associations were included in the model. The differences across the subgroups were tested for significance using the overall F-test.

The following factors were investigated:

- indicators for socio-demographic background: age, type of housing, gender, marital status, education level and income status;
- indicators for diet-related lifestyle and antrophometry: waist circumference, body mass index, home-delivered hot meals, under-nutrition, smoking, physical activity and use of alcohol;
- indicators of health and physical functioning of older adults: ability to climb stairs and prevalence of chronic diseases.

For vitamin D also the time spent outdoors was considered, because sunlight exposure is required for vitamin D production by the skin. For the analyses with drinks, the association with alcohol consumption was not considered.

Text box 2.1 Dietary reference intakes and their relation to the probability of health effects

Dietary Reference Intakes (DRI) refer to a set of reference values for nutrients for use in dietary evaluation:

Average Requirement (AR)
Level of intake sufficient to meet the requirement for half of the healthy individuals in a particular life stage and sex group (in Dutch: 'Gemiddelde behoefte').

Recommended Dietary Allowance (RDA)
Level of intake sufficient to meet the requirements for nearly all healthy individuals in a particular life stage and sex group (average requirement + 2*standard deviation)
(in Dutch: 'Aanbevolen dagelijkse hoeveelheid').

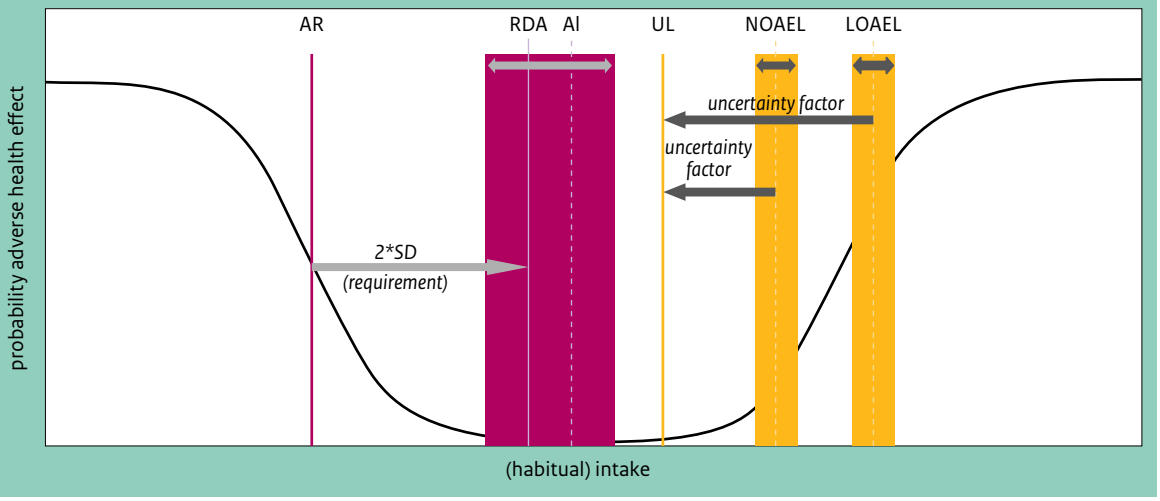
Adequate Intake (AI)
Level of intake assumed to be sufficient for almost all individuals in a particular life stage and sex group. Used when an RDA cannot be determined (in Dutch: 'Adequate inneming').

Tolerable Upper Intake Level (UL)
The highest average daily nutrient intake level likely to pose no risk of adverse health effects to almost all individuals in the general population.

No Observed Adverse Effect Level (NOAEL)

Lowest Observed Adverse Effect Level (LOAEL)

Figure 2.1 Schematic overview of the relationship between habitual intake and probability of adverse health effects including the different dietary reference intakes.[54]



2.3.9 Effect of selection bias

In order to gain insight into the effect of selection bias on the results, firstly the socio-demographic factors and some lifestyle indicators of the study population were compared to results from other representative studies. These differences were not statistically tested. As a next step, the impact of this potential selection bias was investigated by calculating the differences in the main dietary factors by age, education, health and functionality for potential selection bias. The weighted mean intake by each subgroup was divided by the mean intake of the whole study population in order to get relative values for each nutrient or food item. These means were sex-adjusted. The differences in means by subgroups were tested for significance using the overall F-test.

Text box 2.2 Average Requirement cut point method[87]

Proportion with a habitual intake below their requirement

Individuals in a group vary both in the amounts of a nutrient they consume and in their requirements for the nutrient. This is illustrated in Figure 2.2. It plots the usual intakes and requirements in a group (oval). The 45° line represents the points where the nutrient intake equals the nutrient requirement. Thus, the points to the right of that line are those individuals whose intakes are greater than their requirements. The points to the left of that line (the yellow area) are those individuals whose intakes are less than their requirements.

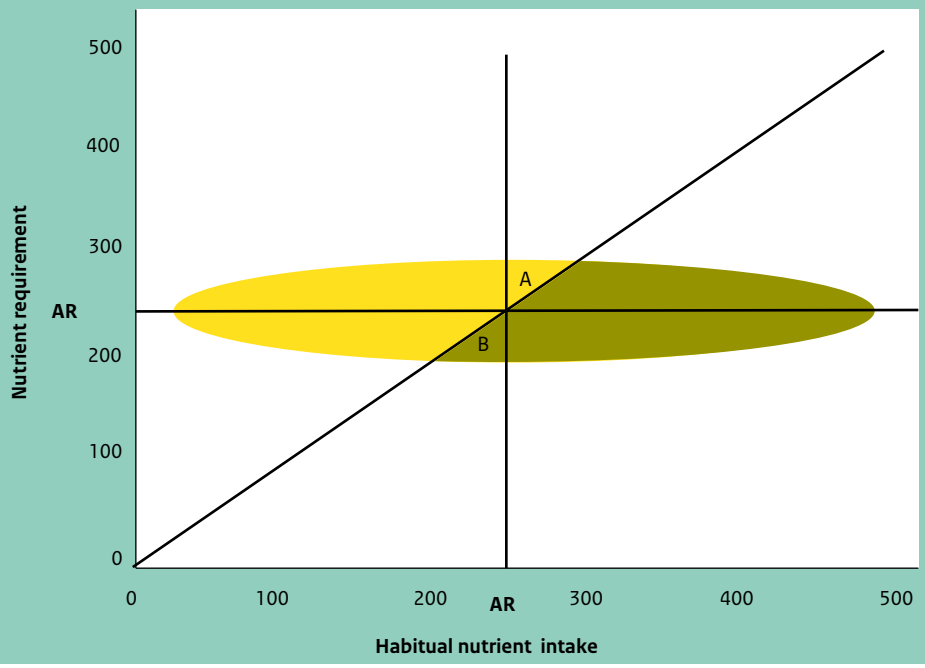
Why the AR cut point method?

If information was available on both the usual intakes and the requirements of all individuals in a group, determining the proportion of the group with intakes below their requirements would be straightforward. One would observe how many individuals had inadequate intakes. Unfortunately, collecting such data is unachievable. Therefore, it can be approximated based on habitual intake values alone by using the average requirement cut point method.

How does it work?

Given several assumptions, one counts how many individuals in the group of interest have usual intakes that are below the average requirement. That proportion is the estimate of the proportion of individuals in the group with inadequate intakes. This is also illustrated in Figure 2.2. It assumes that the numbers of individuals indicated in areas A and B of Figure 2.2 are equal.

Figure 2.2 Graphic illustration of the average requirement cut point method



3 Study population

3.1 Response

Table 3.1 shows the response to the recruitment of community-dwelling men and women aged 70 years and older for the DNFCS-Older adults. Of the 3,138 people invited, 9% (n=290) were indicated as non-eligible. Of the remaining 2,848 eligible older adults, 26% participated in the study (n=739), 57% refused to participate and 17% did not respond to the invitation to participate in the survey. Due to the initially very low response rate, in spring 2011 the recruitment strategy for the DNFCS-Older adults was changed from written recruitment to face-to-face recruitment. Although this caused a considerable improvement in the response rate from 19 to 35%, the response rate is still considered low.
More than 60% of the persons who refused to participate completed a short questionnaire consisting of seven questions: three on socio-demographic topics, three on characteristics of their diet, and one on reasons for non-response (multiple answers were possible).

The most important reasons for non-response were: not interested (41%), lack of time (29%) and a perceived burden of study participation (23%). Lack of time was more often mentioned as a reason for non-participation among non-respondents invited via the face-to-face strategy (43%) than among those invited via the initial written recruitment strategy (17%; see Table 3.2).
Table 3.3 shows the response rate of the invitees in the DNFCS-Older adults, by sex, age and socio-demographic characteristics. The overall response rate varied between 17 and 30%. As expected, the response rate decreased with increasing age. In men and women of between 70 and 75 years of age, the response rate was similar, i.e. 30%. In the oldest age group, that of persons aged 85 years and older, the response rate was 22% for men and 17% for women. The oldest participant included was a woman of 94 years of age. With regard to region, the response rate was lowest in the north-west of the Netherlands (23%) and with respect to the level of urbanisation the response rate was highest in the moderately urbanised areas (30%).

3.2 Representativeness of the study population and study period

The study design ensured a representative distribution among regions in the net sample. Moreover, a weighting factor was created to obtain a study population that is representative for the Dutch community-dwelling older adults with regard to sex, age, region and level of urbanisation.

Through the information obtained from the non-response questionnaire, an indication of representativeness with regard to level of education and of some dietary information of the study participants for the Dutch

Table 3.1 Response of invitees among Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012).

	Overall sample		Written recruitment		Face-to-face recruitment	
	n	%	n	%	n	%
Overall sample	3,138		1,623		1,515	
Not eligible	290		103		187	
Adjusted sample	2,848	100.0	1,520	100.0	1,328	100.0
- Non-contacts	492	17.3	358	23.6	134	10.1
- Data unusable or incomplete	3	0.1	1	0.1	2	0.2
- Refusals	1,614	56.7	880	57.9	734	55.3
- With non-response questionnaire	991		579		412	
- Without non-response questionnaire	623		301		322	
- Participants	739	25.9	281	18.5	458	34.5

Table 3.2 Reasons[a] for non-response among actively refusing non-respondents in DNFCS-Older adults 2010-2012.

	Total (n=1,614)		Written recruitment (n=880)		Face-to-face recruitment (n=734)	
Reasons	n	%	n	%	n	%
Lack of time	460	28.5	148	16.8	312	42.5
Not interested	666	41.3	322	36.6	344	46.9
Not healthy	113	7.0	63	7.2	50	6.8
High burden	378	23.4	219	24.9	159	21.7
Other	118	7.3	79	9.0	39	5.3
Unknown	318	19.7	163	18.5	155	21.1

[a] Multiple answers were possible (sum>100%)

community-dwelling older adults could be obtained. For the interpretation of this comparison, it should be noted that there were more persons over the age of 80 years among the non-respondents than among the respondents. This was also the case for those non-respondents that completed the non-response questionnaire (see Table 3.4).

Table 3.5 shows a comparison of some characteristics between participants and non-respondents. These are unadjusted comparisons. The results after adjustment are described in the text, but are not shown.

- The participating men and women were educated to a higher level than non-respondents. This was also the case after adjustment for age.
- Fish was consumed more frequently among male non-participants than among male participants (also after adjustment for age and education). This difference was not observed among women.
- The participants included relatively more persons who consumed fruit on a daily basis (21 percentage points point difference in men, and 14 percentage points in women). A significant difference was also observed after adjustment for age and education level.
- Among the participants there were more persons who consumed alcohol than among the non-respondents. This difference was, however, not statistically significant after adjustment for age and education.

Table 3.6 presents the number and distribution of the recall days by day of the week and season. Apart from some minor differences, the distributions were close to optimal. Recalls were slightly unequally spread across the year; winter was somewhat overrepresented (28%) and spring was slightly underrepresented (23%). By also weighing the results for the combination of recall days and seasons, the results can be considered representative for the diet across a calendar year.

3.3 Socio-demographic characteristics

The mean age of the men was 76.6 years, and that of the women was almost 2 years more, i.e. 78.4 years (weighted results; data not shown). Other socio-demographic characteristics of the respondents of DNFCS-Older adults, community-dwelling men and women aged 70 years and older, are shown in Table 3.7. Almost all respondents (97%) were of Dutch origin. Overall, half of the respondents were married, had a registered partnership or were cohabiting;

Table 3.3 Response and representativeness on socio-demographic characteristics of invitees in DNFCS-Older adults 2010-2012.

	Eligible sample			Participants		
	n	%	Response %	n	%	Weighted[b] %
Total						
Total (eligible)	2,848	100.0	25.9	739	100.0	100.0
Sex, age[a]						
Men, 70-74 years	520	18.3	30.4	158	21.4	16.1
Women, 70-74 years	434	15.2	30.2	131	17.7	20.7
Men, 75-79 years	389	13.7	28.8	112	15.2	12.6
Women, 75-79 years	442	15.5	25.6	113	15.3	15.8
Men, 80-84 years	289	10.1	24.2	70	9.5	7.3
Women, 80-84 years	353	12.4	21.5	76	10.3	12.0
Men, 85+ years	151	5.3	21.9	33	4.5	3.6
Women, 85+ years	270	9.5	17.0	46	6.2	11.9
Region[c]						
North	521	18.3	28.8	150	20.3	20.0
Middle	547	19.2	26.9	147	19.9	20.0
North-west	630	22.1	22.9	144	19.5	20.0
South-west	598	21.0	25.4	152	20.6	20.0
South-east	552	19.4	26.4	146	19.8	20.0
Urbanisation[d]						
High	1,428	50.1	24.3	347	47.0	42.1
Moderate	503	17.7	29.8	150	20.3	21.9
Low	917	32.2	26.4	242	32.7	36.0

[a] The target for gender strata was not representativeness, but rather total number
- Age of eligible sample was determined at the moment of sampling
- Age of participants was determined on the first recall day

[b] Weighted for socio-demographic characteristics, day of the week and season

[c] North: Groningen, Hoogeveen, Westerveld; Middle: Utrecht, Zutphen, Groesbeek; North-west: Amsterdam, Velsen, Wieringen; South-west: Rotterdam, Zoetermeer, Borsele; South-east: Breda, Uden, Leudal

[d] High: ≥1,500 adresses per square kilometre; Moderate: 1,000 - <1,500 addresses per square kilometre; Low: <1,000 addresses per square kilometre

Table 3.4 Comparison of age between participants and non-respondents in DNFCS-Older adults 2010-2012.

	Participants (n=739)		All non-respondents (n=2,109)		Non-respondents with questionnaire (n=991)[a]	
	n	%	n	%	n	%
Men						
70-79 years	270	72.4	638	65.4	302	64.8
80+ years	103	27.6	338	34.6	164	35.2
Women						
70-79 years	244	66.7	628	55.4	310	59.0
80+ years	122	33.3	505	44.6	215	41.0

[a] Non-respondents who completed the non-response questionnaire

one third were widows or widowers, and about 10% had never married, were divorced or lived separately. The marital status differed between men and women: three quarters of the men were married and less than 15% of the men were widowers, whereas about 40% of the women were married and almost half of them were widows. These data correspond with the Dutch population-wide percentages of the male population of over 65 years of age. However, among the nationwide Dutch female population of over 65 years of age the percentage of married women is higher (46%) and 40% are widows.[33] This may be explained by the lower age limit in the CBS data.

Table 3.5 Comparison of several characteristics of participants (n=739) and non-respondents (n=991)[a] in Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012).

	Men				Women			
	Participants (n=373)		Non-respondents (n=466)		Participants (n=366)		Non-respondents (n=525)	
	n	%	n	%	n	%	n	%
Education								
Primary education	48	12.9	200	42.9	80	21.9	309	58.9
Lower vocational or advanced elementary education	115	30.8	70	15.0	165	45.1	98	18.7
Intermediate vocational or higher secondary education	103	27.6	86	18.5	58	15.8	53	10.1
Higher vocational education or university	105	28.2	75	16.1	62	16.9	25	4.8
Unknown	2	0.5	35	7.5	1	0.3	40	7.6
Fish consumption								
<1 day/week	144	38.6	147	31.5	142	38.8	192	36.6
1 day/week	142	38.1	202	43.3	144	39.3	219	41.7
≥2 days/week	87	23.3	111	23.8	80	21.9	109	20.8
Unknown	0	0.0	6	1.3	0	0.0	5	1.0
Fruit consumption								
<3 days/week	49	13.1	100	21.5	20	5.5	57	10.9
3-6 days/week	45	12.1	112	24.0	28	7.7	82	15.6
7 days/week	279	74.8	249	53.4	318	86.9	381	72.6
Unknown	0	0.0	5	1.1	0	0.0	5	1.0
Alcohol consumption								
Never	65	17.4	119	25.5	116	31.7	244	46.5
>0 - <3 days/week	107	28.7	152	32.6	130	35.5	149	28.4
≥3 days/week	201	53.9	188	40.3	120	32.8	121	23.0
Unknown	0	0.0	7	1.5	0	0.0	11	2.1

[a] Non-respondents who completed the non-response questionnaire

Dutch population-wide data[33] indicate that around 60% of all adults aged 70 years and older live with or without a partner in independent home circumstances. The selection for DNFCS-Older adults was aimed specifically at community-dwelling older adults; most of them (85%) lived self-reliantly in independent home circumstances. More than half of the women and one fifth of the men lived on their own without a partner, children or other persons. This is similar to the population-wide data.

Of this generation of older adults that was for the most part born before the Second World War, more women than men had only had lower education. About one fifth of the women had had primary education, and half of them had had lower vocational or advanced elementary education. For men this was the case for about 11 and 30%, respectively. In the LASA study, a larger proportion of women and men had had primary education only (almost 40 and 20%, respectively; see Appendix C). This confirms the conclusion drawn in Section 3.2 that the study population of DNFCS-Older adults is biased towards higher-educated people.

Income also differed between men and women. More women than men received general old-age pension (AOW) only or combined with a small supplementary income. Almost 20% of the male respondents had a high income versus less than 10% of the women (data not shown). No comparable CBS data on income are available.

3.4 Health status and functionality

An indication of the health status of the respondents is summarised in Table 3.8. The overall ratio of the presence of chronic diseases reported was evenly divided between no chronic disease, one type of disease and two or more types. Men reported being healthier than women: 41% did not report any chronic disease against 27% of the women. In addition, women more often reported two or more chronic diseases. The percentage of persons with one or two chronic diseases was highest among those aged 80 years and older (data not shown). In the CBS data the proportion of older adults without chronic diseases was lower[33] than in the present survey.

Table 3.6 Distribution of interviews among days of the week and seasons in DNFCS-Older adults 2010-2012.

	Total (n=739)		Men (n=373)		Women (n=366)	
	n	%	n	%	n	%
Day of the week						
Monday	209	14.1	108	14.5	101	13.8
Tuesday	206	13.9	111	14.9	95	13.0
Wednesday	210	14.2	107	14.3	103	14.1
Thursday	204	13.8	111	14.9	93	12.7
Friday	209	14.1	100	13.4	109	14.9
Saturday	222	15.0	111	14.9	111	15.2
Sunday	218	14.7	98	13.1	120	16.4
Combination of recall days						
1 weekday, 1 weekend[a] day	333	45.1	163	43.7	170	46.4
2 weekdays	248	33.6	137	36.7	111	30.3
2 weekend[a] days	158	21.4	73	19.6	85	23.2
Season[b]						
Spring	168	22.7	84	22.5	84	23.0
Summer	170	23.0	82	22.0	88	24.0
Autumn	193	26.1	96	25.7	97	26.5
Winter	208	28.1	111	29.8	97	26.5

[a] Friday, Saturday, Sunday
[b] Spring: March, April, May; Summer: June, July, August; Autumn: September, October, November; Winter: December, January, February

Table 3.7 Socio-demografic characteristics of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Marital status			
Married or registered cohabitation contracts, living together	54.9	78.8	39.2
Unmarried or never been married	5.4	3.3	6.8
Divorced or living apart	5.6	4.5	6.3
Widow / widower	34.1	13.4	47.7
Type of housing			
Single-family dwelling, detached house, apartment, farm, flat	84.5	90.6	80.5
Service flat, elderly commune, flat for elderly/pensioners/old people or living self-reliantly near a rest home	15.5	9.4	19.5
Living together			
No	43.3	20.2	58.5
Yes, with partner, children or other person(s)	56.6	79.6	41.5
Unknown	0.1	0.2	0.0
Income status			
Low	13.7	8.0	17.4
Middle/high	84.9	89.7	81.8
Unknown	1.4	2.3	0.8
Native country			
Dutch origin	97.0	96.4	97.4
Not of Dutch origin	3.0	3.6	2.6
Education level			
Primary education	16.9	11.4	20.5
Lower vocational or advanced elementary education	42.7	29.7	51.2
Intermediate vocational or higher secondary education	20.1	27.2	15.4
Higher vocational education or university	20.0	31.2	12.7
Unknown	0.4	0.5	0.3

Table 3.8 Health status of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Chronic disease (last 12 months)			
None	32.6	41.3	27.0
Yes, 1 type of chronic disease	31.1	31.1	31.1
Yes, 2 or more types of chronic diseases	36.3	27.6	41.9
Type of chronic diseases (last 12 months)			
Diabetes mellitus	11.1	10.6	11.4
Stroke, brain haemorrhage	3.8	4.8	3.3
Myocardial infarction	3.4	3.6	3.3
Other serious heart condition	15.7	10.9	18.9
Any type of cancer	4.6	6.3	3.5
Hypertension	30.4	21.1	36.5
Constriction of blood vessels in abdomen or legs	10.1	8.2	11.4
CARA/COPD	8.4	7.6	8.9
Severe or persistent intestinal disorder	8.7	2.8	12.6
Severe or persistent back disorder	8.4	3.4	11.6
Chronic arthritis	8.4	3.8	11.5
Severe or persistent neck or shoulder disorder	5.4	2.1	7.6
Severe or persistent disorder of elbow, wrist or hand	3.2	1.7	4.3
Osteoporosis	9.1	0.3	14.8
Disorder of nervous system	1.4	3.0	0.3
Dizziness with falling down	4.4	2.7	5.6
Other protracted illnesses	12.1	11.5	12.5
MMSE score[a]			
High	96.6	96.0	97.0
Low	0.8	0.8	0.8
Unknown	2.6	3.2	2.2
Eating difficulties			
No difficulty eating and drinking	95.7	95.5	95.8
Some difficulty eating and drinking	4.0	3.6	4.2
Great difficulty eating and drinking	0.3	0.7	0.0
Unknown	0.1	0.2	0.0

[a] See Section 3.4

When the respondents were asked whether they had suffered a specific type of chronic disease during the last 12 months, hypertension was mentioned most often, i.e. by 37% of all women and about one fifth of the men; followed by myocardial infarction and serious heart problems (22% of women, 15% of men). About 11% of both men and women had diabetes mellitus. Overall, women scored higher on the list of chronic diseases than men, in particular for osteoporosis (women 15%; men 0.3%). In addition, more women suffered from intestinal disorders (13%), back disorders (12%), chronic arthritis (12%) and neck or shoulder disorders (8%) than men (3%, 3%, 4% and 2%, respectively). Men scored a little higher than women in relation to stroke (5% of men versus 3% of women) and cancer (6% versus 4%). About 8-9% of the respondents mentioned CARA/COPD.

The MMSE score was measured by using the Dutch translation[54] of the standardised Mini Mental State Examination questionnaire.[11] When up to one error was made in the first half of the MMSE questions (the maximum score was 21), further questions were skipped and the total score was determined to be high (indication of normal cognition). Almost all respondents (97%) had a high score, which was 20 or 21 for the first half of the MMSE questions or 25 or higher for the whole questionnaire (see Table 3.8). A comparison of the MMSE score of the study population with LASA participants could only be made for some of the specific questions and not for the total score. For several of the questions, LASA participants made more errors (see Appendix C). Probably, the inclusion criteria of DNFCS-Older adults 2001-2012 (see Chapter 2) resulted in participation of mainly mentally healthy people.

Table 3.9 Anthropometric values of Dutch adults aged 70 years and older (DNFCS Older adults 2010-2012), weighted.

	Total (n=739)	Men (n=373)	Women (n=366)
	Mean	Mean	Mean
Height (cm)[a]	167.3	175.2	161.9
Weight (kg)[b]	75.7	82.8	70.9
Waist (cm)[c]	98.2	102.4	95.4
Mid-upper arm circumference (cm)[d]	29.7	30.2	29.3
Body Mass Index (kg/m²)[e]	27.1	27.0	27.1
	%	%	%
Evaluation of weight based on Body Mass Index (BMI)			
BMI <20 kg/m²	0.9	0.5	1.2
BMI ≥20 - 25 kg/m²	29.9	29.2	30.4
BMI ≥25 - 30 kg/m²	45.0	49.0	42.5
BMI ≥30 kg/m²	19.0	17.9	19.7
Unknown	5.1	3.4	6.2
Evaluation of weight based on waist circumference (WC)			
Men WC >=79 - <102 cm / Women WC 68 - <88 cm	34.4	50.7	23.7
Men WC ≥102 cm / Women WC ≥88 cm	62.2	48.3	71.3
Unknown	3.4	1.0	5.0

[a] 10 men and 17 women missing; [b] 5 men and 7 women missing; [c] 4 men and 12 women missing; [d] 3 men and 3 women missing; [e] 11 men and 19 women missing

This may also be explained by the inclusion of higher-educated people in the DNFCS-Older adults.

Less than 5% of the respondents mentioned having eating difficulties. Reasons were difficulty swallowing and dental problems (data not shown). No general Dutch data are available for comparison. Most men (91%) and women (86%) were able to climb a staircase of 15 steps or walk outside for 5 minutes without resting (see Table 3.11). Information on physical activity level is described in Section 3.7.

3.5 Anthropometry

During the home visits, body height, weight, waist circumference and mid-upper arm circumference were measured. Waist circumference was measured twice; the mean waist circumference was calculated and is presented in the results. The results are shown in Table 3.9.

The mean height of the respondents measured was more or less similar to the LASA data: 175 cm in our study to 174 cm in the LASA data for men and 162 cm to 161 cm for women (see Appendix C). For men, the mean weight of 83 kg also corresponded with that observed in LASA, but the women in the DNFCS-Older adults weighed about 3 kg less than the older women in LASA.

In Table 3.9 the classification of BMI data (kg/m²) of the study population is given according to the general cut-off points for the evaluation of BMI for adults.[16] For adults these are related to the estimation of underweight (<20), normal weight (≥20-25), overweight (≥25-30) and obesity (≥30). However, for older adults other cut-off points should probably be taken into account to categorise weight. The percentage of respondents with a BMI of <20 kg/m² was about 1%. Also in LASA few respondents (<2%) were classified in this BMI class. About 30% of the respondents had a BMI of between 20 and 25 kg/m². Almost 50% of the men and more than 40% of the women of the study group had a BMI of between 25 and 30 kg/m². About 20% of the respondents had a BMI of ≥30 kg/m². In LASA, the proportion of men with a BMI of over 30 kg/m² was similar, but the proportion of women was much higher (33%; see Appendix C).

Another method of evaluation of weight, or abdominal obesity, is based on waist circumference. The starting point is that men with a waist circumference of below 79 cm and women with a waist circumference of below 68 cm are considered to be underweight.[20] None of the respondents were classified as such. Waist circumferences of between 79 and 102 cm for men and between 68 and 88 cm for women are evaluated as 'normal'. Half of the men and about a quarter of the women were included in those ranges of normal waist circumference. This resulted in the observation that about 50% of the men (≥102 cm) and around 70% of the women (≥88 cm) had a high waist circumference. In the LASA study, 10% more women were classified as such (see Appendix C). The results for arm circumference are given in Section 3.6.

Table 3.10 Cross tabulation of Body Mass Index (BMI) and waist circumference (WC) classification of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739)[a]		Men (n=373)[b]		Women (n=366)[c]	
	Men WC ≥79 - <102 cm / Women WC ≥68 - <88 cm	Men WC ≥102/ Women WC ≥88 cm	WC ≥79 - <102 cm	WC ≥102 cm	WC ≥68 - <88 cm	WC ≥88 cm
Category of BMI	%	%	%	%	%	%
BMI <20 kg/m²	91.6	8.4	100.0	0.0	89.2	10.8
BMI ≥20 – 25 kg/m²	70.9	29.1	84.6	15.4	62.2	37.8
BMI ≥25 – 30 kg/m²	24.8	75.2	47.6	52.4	7.5	92.5
BMI ≥30 kg/m²	1.2	98.8	2.8	97.2	0.2	99.8

[a] Missing n=36; [b] Missing n=13; [c] Missing n=23

The data of the evaluation of weight according to BMI data and waist circumference do not correspond completely. Based on waist circumference, more men seem to have a normal weight (50%) than based on BMI (30%). For women this turns out to be the opposite: 23% had a normal weight based on waist circumference versus 30% based on BMI. Table 3.10 shows the increase in waist circumference with an increasing BMI. There was a difference between men and women here: about half of the men within the BMI category of ≥25-30 kg/m² belonged to the highest category of waist circumference of ≥102 cm, whereas more than 90% of the women with a BMI of ≥25-30 kg/m² had a waist circumference of ≥88 cm, the cut-off point for the highest category of waist circumference for women.

3.6 Prevalence of undernutrition

In Table 3.11 results are shown according to the SNAQ^{65+} criteria, a set of criteria, called the Short Nutritional Assessment Questionnaire 65+, for screening for (the risk of) undernutrition in community-dwelling older persons.[9] To assess the SNAQ^{65+} criteria, results of the mid-upper arm circumferences measured were combined with answers to the general questionnaire. See Section 2.2.3 for more information. Based on the SNAQ^{65+} criteria the following groups can be distinguished: (1) no undernutrition; (2) risk of undernutrition (poor appetite last week *and* difficulties climbing a staircase); and (3) undernutrition (mid-upper arm circumference of <25 cm or involuntary weight loss of 4 kg in 6 months).[9]
Most respondents measured a mid-upper arm circumference of 25 cm or more. Almost 90% were not aware of any weight loss during the last 6 months and about 95% did not report any loss of appetite. Thereby, 91% of the men and 86% of the women were able to climb stairs of 15 steps or were able to walk for 5 minutes. Overall, this resulted in 89% of the men and 84% of the women who were not at risk of undernutrition.

About 9% of the men and 15% of the women were classified as undernourished. In most of them this was due to weight loss during the past 6 months. Less than 1% of the men and women were at risk of undernutrition, whereas in the LASA study this group was larger, i.e. 7% of the men and 10% of the women (see Appendix C).

3.7 Physical activity and exposure to sunlight

As part of the general questionnaire the respondents were asked for the number of days per week when they had more than 30 minutes of moderate activity during summer and during the rest of the year. The overall physical activity was estimated as the mean of the number of days of activity during summer and during the rest of the year. In Table 3.12 these data are shown. About 6% were classified as being inactive (less than 30 minutes of moderate activity on 0-0.5 days). More men (22%) than women (12%) were semi-active (moderate activity on 1-4.5 days). The majority of older adults were norm-active (≥5 days). This was the case for more women (83%) than men (71%). During the summer more respondents (78% of the men and 86% of the women) were norm-active than during the rest of the year (65% and 81%, respectively) (data not shown).
The mean time outdoors is shown in Table 3.12. Similar to those for physical activity, these data concern mean data of the frequency of going outside during summer and during the rest of the year. More men (82%) than women (66%) went out daily. The mean year-round percentages show that 16% of the men and 32% of the women went out some times a week. The Health Council of the Netherlands advises exposure to sunlight from March to October during 15 to 30 minutes per day in the middle of the day.[47] The duration and time of exposure of the respondents are not known. During summer almost all respondents went out daily (96% of the men and 93% of the women) (data not shown).

Table 3.11 Prevalence of undernutrition (in accordance with screening instrument SNAQ^{65+}) and its separate criteria for undernutrition of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted[a].

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Undernutrition			
No undernutrition	85.8	89.0	83.7
At risk of undernutrition (loss of appetite in last week and difficulties in walking stairs of 15 steps)	0.6	0.7	0.6
Undernutrition (mid-upper arm circumference <25 cm or unintended weight loss 4 kg in 6 months)	12.5	9.4	14.6
Unknown	1.0	0.9	1.1
Mid-upper arm circumference			
<25 cm	2.9	2.0	3.4
≥25 cm	96.3	97.3	95.6
Unknown	0.8	0.7	1.0
Unintended weight loss (4 kg in 6 months)			
Yes	10.0	8.0	11.4
No	89.9	91.8	88.6
Unknown	0.1	0.2	0.0
Loss of appetite in last week			
Yes	3.5	5.2	2.4
No	96.3	94.8	97.2
Unknown	0.2	0.0	0.3
Able to climb stairs of 15 steps or able to walk for 5 minutes			
Yes	87.6	90.5	85.7
No	12.0	9.4	13.8
Wheel chair user	0.2	0.0	0.3
Unknown	0.2	0.2	0.2

[a] See Section 2.2.3

Table 3.12 Characteristics of physical activity and exposure to sunlight in Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Physical activity[b]			
Inactive (0 - 0.5 days/week)	5.6	6.6	4.9
Semi active (1 - 4.5 days/week)	16.2	22.3	12.3
Norm active (≥5 days/week)	78.1	71.1	82.6
Unknown	0.1	0.0	0.1
Time outdoors[a]			
Every day	72.5	82.0	66.3
Not every day, but several times a week	26.0	16.3	32.3
Once a week or less, at least once a month	0.7	0.9	0.6
Less than once a month	0.8	0.8	0.8

[a] Mean frequency of going outside during summer and during the rest of the year
[b] Days with at least 30 minutes of moderate activity

Table 3.13 Smoking and alcohol use by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Smoking			
No, respondent has never smoked	34.9	12.6	49.5
No, respondent used to smoke, but not anymore	53.5	71.4	41.8
Yes	11.6	15.9	8.7
Number of days when alcoholic drinks are consumed			
No alcohol	23.6	20.6	25.6
<1 day/week	22.9	10.0	31.3
1-5 days/week	25.0	24.5	25.3
6-7 days/week	28.5	44.8	17.7

Table 3.14 Preparation of hot meals by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Prepares own hot meals			
7 days/week	44.7	20.0	60.9
1 - 6 days/week	25.8	23.5	27.3
<1 day/week	6.3	12.8	2.0
Never	23.2	43.5	9.8
Unknown	0.1	0.2	0.0
Someone else in household prepares hot meals			
7 days/week	17.0	38.8	2.7
1 - 6 days/week	14.4	27.7	5.7
<1 day/week	4.2	2.6	5.3
Never	47.1	25.6	61.2
Unknown	0.1	0.2	0.0
Not applicable – participant lives alone	17.2	5.1	25.1
Home-delivered hot meals from company/institution			
7 days/week	0.4	0.2	0.6
1 - 6 days/week	3.2	5.8	1.5
<1 day/week	0.5	0.2	0.6
Never	95.9	93.6	97.3
Unknown	0.1	0.2	0.0

3.8 Smoking and consumption of alcoholic beverages

Smoking and alcohol use are shown in Table 3.13. Almost half of the women and about 13% of the men had never used tobacco. Sixteen percent of the male and 9% of the female respondents stated that they smoked; for men this percentage corresponds with the STIVORO data,[55] while for women the STIVORO data are higher. However, the DNFCS smoking figures are in line with data from the LASA study.

More men than women used alcohol almost daily (45% versus 18%). One fifth of the men and one fourth of the women responded that they did not consume any alcoholic beverages. In the LASA study there were less men (13%) who indicated that they did not consume any alcoholic drinks. The difference between data on the use of alcohol in women in Table 3.13 and Table 3.5 is remarkable. The latter shows that 32% of the female respondents did not use any alcohol (data unweighted). The difference can partly be explained by the underrepresentation of women in the oldest age group. In the weighted results their data weigh heavily.

Table 3.15 Number of food consumption occasions in Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Breakfast			
None of the recall days	0.3	0.0	0.5
On one of the recall days	1.1	1.3	0.9
On both recall days	98.6	98.7	98.6
Lunch[c]			
None of the recall days	2.0	3.0	1.4
On one of the recall days	4.4	6.6	3.0
On both recall days	93.5	90.4	95.6
Dinner[a]			
None of the recall days	0.5	1.2	0.1
On one of the recall days	2.5	0.7	3.6
On both recall days	97.0	98.1	96.3
Mean number of food consumption occasions[b]			
<5	0.5	0.8	0.2
≥5-6	4.3	4.1	4.4
≥6-7	14.1	12.9	14.9
≥7-8	18.9	18.8	18.9
≥8-9	20.5	25.7	17.1
≥9-10	20.4	13.1	25.1
≥10	21.4	24.6	19.4
Mean number of food consumption occasions outside main meals[b]			
<2	0.5	0.8	0.2
≥2-3	2.9	3.0	2.8
≥3-4	14.2	12.7	15.2
≥4-5	19.1	18.5	19.5
≥5-6	20.7	26.4	17.1
≥6-7	20.5	13.2	25.3
≥7-8	10.7	11.1	10.5
≥8-9	7.0	10.5	4.6
≥9	4.4	3.8	4.8

[a] Dinner is a main meal consumed late afternoon or in the evening and not necessarily a hot meal
[b] Calculated based on mean of two recall days per person
[c] Lunch in main meal consumed at noon and not necessarily a cold meal

3.9 General characteristics of the diet

Table 3.14 shows information on the preparation of hot meals. There was a clear distinction between men and women here. About 20% of the men and 60% of the women prepared their own hot meal on a daily basis, whereas more than 40% of the men and 10% of the women never prepared any hot meals. Furthermore, for 39% of the men someone else in the household prepared their hot meal on all days of the week, whereas this was the case for only 3% of the women. Home-delivered hot meals from companies or institutions were rarely consumed: 94% of the men and 97% of the women reported never using these. Overall, about 63% of both men and women ate a hot meal daily, prepared by themselves, a partner or through home delivery. Only 3% of the men and 8% of the women ate such a hot meal five days a week and less than 3% hardly ever used these types of hot meals at all (data not shown).

Information on the number of food consumption occasions has been summarised in Table 3.15. This information is based on the interview data. Almost all of the participants had breakfast, lunch and dinner daily. Dinner was defined as an evening meal, irrespective of the contents of the meal. 99% had breakfast, 97% had dinner and 94% of the participants had lunch daily. With regard to main meals, men showed the lowest percentages for lunch (90%). About 18% of the men and 19% of the women reported less than seven food consumption occasions per day, including breakfast, lunch and dinner. About 63% of the men and 62% of the women consumed

Table 3.16 Diets followed by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Diets on recall days			
None	75.7	80.7	72.4
Yes, one or more diets	24.3	19.3	27.6
Type of diet			
Diabetes	8.4	6.0	9.9
Salt restricted, e.g. hypertension	6.0	5.2	6.6
Fat and/or cholesterol restricted	3.8	3.3	4.2
Energy restricted (own initiative)	3.0	3.1	2.9
Energy restricted (doctor's/dietician's advice)	2.0	1.6	2.3
Energy and/or protein enriched	0.3	0.5	0.1
Dietary fibre enriched	0.2	0.1	0.3
Easily digestible, e.g. stomach/intestinal disease	0.5	0.1	0.7
Lactose restricted	0.5	0.2	0.7
Gluten free	0.5	0.4	0.5
Other food allergy or intolerance	0.6	1.3	0.2
Vegetarian: no meat/fish at all	1.4	0.0	2.3
Vegetarian: fish, but no meat	1.3	0.8	1.7
Vegetarian: meat less than once a week	0.4	0.8	0.1
Macrobiotic	0.1	0.1	0.0
Islamic diet	0.1	0.0	0.2
Other	1.6	0.2	2.5

food/drinks on eight or more food consumption occasions per day. Thirty-five percent of the men and 38% of the women consumed food/drinks on less than five food consumption occasions per day outside main meals. One in four men and one in five women consumed food/drinks on seven or more food consumption occasions outside main meals.

In Table 3.16 information on the use of a special diet at recall days is presented. This information includes both prescribed diets and self-inflicted diets and dietary regimens. Within each of the two 24-hour dietary recalls, two different special diets could be reported; the information in Table 3.16 refers to diets reported on at least one of the survey days. One fifth of the men and 28% of the women reported one or more different diets. Diets for diabetes, salt restricted diets and energy restricted diets were most commonly used. Vegetarian dietary habits were reported by about 3% of the population.

In the general questionnaire, questions were also asked about discretionary salt use during cooking and at the table (see Table 3.17). In men, 18% reported never using discretionary salt in home-prepared meals, whereas 58% used it on a daily basis. For women, 12% never used salt during cooking, whereas 57% used it on a daily basis. The most commonly used salt in meal preparation was iodised salt (used by 54% of the men and 62% of the women). At the table, salt was used less frequently. Almost 60% of men and over 80% of women never used salt at the table, whereas 7 and 3% did so on a daily basis. At the table, more salt without than with iodine was used. The information on discretionary salt use was used for the estimation of sodium and iodine intake (see Chapter 6).

3.10 Conclusion

At 26%, the response rate in this study of Dutch community-dwelling older adults was low. Therefore, the possibility of selection bias was explored in this chapter. Comparison of participants and non-participants who filled out a non-response questionnaire indicated a selection bias towards better-educated older adults. Since a non-response questionnaire was only available for part of the non-respondents, this can only be considered as an indication. In addition, several characteristics could be compared with data from other studies on community-dwelling older adults thought to be representative for the Netherlands, notably CBS[33] and LASA (see Appendix C). The results indicated that the older adults in this Dutch National Food Consumption Survey were in better health (less chronic diseases) and appeared to have less cognitive and physical impairments than the general community-dwelling older population; furthermore, a smaller proportion of the women had a BMI of ≥30 kg/m^2. The

Table 3.17 Discretionary salt used in home-prepared meals and at the table of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Frequency of discretionary salt in home-prepared meals			
Never	14.3	18.3	11.8
<1 day/week	6.4	3.9	8.0
1 - 6 days/week	21.4	19.9	22.4
7 days/week	57.3	57.7	57.1
Unknown	0.6	0.3	0.7
Type of salt used in home-prepared meals			
No salt added/unknown	14.9	18.6	12.5
Salt with iodine	58.8	53.9	62.0
Salt without iodine	23.4	22.6	24.0
Respondent doesn't know	2.9	5.0	1.5
Frequency of discretionary salt at the table			
Never	72.3	58.1	81.7
<1 day/week	8.3	13.0	5.2
1 - 6 days/week	15.1	21.9	10.6
7 days/week	4.2	6.8	2.5
Unknown	0.1	0.2	0.0
Type of salt used at the table			
No salt added/unknown	72.4	58.1	81.7
Salt with iodine	11.3	19.0	6.2
Salt without iodine	15.8	22.1	11.7
Respondent doesn't know	0.5	0.8	0.3

study population thus represents a relatively more vital population of older adults. Generally, the magnitude of the selection bias was that a 5 to 10% lower proportion of the population was classified as educated to a low level, having a functional impairment, and having chronic diseases.

Based on the selection bias observed towards higher education, better functionality and better health status, observed, the question is whether a selection bias towards persons with a healthier diet occurred. This appeared to be the case for fruit consumption, but not for fish consumption (non-participating men consumed more fish), whereas for other dietary aspects it is unknown. To explore the potential effects of selection bias, differences in dietary intake between subgroups of education, health and functionality are described in Chapter 7.

A BMI of below 20 kg/m^2 was observed in a small proportion of the older community-dwelling population (2% or less). Undernutrition according to the screening instrument SNAQ^{65+} was present in one in eight older adults. Both observations are in line with other representative studies. In international studies, based on information from the Mini Nutritional Assessment, a prevalence of malnutrition in community-dwelling older men and women of 9.5% and 5.3% respectively was found.[56] Comparison of the results is difficult due to the use of different methodologies to assess the prevalence of undernutrition and the heterogeneity of the study populations.
In 2011, the Health Council of the Netherlands concluded that a low BMI, weight loss and reduced food consumption are associated with a higher mortality risk. However, it is unclear whether these are causal relationships. In addition, the criteria for defining undernutrition or underweight are poorly scientifically justified.[15] For this reason, the significance of the prevalences found is unclear.

On the other side of the spectrum, 20% of the study population had a BMI of 30 kg/m^2 or more. As age increases, the influence of obesity on the risk of death decreases. Based on a meta-analysis it was concluded that a BMI in the range of ≥25-30 kg/m^2 is not associated with a significantly increased risk of mortality in older adults, while a BMI in the moderately obese range is associated with a modest increase (RR 1.10) in mortality risk.[57] However, BMI and waist circumference are important determinants of mobility disability in older adults.[58]

Although the majority of the population had one or more chronic diseases, a large proportion was norm-active and regularly went outside, and thus exposed themselves to sunlight. More than half of the women prepared their own meals on a daily basis. This was done by one fifth of the men. For most of the other men, someone else in the household usually prepared their meals. Home-delivered meals were rarely consumed.

4 Foods

4.1 Introduction

This chapter presents the consumption of foods by the participants in DNFCS-Older adults 2010-2012. Data are given for the 17 main food groups and selective subgroups according to the EPIC-Soft classification (Section 4.2); consumption of foods by places of consumption (Section 4.3) and food consumption occasions (Section 4.4) is presented subsequently. In Section 4.5 the habitual consumption of fruit, vegetables and fish is described and compared with the recommendations, together with the consumption of the food groups mentioned in the food based dietary guidelines. Section 4.6 includes results on the consumption of fortified foods and Section 4.7 on the use of dietary supplements. Finally, conclusions on food consumption by older community-dwelling adults are given in Section 4.8.

4.2 Food groups

In this survey a total of 8,904 unique foods in terms of food names and descriptors within the EPIC-Soft system were reported. These were merged to 1,347 different codes of the NEVO-database.[30]

Consumption of all main EPIC-Soft food groups by men is presented in Table 4.1 and by women in Table 4.2. Intake of subgroups (level 1) is included in the tables if this was consumed on more than 25% of the consumption days. Means, medians, and the 5th and 95th percentiles of intake are given after averaging consumption over two survey days (including non-consumers). Moreover, the percentages of consumption days and intake on consumption days are presented. In Appendix D, consumption data for all food groups and subgroups are given.

Food groups that were consumed on 90% or more of the consumption days by both men and women were 'Vegetables', 'Dairy', 'Cereals and cereal products' and its subgroup 'Bread', 'Fat', 'Non-alcoholic beverages' and its subgroup 'Coffee, tea'. 'Meat and meat products' were consumed on 95% of the consumption days by men, but on only 86% of the consumption days by women. The subgroup 'Water' was consumed on 92% of the consumption days by women, and 82% by men. 'Potatoes and other tubers' were consumed on over 70% of the consumption days by both men and women, and 'Fruits' on about 85% of the consumption days. The main food group with the least number of consumption days was 'Legumes' (3%-5%).

Based on the median intake of main food groups, men consumed larger amounts of 'Potatoes and other tubers', 'Cereals and other cereal products', 'Meat and meat products', 'Fat', 'Sugar and confectionery', 'Condiments and sauces', and especially 'Alcoholic beverages' compared

Table 4.1 Food consumption in g/day (food groups and main subgroups) of Dutch men aged 70 years and older (DNFCS-Older adults 2010-2012, n=373), weighted.

	Men								
						On consumption days			
Food groups based on EPIC-Soft Classification	Mean	Median	P5	P95	Consumption days %	Mean	Median	P5	P95
01. Potatoes and other tubers	**116**	**101**	**0**	**306**	**72**	**165**	**140**	**60**	**332**
02. Vegetables	**148**	**136**	**22**	**288**	**93**	**170**	**160**	**39**	**344**
0201. Leafy vegetables (except cabbages)	31	0	0	132	29	108	92	10	262
0202. Fruiting vegetables	46	26	0	166	48	105	85	10	267
0204. Cabbages	24	0	0	120	21	142	143	5	278
0207. Onion, garlic	10	0	0	45	30	38	26	2	100
03. Legumes	**4**	**0**	**0**	**37**	**5**	**107**	**78**	**7**	**248**
04. Fruits, nuts and olives	**155**	**141**	**0**	**386**	**83**	**189**	**165**	**32**	**435**
0401. Fruits	147	140	0	381	80	188	165	34	418
05. Dairy products	**374**	**345**	**91**	**752**	**99**	**386**	**364**	**57**	**776**
0501. Milk	165	111	0	495	62	280	241	38	558
0503. Yoghurt	75	38	0	257	40	199	170	51	511
0505. Cheese (including fresh cheeses)	35	33	0	77	78	45	42	12	93
0506. Cream desserts, puddings (milk based)	60	0	0	228	30	185	165	70	340
0508. Milk for coffee and creamers	12	3	0	44	45	24	19	4	55
06. Cereals and cereal products	**188**	**177**	**77**	**323**	**100**	**185**	**170**	**68**	**371**
0603. Bread, crisp bread, rusks	143	134	57	253	99	147	139	55	275
07. Meat and meat products	**99**	**89**	**30**	**200**	**95**	**108**	**98**	**20**	**236**
0701.Fresh meat	43	33	0	131	49	95	80	20	217
0704. Processed meat	44	32	0	113	75	58	40	9	146
08. Fish and shellfish	**22**	**0**	**0**	**98**	**17**	**118**	**98**	**34**	**227**
09. Eggs and egg products	**13**	**0**	**0**	**54**	**25**	**49**	**50**	**6**	**99**
10. Fat	**34**	**32**	**9**	**70**	**100**	**34**	**31**	**6**	**72**
1001. Vegetable oils	4	0	0	14	32	11	7	1	27
1002. Butter	4	0	0	23	24	16	13	2	43
1003. Margarines	25	21	0	62	89	28	25	2	68
11. Sugar and confectionery	**51**	**41**	**0**	**149**	**86**	**55**	**41**	**7**	**155**
1101. Sugar, honey, jam	26	19	0	83	69	36	28	4	96
1102. Chocolate, candy bars, paste, chocolate confetti/flocks	10	0	0	43	35	26	19	6	63
12. Cakes	**46**	**37**	**0**	**120**	**78**	**58**	**45**	**9**	**144**
1201. Cakes, pies, pastries, etc.	28	19	0	96	44	61	46	18	151
1202. Dry cakes, biscuits	18	15	0	57	60	30	24	7	73
13. Non-alcoholic beverages	**1,295**	**1,234**	**633**	**2,137**	**100**	**1,298**	**1,212**	**605**	**2,290**
1301. Fruit and vegetable containing drinks	60	0	0	237	31	174	145	21	385
1303. Coffee, tea and herbal teas	808	773	269	1,482	100	825	765	296	1,516
1304. Waters	345	284	0	1,038	82	431	326	70	1,181
14. Alcoholic beverages	**189**	**96**	**0**	**804**	**56**	**346**	**247**	**56**	**995**
1401. Wine	82	0	0	370	33	254	182	84	726
15. Condiments and sauces	**29**	**20**	**0**	**81**	**66**	**39**	**29**	**3**	**108**
16. Soups, bouillon	**94**	**0**	**0**	**370**	**32**	**282**	**244**	**138**	**528**
1601. Soups	79	0	0	308	29	270	244	141	495
17. Miscellaneous	**13**	**0**	**0**	**71**	**9**	**112**	**81**	**44**	**240**

Table 4.2 Food consumption in g/day (food groups and main subgroups) of Dutch women aged 70 years and older (DNFCS-Older adults 2010-2012, n=366), weighted.

	Women								
						On consumption days			
Food groups based on EPIC-Soft Classification	Mean	Median	P5	P95	Consumption days %	Mean	Median	P5	P95
01. Potatoes and other tubers	**82**	**70**	**0**	**174**	**73**	**117**	**104**	**36**	**221**
02. Vegetables	**141**	**128**	**26**	**273**	**91**	**162**	**152**	**28**	**324**
0201. Leafy vegetables (except cabbages)	26	0	0	107	30	85	60	15	197
0202. Fruiting vegetables	38	22	0	147	48	92	66	5	238
0204. Cabbages	34	1	0	118	29	123	134	4	240
0207. Onion, garlic	9	0	0	43	28	34	21	2	123
03. Legumes	**3**	**0**	**0**	**20**	**3**	**89**	**89**	**2**	**214**
04. Fruits, nuts and olives	**169**	**164**	**0**	**365**	**86**	**204**	**191**	**30**	**420**
0401. Fruits	162	154	0	365	83	203	186	34	421
05. Dairy products	**331**	**306**	**60**	**735**	**99**	**327**	**312**	**31**	**736**
0501. Milk	160	128	0	508	59	247	211	27	589
0503. Yoghurt	71	40	0	251	44	172	150	52	333
0505. Cheese (including fresh cheeses)	34	28	1	73	80	39	29	12	88
0506. Cream desserts, puddings (milk based)	34	0	0	139	24	149	139	48	276
0508. Milk for coffee and creamers	10	3	0	35	47	21	16	4	46
06. Cereals and cereal products	**141**	**139**	**70**	**231**	**100**	**141**	**130**	**59**	**248**
0603. Bread, crisp bread, rusks	116	115	52	188	99	115	105	43	193
07. Meat and meat products	**81**	**77**	**7**	**161**	**86**	**92**	**85**	**12**	**192**
0701.Fresh meat	45	38	0	148	50	84	77	19	179
0704. Processed meat	26	15	0	78	60	43	29	10	118
08. Fish and shellfish	**22**	**0**	**0**	**100**	**18**	**122**	**111**	**22**	**209**
09. Eggs and egg products	**11**	**0**	**0**	**39**	**26**	**39**	**49**	**4**	**72**
10. Fat	**25**	**24**	**8**	**51**	**99**	**25**	**22**	**6**	**54**
1001. Vegetable oils	2	0	0	11	25	9	6	1	31
1002. Butter	6	0	0	27	30	17	12	3	39
1003. Margarines	16	16	0	41	82	20	18	2	45
11. Sugar and confectionery	**30**	**22**	**1**	**83**	**88**	**36**	**27**	**5**	**100**
1101. Sugar, honey, jam	13	10	0	44	62	23	20	3	53
1102. Chocolate, candy bars, paste, chocolate confetti/flocks	6	3	0	21	41	17	13	4	46
12. Cakes	**46**	**35**	**0**	**120**	**86**	**50**	**40**	**8**	**143**
1201. Cakes, pies, pastries, etc.	29	19	0	104	51	53	39	19	136
1202. Dry cakes, biscuits	16	13	0	45	65	25	19	6	59
13. Non-alcoholic beverages	**1,510**	**1,368**	**768**	**2,582**	**100**	**1,497**	**1,369**	**714**	**2,582**
1301. Fruit and vegetable containing drinks	69	0	0	285	39	187	165	32	409
1303. Coffee, tea and herbal teas	844	746	234	2,091	100	848	768	282	1,810
1304. Waters	569	501	0	1,511	92	601	499	99	1,497
14. Alcoholic beverages	**61**	**0**	**0**	**268**	**32**	**170**	**127**	**28**	**376**
1401. Wine	41	0	0	230	21	184	141	65	373
15. Condiments and sauces	**23**	**14**	**0**	**63**	**63**	**36**	**24**	**2**	**107**
16. Soups, bouillon	**84**	**0**	**0**	**319**	**33**	**247**	**231**	**105**	**487**
1601. Soups	78	0	0	290	29	258	256	114	488
17. Miscellaneous	**11**	**0**	**0**	**65**	**9**	**138**	**102**	**32**	**329**

Table 4.3 Average contribution of places of consumption to total food group consumption of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Food groups based on EPIC-Soft Classification	At home Mean %	Not at home Mean %
01. Potatoes and other tubers	93	7
02. Vegetables	93	7
03. Legumes	95	5
04. Fruits, nuts and olives	95	5
05. Dairy products	94	6
06. Cereals and cereal product	95	5
07. Meat and meat products	89	11
08. Fish and shellfish	84	16
09. Eggs and egg products	91	9
10. Fat	94	6
11. Sugar and confectionery	90	10
12. Cakes	79	21
13. Non-alcoholic beverages	90	10
14. Alcoholic beverages	69	31
15. Condiments and sauces	88	12
16. Soups, bouillon	87	13
17. Miscellaneous	77	23

to women. Women consumed larger median quantities of 'Fruits, nuts, and olives' (for the larger part consisting of fruits), and 'Non-alcoholic beverages' than men. Other food group differences by sex were small.

4.3 Consumption by place of consumption

Among Dutch older adults, more than 70% of all food groups were consumed at home, with contributions of more than 85% for the majority of the food groups (see Table 4.3). The largest contributions for out of home consumption were observed for 'Alcoholic beverages' (31%), 'Miscellaneous' (23%), and 'Cakes' (21%).

4.4 Consumption by food consumption occasions

Table 4.4 shows the average contribution of food consumption occasions to the consumption of main food groups. On average, more than half of the consumption of the food groups 'Potatoes and other tubers', 'Vegetables', 'Condiments and sauces', 'Meat and meat products' and 'Fish and shellfish' were consumed at dinner. Lunch was the most important food consumption occasion for 'Soups, bouillon', 'Cereals and cereal products', and 'Dairy products', with contributions of 32% to 47%. For the food groups 'Cakes', 'Alcoholic beverages', 'Non-alcoholic beverages', 'Fruits, nuts and olives' and 'Sugar and confectionery', food consumption occasions outside main meals contributed most to total intake, with on average more than three quarters of the contributions for the first two food groups. Breakfast was not the largest contributor to any of the food groups, average contributions of 30% or more being provided by 'Sugar and confectionery' and 'Cereals and cereal products'.

4.5 Food based dietary guidelines

4.5.1 Fruit and vegetables

Table 4.5 shows the habitual consumption of fruit, vegetables, and fish per day by Dutch older adults. The definition of the food groups 'Fruit' and 'Vegetables' in this Table (see Appendix B) is different from that of the groups 'Fruits, nuts, and olives' and 'Vegetables' of the EPIC-Soft classification as shown in Tables 4.1-4.4. The main difference for the food group 'Fruits' is the exclusion of nuts and olives, and the inclusion of some fruit juices with high fibre content in the definition of the food based dietary guidelines. The difference for vegetables is the inclusion of the contribution of vegetables from sauces and soups in the classification according to the food based dietary guidelines.

The median fruit consumption was 145 g/day for men and 160 g/day for women (Table 4.5). These values are considerably lower than the guideline of 200 g/day (two portions/day), so that fruit consumption can therefore be considered as not optimal. The percentage of the population with habitual fruit consumption below the

Table 4.4 Average contribution of food consumption occasions to total food group consumption of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Food groups based on EPIC-Soft Classification	Breakfast Mean %	Lunch[b] Mean %	Dinner[a] Mean %	In between Mean %
01. Potatoes and other tubers	0	28	72	0
02. Vegetables	1	28	69	2
03. Legumes	0	51	48	1
04. Fruits, nuts and olives	10	19	18	53
05. Dairy products	16	32	27	25
06. Cereals and cereal products	32	36	26	6
07. Meat and meat products	4	33	60	3
08. Fish and shellfish	0	31	59	10
09. Eggs and egg products	20	31	44	5
10. Fat	28	34	34	4
11. Sugar and confectionery	35	12	14	39
12. Cakes	7	4	1	88
13. Non-alcoholic beverages	22	7	6	64
14. Alcoholic beverages	0	3	20	77
15. Condiments and sauces	2	27	66	5
16. Soups, bouillon	0	47	41	12
17. Miscellaneous	3	19	44	34

[a] Dinner is a main meal consumed in the afternoon or in the evening, but not necessarily a hot meal.
[b] Lunch is a main meal consumed at noon and not necessarily a cold meal

Table 4.5 Habitual consumption of fruit, vegetables and fish by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Food groups based on food based dietary guidelines	Sex[a]	Mean g/day	P5 g/day	P25 g/day	P50 g/day	P75 g/day	P95 g/day	Guideline g/day	% with intake below guideline
Fish	Men	25	0	16	24	32	48	30	70
	Women	23	8	15	22	29	41	30	77
Fruit	Men	152	22	93	145	202	302	200	74
	Women	169	53	111	160	217	313	200	69
Vegetables	Men	160	73	117	155	198	265	150	46
	Women	157	74	118	153	192	254	150	48

[a] n=373 men; n=366 women

guideline was 74% for older men and 69% for older women.
The median vegetable consumption was about 155 g/day for both men and women, slightly higher than the guideline of 150 g/day (three serving spoons daily). At the population level, therefore, the consumption of vegetables was sufficient. The percentage of the population with a habitual vegetable consumption below the guideline was 46% for older men, and 48% for older women. The interquartile range (P25-P75) for vegetable consumption was smaller than for fruit consumption.

4.5.2 Fish

The guideline for fish consumption is to consume fish at least twice a week, with a portion size of 100-150 g. On a daily basis this can be seen as a recommended intake of at least 29-43 g/day. For the present analyses the guideline was considered as 30 g/day (Table 4.5). The median habitual intake of fish (including shell fish) was lower, i.e. about 23 g/day for both men and women. The percentage of the population with habitual fish consumption below 30 g/day was 70% for older men, and 77% for older women.
A similar picture was seen when the frequency of fish consumption as reported in the general questionnaire was considered. About 23% of older adults reported consumption fish twice or more per week (Table 4.6).

The Health Council of the Netherlands published a report on the ecological aspects of the current food based dietary guidelines.[59] It suggested that eating oily fish once a week might be sufficient to lower the risk of cardiovascular disease. This recommendation can be translated as a

Table 4.6 Reported frequency of fish consumption by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Number of days with fish consumption			
None	6.7	12.0	3.3
<1 day/week	32.3	27.0	35.7
1 day/week	38.1	36.8	39.0
≥2 days/week (=recommended)	22.9	24.2	22.0

Table 4.7 Habitual consumption of food groups by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Food groups based on food based dietary guidelines[b]	Sex[a]	Mean g/day	P5 g/day	P25 g/day	P50 g/day	P75 g/day	P95 g/day	Guideline g/day
Bread	Men	153	74	115	149	187	249	175
	Women	121	69	98	120	143	178	140
Cheese	Men	32	5	21	32	42	58	20
	Women	28	12	19	26	34	51	20
Cooking fat	Men	12	3	7	10	15	25	15
	Women	9	2	5	8	11	19	15
Dairy products	Men	342	88	206	317	450	679	650
	Women	300	70	174	276	399	612	650
Drinks	Men	1,498	873	1,179	1,444	1,757	2,310	1,5-2,0 L
	Women	1,533	821	1,185	1,487	1,831	2,403	1,5-2,0 L
Meat(products), fish, chicken, egg, or other meat replacement product	Men	136	68	104	133	164	214	100-125
	Women	111	59	87	109	133	172	100-125
Potatoes, rice, pasta or legumes	Men	153	65	109	147	191	261	175
	Women	106	51	79	102	129	173	125
Spread	Men	22	5	13	20	29	45	25
	Women	16	2	10	14	20	32	20

[a] n=373 men; n=366 women
[b] see appendix B

recommended intake of 15 g/day. At population level the median intake of fish was higher than this more ecologic-friendly guideline (23 versus 15 g/day). From Table 4.6 it can also be concluded that about 60% of older men and women consume at least 15 g fish per day. This is a combination of all types of fish, however, oily as well as lean. The adequacy of intake of n-3 fish fatty acid is described in Section 5.3.

4.5.3 Other foods

Table 4.7 shows the consumption of specific food groups that are mentioned in the food based dietary guidelines for persons aged 70 years and older.[29] These dietary guidelines describe a possible food pattern for meeting most of the nutrient requirements. However, it should be noted that requirements can also be achieved through other food patterns. The dietary guidelines have been developed for educational purposes and not for evaluation of food consumption at population level.

'Bread' is an important source of carbohydrates, protein, minerals, dietary fibre and B-vitamins. The bread consumption of older men was higher than that of older women, with median values of 149 and 120 g/day, which was lower than the gender specific guidelines of 175 and 140 g/day. Probably connected to this, the use of 'Spreads' was also low, median consumption being 20 g/day for men and 14 g/day for women. Spreads are a source of essential fatty acids and vitamin A, D and E. Another source of these fatty acids and vitamins are 'Cooking fats'. However, the median use of 'Cooking fat' (10 and 8 g/day for men and women, respectively) was also low compared to the guideline.

'Potatoes, rice, pasta and legumes' are important sources of carbohydrates, protein, minerals, dietary fibre and B-vitamins. The consumption of this food group was higher for men as compared with women, with median intakes of 147 and 102 g/day, respectively. The median intakes were lower than the guideline.

'Dairy products' are a source of protein, calcium, and B-vitamins. Consumption of dairy products was also higher for men than for women. Median intakes of 317 g/day for men and 276 g/day for women were less than half the 650 g/day mentioned in the food based dietary guidelines. The median consumption of cheese (32 and 26 g/day), however, was higher than the guideline of 20 g/day.

The median consumption of 'Meat (products), fish, chicken, egg or other meat replacement products' was 133 g/day for men and 109 g/day for women. For women this was within the range of 100-125 g/day given in the food based dietary guideline, and for men it was slightly above this range. 'Meat (products), fish, chicken, egg or other meat replacement products' are a source of protein, minerals like iron, and B-vitamins.

For 'Drinks' (both alcoholic and non-alcoholic, but excluding milk beverages), the median consumption was 1.4-1.5 l/day. This was close to the lower limit of 1.5-2.0 l/day of the guideline for drinks.

4.6 Fortified foods

About 70% of the study population consumed fortified products on one or both of the survey days.

The most frequently consumed fortified products, when considering the number of consumption days, were part of the food group 'Fat', more specifically the subgroup 'Margarines' (see Table 4.8). For these analyses, spreads enriched with vitamin E, vitamin A or vitamin D were not classified as fortified products for these nutrients. However, more than half of the 'Margarines' consumed were fortified with other nutrients. These products were used on 47% consumption days.

For other food groups the percentage of consumption days with a fortified product was much smaller. For 'Yoghurt', 'Syrup', 'Fruit and vegetable containing drinks' 7% of the consumption days included fortified products. About one fifth of the 'Yoghurts', almost one third of the 'Syrups', and over a quarter of the products in the 'Fruit and vegetable containing drinks' group were fortified.

Other food groups with a high proportion of fortified products were 'Yeast' (98%), 'Soy products' (86%) and almost all of the 'Dietetic products' and some unclassified product groups. These products were not often consumed, however.

The contribution of fortified foods to the nutrient intake is described in Chapter 6.

4.7 Dietary supplements

In this study, 408 unique dietary supplements were reported in terms of EPIC-Soft dietary supplement names and descriptors. They were linked to 315 different codes in the NES database[60].

Table 4.9 shows that 45% of the older adults reported using dietary supplements. Overall more persons were taking dietary supplements during wintertime compared to the rest of the year (45% during winter, and 38% during the rest of the year). Dietary supplement use was higher for women than for men, with 52% of women and 36% of men using dietary supplements.

The most commonly taken type of dietary supplements were multivitamin/multimineral supplements; 18% of older adults took these supplements during winter and 15% during the rest of the year. Glucosamine and fish oil were the most widely used non-vitamin, non-mineral dietary supplements, with 5-6% users. Glucosamine is an amino sugar and is marketed as an aid to the structure and function of joints.

In 2012, after the data collection stage of this survey, the Health Council of the Netherlands recommended that all persons aged 70 and older should take daily dietary supplements with 20 µg vitamin D.[48] At the time of data collection, the supplement recommendation was 10 µg daily for those adults over the age of 70 who had a light skin and spent enough time outdoors; and 20 µg daily for other older adults.[61] As described in Chapter 3, eight out of ten men and two thirds of the women did go outdoors daily and probably most of them had a light skin (97% was of Dutch origin). Hence, at the time of the data collection, vitamin D supplements in dosages of 10 µg/day were probably applicable for most of the participants. Assuming that all multivitamin/multimineral dietary supplements contain vitamin D, 26% of the women and 18% of the men were taking a supplement containing vitamin D all year round. About one third of the women and one fifth of the men were taking dietary supplements in the winter containing vitamin D. During the rest of the year the proportions were somewhat lower (27% of the women and 18% of the men).

Table 4.8 Consumption of fortified foods in g/day by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Food groups based on Epic-Soft classification						On consumption days			
	Mean	Median	P95	Proportion of total consumption %	Consumption days %	Mean	Median	P5	P95
05. Dairy products	**21**	**0**	**145**	**6**	**11**	**188**	**158**	**62**	**347**
0501. Milk	3	0	0	2	1	192	185	142	271
0502. Milk beverages	2	0	0	15	1	218	213	144	307
0503. Yoghurt	14	0	94	20	7	182	138	62	380
0504. Fromage blanc, petit suisse	1	0	0	6	1	113	92	50	159
0506. Cream desserts, puddings (milk based)	2	0	0	4	1	176	184	49	220
06. Cereals and cereal products	**1**	**0**	**2**	**1**	**5**	**25**	**19**	**4**	**60**
0603. Bread, crisp bread, rusks	0	0	0	0	2	27	19	7	56
060301. Bread	0	0	0	0	0	68	47	30	102
060302. Crispbread, rusks	0	0	0	4	2	19	18	7	31
0604. Breakfast cereals	1	0	0	14	2	24	16	3	57
10. Fat	**10**	**0**	**36**	**36**	**47**	**23**	**18**	**6**	**48**
1003. Margarines	10	0	36	52	47	23	18	6	48
11. Sugar and confectionery	**2**	**0**	**15**	**5**	**8**	**22**	**12**	**9**	**59**
1101. Sugar, honey, jam	0	0	0	0	0	27	22	15	42
1102. Chocolate, candy bars, etc	0	0	0	3	1	18	8	4	50
1103. Confectionery non-chocolate	0	0	0	2	0	35	35	35	35
1104. Syrup	2	0	9	32	7	21	11	9	58
1105. Ice cream, water ice	0	0	0	1	0	50	50	50	50
12. Cakes	**1**	**0**	**0**	**1**	**3**	**31**	**23**	**19**	**65**
1201. Cakes, pies, pastries, etc.	0	0	0	1	1	28	20	20	53
1202. Dry cakes, biscuits	0	0	0	2	1	33	27	15	68
13. Non-alcoholic beverages	**23**	**0**	**186**	**2**	**8**	**271**	**198**	**90**	**589**
1301. Fruit and vegetable containing drinks	17	0	140	27	7	241	190	79	549
1302. Carbonated/soft/iso drinks, diluted syrups	6	0	0	13	2	369	323	153	671
15. Condiments and sauces	**0**	**0**	**0**	**0**	**1**	**6**	**4**	**3**	**9**
1502. Yeast	0	0	0	98	1	6	4	3	9
17. Miscellaneous	**6**	**0**	**26**	**54**	**4**	**169**	**138**	**46**	**317**
1700. Unclassified	0	0	0	90	0	91	80	71	121
1701. Soy products	4	0	0	86	3	164	134	35	324
1702. Dietetic products	3	0	0	100	1	210	192	34	257
170200. Unclassified	3	0	0	100	1	210	192	34	257

Table 4.9 Intake of dietary supplements by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	Total (n=739) %	Men (n=373) %	Women (n=366) %
Use of dietary supplements			
During winter or rest of the year	45	36	52
During winter	45	35	51
During rest of the year	38	31	42
During winter and rest of the year	37	30	42
Vitamin D containing supplements[a] during winter and rest of the year	23	18	26
Use of specific dietary supplements during winter			
Multivitamins/multiminerals	18	16	20
Multivitamins without minerals	1	0	1
Folic acid	1	0	1
Vitamin B_{12}	2	1	2
Vitamin B-complex	4	2	5
Vitamin C	7	3	10
Vitamin D	6	3	8
Vitamin D containing supplements[a]	28	20	33
Vitamin E	1	0	2
Iron	0	0	1
Calcium	5	1	7
Calcium/vitamin D	6	2	8
Fish oil	6	6	5
Garlic	2	2	2
Ginseng	0	1	0
Ginkgo	0	0	0
Glucosamine	6	4	8
Other	10	6	13
Use of specific dietary supplements during rest of the year			
Multivitamins/multiminerals	15	15	15
Multivitamins without minerals	0	0	0
Folic acid	1	0	1
Vitamin B_{12}	2	2	2
Vitamin B-complex	4	1	6
Vitamin C	4	2	6
Vitamin D	5	3	6
Vitamin D containing supplements[a]	23	18	27
Vitamin E	1	0	2
Iron	0	0	1
Calcium	4	1	6
Calcium/vitamin D	6	1	8
Fish oil	5	5	4
Garlic	2	2	1
Ginkgo	0	0	0
Glucosamine	6	4	7
Other	9	6	12

[a] Combination of mulitvitamins/multiminerals and Vitamin D

4.8 Conclusion

For most food groups, older men generally consumed more or similar amounts to those consumed by older women. However, median consumption of 'Fruit, nuts, and olives', and 'Non-alcoholic beverages' was higher for women. On average, over 85% of the food consumption took place at home for most of the food groups. Exceptions were 'Alcoholic beverages', 'Miscellaneous' and 'Cakes', of which one fifth or more was consumed out of home.

Consumption of fruit was not optimal for this older adult population, with median amounts of about 1.5 pieces of fruit daily whereas two pieces are recommended. Fruit consumption was slightly higher for women than for men. Sufficient consumption of fruit is important as a source of vitamin C, minerals, dietary fibre, and bioactive compounds.

The median consumption of vegetables met the recommended vegetable intake, with median consumption of about three serving spoons per day. Unlike for fruit consumption, the recommended vegetable consumption (150 g/day or three serving spoons) is lower for older adults as compared with other adults (200 g/day).

The guideline of eating fish twice per week, which is included in the Guidelines for a healthy diet 2006[42], was met by two out of ten older adults. Eating fish once per week was done by six out of ten older adults, but not all fish consumed was oily fish. It therefore seems that fish consumption is not optimal from the perspective of lowering the risk of cardiovascular disease. The evaluation of intake of n-3 fish fatty acids is described in Chapter 5.

The comparison of food group consumption with amounts recommended in food based dietary guidelines shows that for several of the food groups intake appears low. However, to draw conclusions hereof, evaluation of nutrient intake is necessary. This evaluation is presented in Chapters 5 and 6.

Dietary supplements were consumed by 45% of the older adults; more in the winter than during the rest of the year. Women used dietary supplements more often than men. The recommendation to take vitamin D containing dietary supplements daily was met by only part of the population: about 26% of the women and 18% of the men. (See Chapter 6 for the importance of supplements to the micronutrient intake and the assessment of vitamin D intake from foods and dietary supplements combined.)

The above conclusions apply to this population of relatively vital older adults (see Chapters 3 and 8). In Chapter 7, consumption of relevant foods is presented for subgroups of older adults, to obtain insight into the possible effects of underrepresentation of older adults with functional impairment, chronic diseases and lower education. Moreover, uncertainties and methodological issues should be considered when interpreting the results. This is done in Chapter 8.

5 Energy, macro-nutrients and water

5.1 Introduction

Information on the habitual intake of energy, macronutrients and water is presented in Sections 5.2-5.8. With the exception of n-3 fish fatty acids, only few participants reported using dietary supplements containing macronutrients. Accordingly, for n-3 fish fatty acids (EPA and DHA), intake from foods as well as the combined intake from foods and dietary supplements are presented. For other nutrients in this chapter only the intakes from food sources are presented.

For energy and each macronutrient, the habitual intake was compared with dietary reference values of EFSA[28, 38-40, 62], sometimes supplemented with dietary reference values of the Health Council of the Netherlands.[41-43] The average energy requirement as derived by EFSA was adjusted for body weights observed in the study population of older Dutch adults. (See Table 5.9 for the reference values used and the authorities that set them.) Whether the assessment of intake was qualitatively or quantitatively performed depended on the type of dietary reference value (see Section 2.3).

For each nutrient, the main food sources that contributed at least 10% to the intake are given. At the end of this chapter, the importance of food groups to the intake of energy and macronutrients is presented (Section 5.9). Thereafter, the intakes of energy and macronutrients by place of consumption (Section 5.10) and by food consumption occasions are presented (Section 5.11). Overall conclusions are drawn at the end of the chapter, in Section 5.12.

5.2 Energy intake

The habitual intake distribution of energy is presented in Table 5.1. The median daily energy intake of older men was 9.1 MJ or 112 kJ/kg body weight. 25% of men had an energy intake below 8.2 MJ/day and 25% above 10.2 MJ/day. The mean energy intake for men was lower than the average requirement[c] of 9.5 MJ/day for sedentary and 10.1 MJ/day for moderately active older adults.[28] Since over 70% of the older men were norm-active (Chapter 3), a moderately active lifestyle seems applicable. This implies that at group level the reported mean energy intake was underestimated, inadequate or a combination of both by 10%. Due to the correlation between energy intake and energy requirement, as well as the lack of information about individual energy requirements[28], it is not possible to evaluate the proportion of men in the population with inadequate energy intake. The evaluation of anthropometric values is a better approach to evaluate energy balance for the long term (see Chapter 3). In the

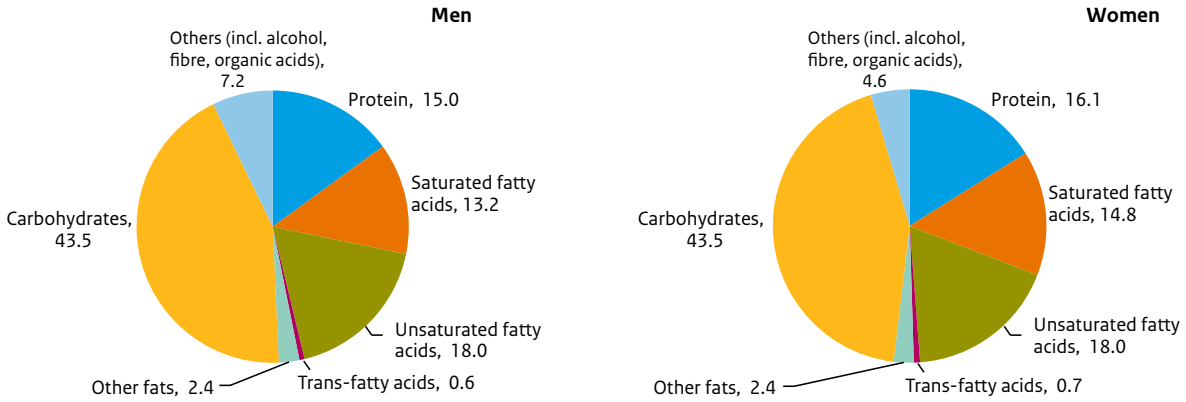
[c] Adjusted for body weights in this Dutch study population.

Table 5.1 Habitual intake distribution of energy by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Energy	Sex[a]	Mean	P5	P25	P50	P75	P95	AR sedentary living	AR moderately active
Energy (kcal/day)	Men	2,197	1,642	1,944	2,176	2,427	2,824		
	Women	1,754	1,236	1,527	1,743	1,969	2,311		
Energy (MJ/day)	Men	9.2	6.9	8.2	9.1	10.2	11.8	9.5	10.1
	Women	7.4	5.2	6.4	7.3	8.3	9.7	7.5	8.1
Energy (kJ/kg bodyweight/day)[b]	Men	113	78	97	112	128	154		
	Women	106	69	88	104	121	149		

[a] n=373 men; n=366 women
[b] Missing for 5 men and 7 women

Figure 5.1 Macronutrients as a percentage of energy intake (mean En%) by sex of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, men n=373, women n=366), weighted.



literature 6.3 MJ (1500 kcal) is considered a threshold of energy intake below which it is difficult to obtain sufficient intake of the micronutrients.[63, 64] About 2% of older men had such a low intake.

For older women, habitual energy intake was lower than for older men. This was also the case when energy intake was expressed per kg body weight. Daily median energy intake was 7.3 MJ or 104 kJ/kg body weight; 25% of the women had an energy intake below 6.4 MJ/day and 25% above 8.3 MJ/day. For older women the mean energy intake was 10% lower than the average requirement[d] of 8.1 MJ/day for moderately active older women. This suggests underestimation of energy intake and/or inadequate energy intake. Over one fifth of the older women had an energy intake below 6.3 MJ (1500 kcal).

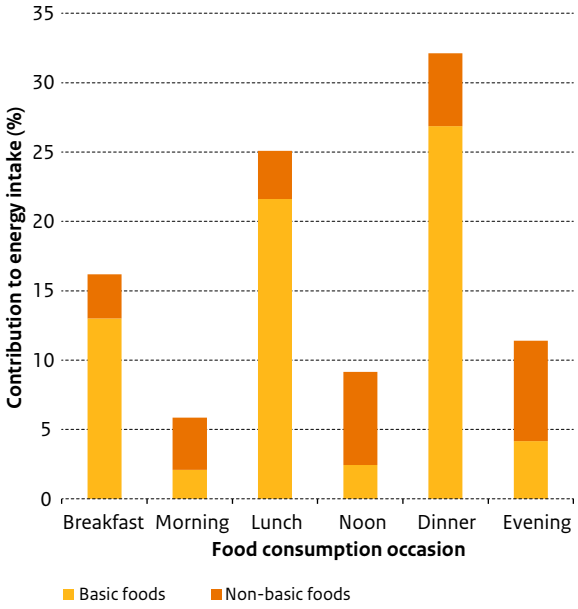
In Figure 5.1 the contribution of macronutrients to energy is shown. Among men, total fat intake contributed 34.2%, protein 15.0%, carbohydrates 43.5%, alcohol 4% and dietary fibre 2% of the energy intake. Among women the contribution from alcohol was less (2%), otherwise contributions were similar. See the next sections for more specific findings on macronutrients.

Three main food groups each contributed over 10% to the total energy intake. These were 'Cereals and cereal products' (21%), 'Dairy products' (16%), and 'Meat and meat products' (11%). (See Table 5.6 for average contributions of all main food groups to energy intake of men and women combined.)

Figure 5.2 shows the average distribution of total energy intake over food consumption occasions, and basic versus non-basic foods. On average, a large proportion of energy intake in the three main meals is derived from basic foods. By contrast, at food consumption occasions outside main meals about one third of energy intake is derived from basic foods.

[d] Adjusted for body weights in this Dutch study population

Figure 5.2 Contribution of basic and non-basic food groups by food consumption occasion to total energy intake in Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.



5.3 Fat

In Table 5.2 the habitual intake distributions of total fat and of relevant subtypes of fatty acids are presented in both absolute amounts (g/day) as well as relative to total energy intake (En%).

Total fat

The median habitual total fat intake was higher for men (83 g/day) than for women (67 g/day). In both men and women, total fat was responsible for slightly more than one-third of the energy intake at the median level (34.2 and 34.5 En%, respectively). This median intake level is close to the upper level of the reference intake range for total fat of 20-35 En% as set by EFSA.[38] About 41% of men and 46% of women had an energy intake outside this range, i.e. above the level of 35 En%. The reference intake is partly based on practical considerations such as current levels of intake and achievable dietary patterns in healthy populations. Total fat intake <35 En% may be compatible with both good health and normal body weight depending on dietary patterns and the level of physical activity.[38]

Three main food groups contributed over 10% to the total fat intake. These were 'Fat' (24%), 'Dairy products' (20%), and 'Meat and meat products' (17%). (See Table 5.6.)

Saturated fatty acids

The median habitual saturated fatty acid intake was 32 g/day or 13.0 En% for older men and 26 g/day or 13.5 En% for older women (Table 5.2). EFSA and the Health Council of the Netherlands recommend that the intake of saturated fatty acids should be as low as possible for healthy blood LDL-cholesterol concentrations.[38, 41] Based on achievable dietary patterns, the Health Council set a recommended maximum intake of 10 En%.[41] For more than 90% of Dutch older adults, the habitual proportion of the energy intake from saturated fatty acids was higher than this recommended maximum.

Four main food groups contributed over 10% to saturated fatty acid intake. These were 'Dairy products' (32%), 'Fat' (18%), 'Meat and meat products' (17%), and 'Cakes' (11%). (See Table 5.6.)

Trans-fatty acids

The median habitual trans-fatty acids intake was 1 g/day for men and women (Table 5.2). This was 0.6 % of energy intake for both genders. Similar to saturated fatty acids, both EFSA and the Health Council recommend that habitual trans-fatty acids intake should be as low as possible for healthy blood cholesterol levels, and in order to prevent coronary heart disease.[38, 41] Based on achievable dietary patterns, the Health Council converted this to a recommended maximum intake of 1 En%.[41] About 4% of the older men and 9% of the older women were found to exceed this level.

Four main food groups contributed over 10% to habitual trans-fatty acids intake. These were the same food groups as for saturated fatty acid intake, though percentage contributions differ, i.e. 'Dairy products' (33%), 'Fat' (21%), 'Cakes' (18%) and 'Meat and meat products' (13%). (See Table 5.6.)

Unsaturated fatty acids

The median habitual intake of total cis-unsaturated fatty acids was 44 g/day for men and 34 g/day for women (Table 5.2). The median habitual intake of the proportion of the energy intake from cis-unsaturated fatty acids was slightly less than 18 En% for both sexes. About one third of the cis-unsaturated fatty acids intake came from polyunsaturated fatty acids (PUFA), with a median intake of 16 g/day (6.7 En%) for men and 12 g/day (6.4 En%) for women.

Three main food groups contributed over 10% to cis-unsaturated fatty acids intake. These were 'Fat' (29%), 'Meat and meat products' (18%) and 'Dairy products' (11%). These three groups were also the main contributors to total fat intake (Table 5.6).

Table 5.2 Habitual intake distribution of fat and fatty acids by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Mean	P5	P25	P50	P75	P95	RI	% with intake outside RI	AI	Prevalence inadequate intake
Fat (g/day)	Men	84	57	72	83	96	116				
	Women	68	42	56	67	79	99				
Fat (En%)	Men	34.2	28.0	31.6	34.2	36.7	40.3	20-35	41		
	Women	34.7	27.3	31.5	34.5	37.7	42.4	20-35	46		
Saturated fatty acids (g/day)	Men	32	21	27	32	37	46				
	Women	27	15	21	26	32	43				
Saturated fatty acids (En%)	Men	13.1	9.7	11.6	13.0	14.5	16.7	<10	93		
	Women	13.8	9.5	11.7	13.5	15.6	19.2	<10	92		
Trans-fatty acids (g/day)	Men	1	1	1	1	2	3				
	Women	1	1	1	1	2	2				
Trans-fatty acids (En%)	Men	0.6	0.3	0.5	0.6	0.7	1.0	<1	4		
	Women	0.7	0.4	0.5	0.6	0.8	1.1	<1	9		
Unsaturated fatty acids (g/day)	Men	45	29	37	44	51	64				
	Women	35	22	29	34	40	51				
Unsaturated fatty acids (En%)	Men	18.0	13.9	16.2	17.9	19.8	22.6				
	Women	17.7	13.7	15.9	17.6	19.3	22.0				
Mono unsaturated fatty acids (g/day)	Men	28	18	23	27	32	39				
	Women	22	14	18	21	26	33				
Mono unsaturated fatty acids (En%)	Men	11.2	8.8	10.1	11.1	12.2	13.8				
	Women	11.2	8.4	9.9	11.0	12.3	14.4				
Poly unsaturated fatty acids (g/day)	Men	17	9	13	16	20	27				
	Women	13	7	10	12	15	20				
Poly unsaturated fatty acids (En%)	Men	6.8	4.4	5.6	6.7	7.8	9.9				
	Women	6.5	4.2	5.4	6.4	7.5	9.3				
Linoleic acid (g/day)	Men	14	8	11	13	17	23				
	Women	11	5	8	10	13	17				
Linoleic acid (En%)	Men	5.6	3.5	4.6	5.5	6.5	8.3			4	Low risk
	Women	5.4	3.2	4.3	5.2	6.3	8.1			4	Low risk
Alpha-linolenic acid (g/day)	Men	2	1	1	2	2	3				
	Women	2	1	1	2	2	3				
Alpha-linolenic acid (En%)	Men	0.8	0.5	0.6	0.8	0.9	1.2			0.5	Low risk
	Women	0.8	0.5	0.6	0.8	0.9	1.2			0.5	Low risk
n-3 fatty acids from foods only (mg/day)	Men	294	30	84	170	345	952			250	No statement
	Women	243	23	68	141	290	791			250	No statement
n-3 fatty acids from foods and supplements (mg/day)	Men	304	31	87	178	360	981			250	No statement
	Women	275	24	74	158	328	905			250	No statement

[a] n=373 men; n=366 women

Table 5.3 Habitual intake distribution of protein by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR
Protein (g/day)	Men	83	59	72	82	94	112		
	Women	70	49	61	70	79	95		
Protein (En%)	Men	15.3	12.1	13.9	15.2	16.7	19.1		
	Women	16.2	12.6	14.6	16.1	17.7	20.3		
Protein (g/kg bodyweight/day)[b]	Men	1.02	0.69	0.87	1.00	1.16	1.42	0.66	3
	Women	1.01	0.66	0.85	0.99	1.16	1.43	0.66	5
Animal protein (g/day)	Men	56	37	47	55	63	76		
	Women	45	28	37	45	53	65		
Vegetable protein (g/day)	Men	31	20	25	30	35	45		
	Women	25	16	21	25	28	34		

[a] n=373 men; n=366 women
[b] Missing for 5 men and 7 women

According to EFSA, there is no consistent evidence that the intake of any of the cis-unsaturated fatty acids has detrimental effects on health,[38] so no tolerable upper intake levels are derived.

Linoleic acid

The median intake of linoleic acid was 13 g/day for men and 10 g/day for women (Table 5.2). For linoleic acid, EFSA set an adequate intake (AI) level of 4 En% based on the lowest estimated mean intakes of the various population groups from a number of European countries where overt linoleic acid deficiency symptoms were not present.[38] In this population of older men and women, median linoleic acid intake contributed 5.5 and 5.2 En% to total energy intake, which was higher than the adequete intake of 4 En%. The prevalence of inadequate intake can therefore be regarded as low.

'Fat', 'Cereals and cereal products' and 'Condiments and sauces' are the main food groups that contributed to linoleic acid intake, with contributions of 39%, 14% and 12%, respectively (Table 5.6). Dietary supplements containing linoleic acid were used by two persons on both survey days.

Alpha-linolenic acid (ALA)

The median intake of alpha-linolenic acid was 2 g/day (0.8 En%) for men and for women (Table 5.2). The adequate intake for alpha-linolenic acid was set at 0.5 En% per day by EFSA.[38] Similar to linoleic acid, this adequate intake was based on the lowest estimated mean intakes of the various population groups from a number of European countries where overt alpha-linolenic acid deficiency symptoms are not present. A low prevalence of inadequate intakes could be concluded.

The food group 'Fat' contributed 36% to alpha-linolenic acid intake (Table 5.6). Three other main food groups contributed 10% or more, i.e. 'Cereals and cereal products' (11%), 'Dairy products' (10%), and 'Condiments and sauces' (10%). Dietary supplements with alpha-linolenic acid were taken by three persons (two on both survey days, one on one survey day).

N-3 fish fatty acids (EPA and DHA)

The median habitual intake of n-3 fish fatty acids from foods was 170 mg/day for men and 141 mg/day for women. Inclusion of n-3 fish fatty acids from dietary supplements increased median intakes to 178 mg for men and 158 mg for women. Since median habitual n-3 fish fatty acid intake was below the adequete intake of 250 mg, no statement about the prevalence of inadequate intake can be made (Table 5.2). The adequate intake of 250 mg for EPA plus DHA was based on cardiovascular considerations.[38]

'Fish and shellfish' contributed 29% to the intake of n-3 fish fatty acids, but the contribution of 'Meat and meat products' was of a similar magnitude (28%), whereas 'Eggs and egg products' contributed 10% (Table 5.6).

5.4 Protein

For men, median habitual intake of protein was 82 g/day or 1.0 g/kg body weight per day (Table 5.3). Three percent of the older men had a habitual protein intake below the average requirement of 0.66 g/kg required for nitrogen balance.[40] Expressed as a contribution to the total energy intake, median protein intake was 15.2 En%. For men the median habitual intake was higher for animal than for vegetable protein, i.e. 55 versus 30 g/day.

Table 5.4 Habitual intake distribution of carbohydrates and dietary fibre by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Mean	P5	P25	P50	P75	P95	RI	% with intake outside RI	AI	Prevalence inadequate intake
Carbohydrates (g/day)	Men	233	162	200	230	263	316				
	Women	191	128	163	190	218	261				
Carbohydrates (En%)	Men	42.8	33.7	39.0	42.7	46.5	52.0	45-60	66		
	Women	44.0	35.7	40.7	44.0	47.3	51.9	45-60	58		
Mono- and disaccharides (g/day)	Men	108	61	86	105	127	162				
	Women	94	53	75	93	111	140				
Polysaccharides (g/day)	Men	125	84	105	123	142	175				
	Women	97	64	82	96	110	132				
Dietary fibre (g/day)	Men	22	14	18	22	25	32			25	No statement
	Women	19	12	16	19	22	27			25	No statement
Dietary fibre (g/MJ)	Men	2.4	1.7	2.1	2.4	2.8	3.4			3.4	No statement
	Women	2.6	1.8	2.2	2.6	3.0	3.5			3.4	No statement

[a] n=373 men; n=366 women

For women, median habitual intake of protein was 70 g/day. Although absolute median protein intake was lower than for men, expressed per kg body weight it was similar (1.0 g/kg per day) and expressed as a contribution to energy intake it was higher (16.1 En%). Five percent of the older women had a habitual protein intake below the average requirement of 0.66 g/kg.[40] For women the median habitual intake of animal protein was 45 g/day and of vegetable protein 25 g/day.

The 95th percentile of habitual protein intake was about 1.4 g/kg body weight for both men and women. Although EFSA judged there was insufficient data to establish a Tolerable Upper Intake Level for protein, these levels of intake are considered safe.[40]

Three food groups were responsible for about three quarters of total protein intake. These were 'Meat and meat products' (28%), 'Dairy products' (25%) and 'Cereals and cereal products' (20%). The first two food groups were the main contributors to animal protein (43% and 40%, respectively), whereas 'Cereals and cereal products' at 55% was the main contributor to vegetable protein. (See Table 5.6.)

5.5 Carbohydrates

Total carbohydrates

For men, the absolute median habitual intake of carbohydrates was 230 g/day (Table 5.4). Expressed as a contribution to energy intake the median was 42.7 En%, below the reference intake range of 45 to 60 En% as set by EFSA.[39] Diets with glycaemic carbohydrate contents of 45 to 60 En%, in combination with reduced intakes of fat and saturated fatty acids, are compatible with the improvement of metabolic risk factors for chronic disease, as well as with the mean carbohydrate intakes observed in some European countries. Sixty six percent of the older men had a carbohydrate intake outside, i.e. below the reference range.

For women, the absolute median habitual intake of carbohydrates was 190 g/day, and thus 20% lower compared with men. Expressed as a contribution to energy intake it was 44.0 En%, which was close to the lower limit of the reference intake range.[39] Fifty eight percent of the older women had a carbohydrate intake below the reference range.

Five food groups contributed more than 10% to the total carbohydrate intake. These were 'Cereals and cereal products' (33%), 'Cakes' (12%), 'Sugar and confectionery' (11%), 'Dairy products (11%) and 'Fruits, nuts and olives' (10%). (See Table 5.6.)

Table 5.5 Habitual intake distribution of alcohol and water by Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Mean	P5	P25	P50	P75	P95	RI	% with intake outside RI	AI	Prevalence inadequate intake
Alcohol (g/day)	Men	17	0	1	13	28	50	<20	38		
	Women	6	0	0	2	8	24	<10	20		
Alcohol (En%)	Men	5.6	0.0	0.3	4.1	9.2	16.8				
	Women	2.1	0.0	0.0	0.7	2.8	8.8				
Water (g/day)	Men	2,447	1,740	2,105	2,402	2,740	3,308			2,500	No statement
	Women	2,385	1,585	2,010	2,346	2,718	3,318			2,000	Low risk

[a] n=373 men; n=366 women

Mono-, di- and polysaccharides

For men, the median habitual mono- and disaccharides intake was 105 g/day. The median intake of polysaccharides was higher, i.e. 123 g/day. For women, these intakes were 93 and 96 g/day, respectively (see Table 5.4).

Four food groups contributed more than 10% to mono- and disaccharides (see Table 5.6). These were 'Dairy products' (21%), 'Sugar and confectionery' (21%), 'Fruits, nuts, and olives' (19%) and 'Cakes' (14%). For polysaccharide intake, however, 'Cereals and cereal products' were the main contributor (57%), followed by 'Potatoes and other tubers' (16%) and 'Cakes' (11%).

5.6 Dietary fibre

The median habitual dietary fibre intake from foods was 22 g/day or 2.4 g/MJ for men, and 19 g/day or 2.6 g/MJ for women (see Table 5.4). EFSA set an adequate intake for absolute dietary fibre intake at 25 g/day for adults, adequate for normal laxation in adults.[39] The median dietary fibre intake from foods was below the adequate intake, meaning that no statement about adequacy of dietary fibre intake can be made.

The guideline for dietary fibre of the Health Council of the Netherlands was set proportionally to energy intake at 3.4 g/MJ.[43] This guideline considered the intestinal function of fibre and its protective effect against coronary heart disease. The Dutch guideline level for dietary fibre was based on the adequate intake level as derived by the US Institute of Medicine[65]. The level was based on the 90th percentile of intake in several large US cohort studies. Moreover, in DNFCS-Older adults the 90th percentile of intake was close to the guideline level of 3.4 g/MJ. This shows that dietary fibre intake was not optimal.

Three food groups were responsible for about 70% of dietary fibre intake (see Table 5.6). The main contributor was 'Cereals and cereal products' (39%); 'Vegetables' contributed 18%, and 'Fruit, nuts and olives' 15%. Only one person used a dietary supplement containing dietary fibre on the survey days.

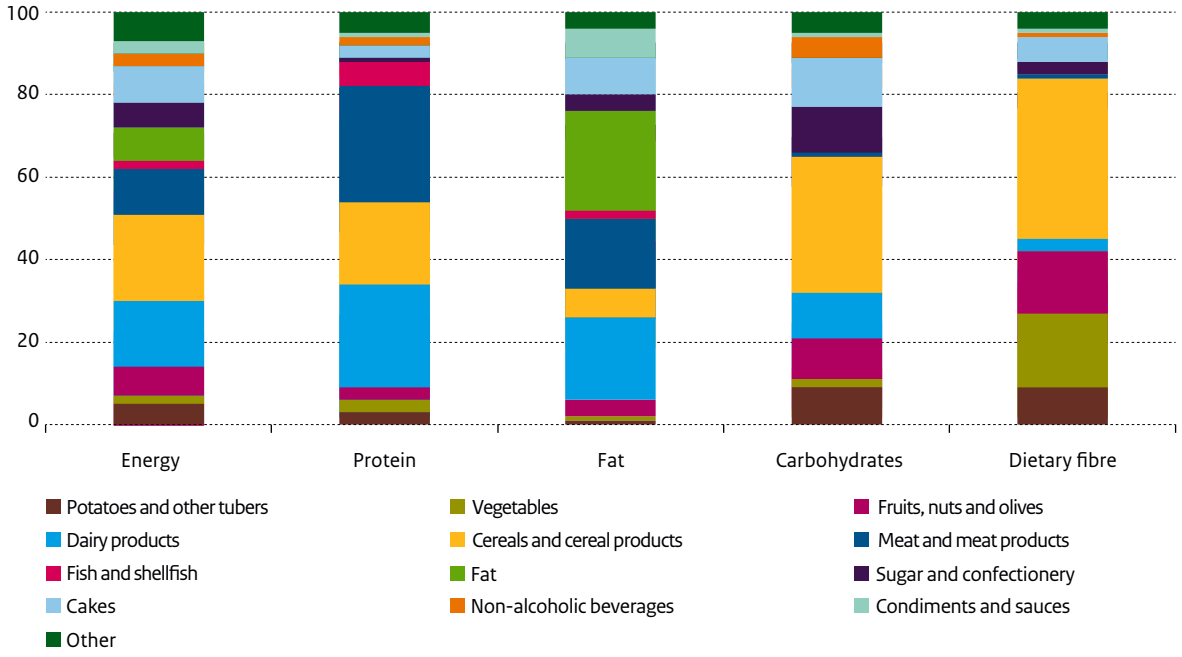
5.7 Alcohol

The median habitual alcohol intake was 13 g/day or 4.1 En% for men. For older women habitual alcohol intake was lower, with median values of 2 g/day or 0.7 En% (Table 5.5). Adult men who are in the habit of drinking alcohol are advised to limit consumption to two Dutch standard units a day, while adult women should restrict themselves to one standard unit a day. One standard unit can be seen as 10 g alcohol. Such moderate drinking will not normally entail any health risk, but can reduce the likelihood of mortality from cardiovascular diseases.[42] Among men, 38% habitually consumed more than 20 g alcohol daily, and among women 20% consumed more than 10 g daily. In Chapter 3 it was shown that one in five men and one in four women did not consume alcohol.

5.8 Water

The median habitual water intake from foods and beverages was about 2,400 g for men and 2,350 for women. For the 5th percentile of water intake differences between men and women were larger, i.e. about 1740 versus 1,590 g. For men, the median intake was lower than the adequate intake of 2,500 g[62], so it cannot be concluded that water intake is adequate. For women, adequate intake level for water is lower (2,000 g)[62], so that the risk of inadequate water intake for them is low.

Figure 5.3 Percentage contribution of food groups to the intake of energy, protein, fat, carbohydrates, and dietary fibre in Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012 n=739), weighted.



5.9 Sources of energy, macronutrients and water

The mean contribution of each food group and dietary supplement to the reported intake of energy, macronutrients and water is shown in Table 5.6. Figure 5.3 presents the importance of foods to the intake of energy, the total intake of protein, fat, carbohydrates, and dietary fibre.

The most important sources of energy, macronutrients and water are given in Sections 5.1 to 5.7. In this section, the importance of each food group to the intake of energy, macronutrients and water is described for contributions of at least 10%.

- 'Dairy products' contributed 16% to energy intake and were an important source of many macronutrients, i.e. total (25%) and animal (40%) protein, total fat (20%), trans-fatty acids (33%), saturated (32%), unsaturated (11%) and mono unsaturated (15%) fatty acids, alpha-linolenic acid (10%), total carbohydrates (11%) and mono- and disaccharides (21%), and water (12%).
- 'Meat and meat products' contributed 11% to energy intake. Moreover, this food group was an important source of total (28%) and animal (43%) protein, and of total fat (17%), saturated (17%) and trans-fatty acids (13%), unsaturated fatty acids (18%), mono unsaturated fatty acids (22%) and n-3 fish fatty acids (28%).
- 'Fish and shellfish' were an important source of n-3 fish fatty acid intake, with a contribution of 29%.
- 'Eggs and egg products' were also an important source of n-3 fish fatty acid intake, but with a smaller contribution of 10%.
- 'Cereals and cereal products' were an important source of energy (21%) and many macronutrients, i.e. total carbohydrates (33%), polysaccharides (57%) and dietary fibre (39%), total (20%) and vegetable (55%) protein, poly unsaturated fatty acids (13%), linoleic acid (14%) and alpha-linolenic acid (11%).
- 'Potatoes and other tubers' were an important source of polysaccharide intake (contribution 16%).
- 'Vegetables' were an important source of dietary fibre intake (18% contribution).
- 'Fruits, nuts, and olives' were an important source of intake of mono- and disaccharides (19%), dietary fibre (15%), and total carbohydrates (10%).
- The food group 'Fat' was an important source of total fat intake (24%), and intake of various types of fatty acids, i.e. saturated (18%), unsaturated (29%), mono unsaturated (24%), poly unsaturated (37%) and trans-fatty acids (21%) fatty acids, linoleic acid (39%) and alpha-linolenic acid (36%).
- 'Condiments and sauces' contributed substantially to the intake of poly unsaturated fatty acids (12%), linoleic acid (12%) and alpha-linolenic acids (10%).
- 'Cakes' contributed with 12% to the intake of carbohydrates, 14% to mono- and disaccharides and 11% to polysaccharides. This food group also

Table 5.6 Average contribution of food groups (%) to the intake of macronutrients for Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Food groups based on EPIC-Soft Classification		Energy	Protein	Vegetable protein	Animal protein	Fat	Saturated fatty acids	Mono unsaturated fatty acids	Poly unsaturated fatty acids	Cis-unsaturated fatty acids	Trans-fatty acids	Linoleic acid	Alpha Linolenic Acid	EPA and DHA	Carbohydrates	Mono- and disaccharides	Polysaccharides	Dietary fibre	Alcohol	Water
01	Potatoes and other tubers	5	3	7	0	1	1	1	1	1	0	1	5	0	9	0	16	9	0	3
02	Vegetables	2	3	9	0	1	0	0	2	1	0	1	7	0	2	3	2	18	0	6
03	Legumes	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
04	Fruits, nuts and olives	7	3	7	0	4	2	5	8	6	0	8	7	2	10	19	3	15	0	6
05	Dairy products	16	25	1	40	20	32	15	4	11	33	3	10	1	11	21	2	3	0	12
06	Cereals and cereal products	21	20	55	0	7	4	6	13	9	4	14	11	3	33	6	57	39	0	3
07	Meat and meat products	11	28	0	43	17	17	22	9	18	13	9	6	28	1	0	1	1	0	3
08	Fish and shellfish	2	6	0	9	2	1	3	3	3	0	1	1	29	0	0	0	0	0	1
09	Eggs and egg products	1	2	0	3	1	1	2	1	1	0	1	0	10	0	0	0	0	0	0
10	Fat	8	0	0	0	24	18	24	37	29	21	39	36	6	0	0	0	0	0	0
11	Sugar and confectionery	6	1	2	1	4	5	4	1	3	1	1	1	0	11	21	2	3	1	0
12	Cakes	9	3	7	1	9	11	9	6	8	18	7	5	6	12	14	11	6	3	0
13	Non-alcoholic beverages	3	2	4	0	0	0	0	0	0	0	0	0	0	5	9	1	1	1	57
14	Alcoholic beverages	4	0	1	0	0	0	0	0	0	0	0	0	0	2	3	1	1	95	4
15	Condiments and sauces	3	1	1	1	7	4	8	12	9	3	12	10	5	1	2	1	1	0	1
16	Soups, bouillon	1	2	2	2	1	1	1	1	1	4	1	1	5	1	1	1	2	0	3
17	Miscellaneous	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
20	Dietary supplements	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0

contributed 18% to trans-fatty acids and 11% to saturated fatty acids.

- 'Sugar and confectionery' were an important source of total carbohydrates, and more specifically of mono- and disaccharides, with contributions of 11 and 21%, respectively.
- 'Non-alcoholic beverages' were the major source of water intake (57%);
- 'Alcoholic beverages' were the major source of alcohol intake (95%).

The food groups 'Soups, bouillon', 'Miscellaneous' and 'Dietary supplements' contributed less than 10% to the intake of energy and macronutrients. The food group 'Legumes' contributed 1% or less.

5.10 Intake by place of consumption

With the exception of alcohol, about 90% of macronutrient intake took place at home (Table 5.7). Alcohol intake had a much higher contribution of outside home consumption, the figure being 31%.

Table 5.7 Average contribution of places of consumption (%) to the intake of macronutrients for Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Nutrient	At home Mean %	Not at home Mean %
Energy	91	9
Protein	91	9
Vegetable protein	93	7
Animal protein	91	9
Fat	90	10
Saturated fatty acids	90	10
Mono unsaturated fatty acids	90	10
Poly unsaturated fatty acids	91	9
Trans-fatty acids	88	12
Alpha Linolenic Acid	92	8
EPA and DHA	90	10
Unsaturated fatty acids-cis	91	9
Linoleic acid	91	9
Carbohydrates	91	9
Mono- and disaccharides	90	10
Polysaccharides	92	8
Dietary fibre	94	6
Alcohol	69	31
Water	91	9

Table 5.8 Average contribution of food consumption occasions (%) to the intake of macronutrients for Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Nutrient	Breakfast Mean %	Lunch[b] Mean %	Dinner[a] Mean %	In between Mean %
Energy	16	25	32	27
Protein	15	30	40	15
Vegetable protein	22	29	29	19
Animal protein	10	30	47	13
Fat	14	27	36	22
Saturated fatty acids	15	27	33	25
Mono unsaturated fatty acids	12	27	40	21
Poly unsaturated fatty acids	17	29	38	16
Trans-fatty acids	15	26	31	29
Alpha Linolenic Acid	19	30	37	14
EPA and DHA	6	31	49	13
Unsaturated fatty acids-cis	14	27	39	19
Linoleic acid	17	29	38	16
Carbohydrates	20	23	27	30
Mono- and disaccharides	18	17	20	45
Polysaccharides	21	28	32	19
Dietary fibre	19	27	35	19
Alcohol	0	3	18	78
Water	16	16	21	47

[a] Dinner is a main meal consumed late afternoon or in the evening and not necessarily a hot meal
[b] Lunch is a main meal consumed at noon and not necessarily a cold meal

5.11 Intake by food consumption occasions

The average contribution to the intake of energy and macronutrients of the three main meals and food consumption occasions outside main meals is shown in Table 5.8. Of total energy intake, on average 16% was consumed at breakfast, 25% at lunch, 32% at dinner and 27% in between main meals. Dinner was also the most important food consumption occasion for most macronutrients. Exceptions were intakes of alcohol, water, total carbohydrates and mono- and disaccharides with the highest contribution from food consumption occasions outside main meals. For vegetable protein, lunch contributed as much as dinner.

Comparing the contribution of each food consumption occasion across macronutrients, dinner contributed the most to the intake of animal protein and fish fatty acids (47-49%); breakfast the most to the intakes of carbohydrates, polysaccharides and vegetable protein (20-22%); lunch to the intake of fish fatty acids, (animal) protein and alpha-linolenic acid (30-31%); and food consumption occasions outside main meals to the intake of alcohol (78%), water (47%) and mono and disaccharides (45%).

5.12 Conclusion

Table 5.9 shows an overview of the assessment of the intake of energy, macronutrients and water by Dutch community-dwelling older adults.

The division of energy intake over the main macronutrients fat, protein, carbohydrates, and alcohol was not optimal. Although protein intake was sufficient for the majority of older adults, average carbohydrate intake was below the recommended intake range, and total fat intake was just within the recommended range for sedentary living populations. Moreover, for one fifth of the women and two fifth of the men, alcohol intake was too high. In addition, intake of dietary fibre was much lower than the Dutch guideline for this item.

With regard to the fatty acid composition of diet, the intake of trans-fatty acids, linoleic acid and alpha-linolenic acid was appropriate, whereas the intake of saturated fatty acids was too high and the intake of n-3 fish fatty acids was low.

From a health perspective, the macronutrient component in the diet could be improved through reducing the intake of saturated fatty acids and increasing the intake of n-3 fish fatty acids, polysaccharides and dietary fibre, and limiting alcohol intake to modest amounts. Such dietary

Table 5.9 Summary table for the evaluation of macronutrient intake by Dutch adults aged 70 years and older (DNFCS 2010-2012, n=739).

Nutrient	Dietary reference value/day	Type of dietary reference value	Source dietary reference value	Result for Dutch older adults	Conclusion
Energy	Men: 9.5-10.1 MJ Women: 7.5-8.1 MJ	AR	EFSA 2013[a]	On average 10% inadequacy and/or underestimation of energy intake	Inconclusive
Total fat	20-35 En%	RI	EFSA 2010	Outside range (too high) for 41% of men and 46% of women	Not optimal
Saturated fatty acids	As low as possible <10 En%	RI RI	EFSA 2010 HC 2001	Outside range for 93% of men and 92% of women	Not optimal
Trans-fatty acids	As low as possible <1 En%	RI RI	EFSA 2010 HC 2001	Outside range for 4% of men and 9% of women	No public health risk
Linoleic acid	4 En%	AI	EFSA 2010	Low risk of inadequacy	No public health risk
Alpha-linolenic acid	0.5 En%	AI	EFSA 2010	Low risk of inadequacy	No public health risk
EPA and DHA	250 mg	AI	EFSA 2010	Prevalence of inadequacy cannot be estimated, but intake is low compared to AI	Inconclusive
Protein	0.66 g / kg body weight	AR	EFSA 2012	Inadequate for 3% of men and 5% of women	No public health risk
Carbohydrates	45-60 En%	RI	EFSA 2010	Outside range (too low) for 66% of men and 58% of women	Not optimal
Dietary fibre	25 g/day 3.4 g/MJ	AI Guideline	EFSA 2010 HC 2006	Prevalence of inadequacy cannot be estimated, but intake is low compared to AI/ guideline	Inconclusive/not optimal
Alcohol	Men: <20 g Women: <10 g	RI	HC 2006	Outside range for 38% of men and 20% of women	Not optimal
Water	Men: 2500 g Women: 2000 g	AI	EFSA 2010	Men: prevalence of inadequacy cannot be estimated Women: low risk of inadequacy	Men inconclusive; Women no public health risk

AR=average requirement; AI=adequate intake; RI=recommended intake for a population
[a] Average requirement was adjusted to body weights in the study population

changes are known to be beneficial for health at older ages, too.[66,67]

It should be recognised, however, that the older population is heterogeneous and these results and recommendations for improvements apply to relatively vital older adults (see Chapters 3 and 8). In Chapter 7, the consumption of energy and relevant nutrients is presented for subgroups of older adults, to obtain insight into the possible effects of underrepresentation of older adults with functional impairment, chronic diseases and lower education.

Moreover, uncertainties and methodological issues should be considered in interpreting results. This is done in Chapter 8.

6 Micronutrients

6.1 Introduction

Information on the habitual intake of micronutrients is presented for vitamins in Section 6.2 and for minerals and trace elements in Section 6.3. This includes information on intake distributions from food only (including fortified foods) and from the combination of food and dietary supplements.

To assess micronutrient intake, the habitual intake of each micronutrient was compared with dietary reference values. Depending on the type of dietary reference value, this assessment was qualitative or quantitative. Only a qualitative evaluation could be made in the case of an adequate intake level (AI); whereas a quantitative evaluation was done in the case of an average requirement (AR) and tolerable upper intake level (UL). When the 95% confidence limit of the proportion with intake below the average requirement included 2.5% or less, the intake was considered adequate. (See Textbox 2.1 for an explanation of the different dietary reference values.)

For comparison with the tolerable upper intake level, the values set by EFSA were used.[50-52] To assess micronutrient adequacy the average requirements and adequate intake levels published by the Health Council of the Netherlands were applied if set in the year 2000 or more recently.[42, 44-48] Otherwise, the Nordic dietary reference values from 2004 were applied.[49] The Nordic reference values are currently being updated. The draft recommendations published in 2012 were unchanged for those nutrients for which the Nordic reference values were applied in this chapter (see http://www.slv.se/en-gb/Startpage-NNR/Public-consultation/ accessed 4 April 2013).

In addition, this chapter presents information on the sources of the micronutrients (Section 6.4), as well as on the intake by place of consumption (Section 6.5) and on food consumption occasions (Section 6.6) of micronutrient intake. Conclusions regarding micronutrient intake are given in Section 6.7.

6.2 Vitamins

The habitual intake distributions were estimated for vitamin A, vitamins B_1, B_2, B_6, and B_{12}, folate, vitamin C, vitamin D and vitamin E.

6.2.1 Vitamin A

Vitamin A (retinol activity equivalents)

In men, the median habitual retinol activity equivalent (RAE) intake was 946 µg RAE/day from foods only and 984 µg RAE/day from the combination of foods and dietary supplements (Table 6.1). The average requirement of vitamin A for men is 610 µg RAE/day.[44] The 5th percentile of

Table 6.1 Habitual intake distribution of vitamin A by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI	UL	% with intake > UL	95% CI
Total vitamin A (µg RAE/ day)	Men	Foods only	1,036	469	709	946	1,261	1,907	610	15	11-23			
	Men	F and S[b]	1,137	514	749	984	1,324	2,277	610	12	6-17			
	Women	Foods only	784	371	550	722	948	1,404	520	21	12-25			
	Women	F and S[b]	1,037	403	620	848	1,188	2,006	520	14	10-18			
Retinol (µg RAE/day)	Men	Foods only	814	345	538	733	999	1,557				3,000	0	
	Men	F and S[b]	878	363	551	748	1,041	1,846				3,000	1	0-3
	Women	Foods only	554	258	386	509	673	1,004				3,000	0	0-0
	Women	F and S[b]	652	279	424	577	798	1,262				3,000	0	0-1

[a] n=373 men; n=366 women; [b] Foods and supplements

total vitamin A intake was 514 µg RAE/day; 12% of the older men had a vitamin A intake below the average requirement of 610 µg RAE/day.

The average requirement of vitamin A for women is 520 µg RAE/day.[44] The habitual vitamin A intake in women was lower than in men. The median intake from foods only was 722 µg RAE/day which increased to 848 µg RAE/day when dietary supplements were taken into account. The 5th percentile of total vitamin A intake was 403 µg RAE/day; 14% of the women had a vitamin A intake below the average requirement of 520 µg RAE/day.

Four food groups each contributed more than 10% to the intake of vitamin A. These were 'Fat' (26%), 'Dairy products' (20%), 'Vegetables' (16%) and 'Meat and meat products' (12%). (See Table 6.20 for contributions of all food groups.)

Retinol

The tolerable upper intake level of 3,000 µg RAE for vitamin A is based on the intake of preformed vitamin A only (i.e. retinoids).[50] The habitual intake of retinol was lower than the intake of total vitamin A, as provitamins A, such as carotenoids, were not included (Table 6.1).
In men, the 95th percentile of habitual retinol intake was 1,557 µg RAE/day from foods only and 1,846 µg RAE/day when the intake from dietary supplements was included. The proportion of older men with retinol intake above the tolerable upper intake level of 3,000 µg RAE retinol was 1%. Highest retinol intakes were observed in participants that consumed liver.

In women, the 95th percentile of habitual retinol intake was considerably lower than in men. When the intake from foods alone was considered, this was 1,004 µg RAE/ day, and from the combination of foods and dietary supplements, this was 1,262 µg RAE/day. Less than 0.5% of the women were estimated as having an intake above the tolerable upper intake level of 3,000 µg RAE/day. This upper limit of 3,000 µg RAE per day may provide insufficient protection against the possible risk of bone fractures in postmenopausal women.[50] Accordingly, postmenopausal women are advised to limit their intake to 1,500 µg RAE per day.[44] Two percent of the women had a habitual intake above this level (data not shown).

With the exception of vegetables, the food groups mentioned as important sources of total vitamin A intake were also important sources of preformed vitamin A. The mean contributions were 35% for 'Fat', 27% for 'Dairy products' and 14% for 'Meat and meat products' (see Table 6.20).

Conclusion

Total vitamin A intake was below the average requirement for about one in eight men and women. This does not necessary mean that the intake for this group was inadequate. Vitamin A has many functions. For older adults, the most important are its role in vision, maintenance of epithelial surfaces, and immune competence.[44] The average requirement for vitamin A is based on adequate liver stores. It is unknown whether an intake below these values will result in health problems. More research on the health effects associated with low observed vitamin A intake is therefore recommended, as

Table 6.2 Habitual intake distribution of vitamin B_1 by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	Adequate intake	Prevalence inade-quate intake
Vitamin B_1 (mg/day)	Men	Foods only	1.1	0.7	0.9	1.1	1.3	1.8	1.1	Low
	Men	Foods and supplements	1.6	0.7	0.9	1.2	1.5	2.8	1.1	Low
	Women	Foods only	1.0	0.6	0.8	0.9	1.1	1.5	1.1	No statement
	Women	Foods and supplements	2.7	0.7	0.9	1.1	1.6	6.7	1.1	Low
Vitamin B_1 (mg/MJ)	Men	Foods only	0.12	0.08	0.10	0.12	0.14	0.19		
	Men	Foods and supplements	0.18	0.08	0.10	0.13	0.17	0.32		
	Women	Foods only	0.13	0.08	0.11	0.13	0.15	0.19		
	Women	Foods and supplements	0.36	0.09	0.12	0.15	0.23	0.91		

[a] n=373 men; n=366 women

well as nutritional status research.[44] No public health problems with regard to high preformed vitamin A intakes are expected.

6.2.2 Vitamin B_1 (Thiamin)

In older men, the median habitual vitamin B_1 intake from foods alone was 1.1 mg/day and the 5th percentile value was 0.7 mg/day (Table 6.2). Inclusion of dietary supplements resulted in a median intake of 1.2 mg/day, whereas the 5th percentile remained unchanged. The median total intake in older men was higher than the adequate intake level of 1.1 mg/day[45], indicating that the prevalence of inadequate intake was low. There are indications that vitamin B_1 requirement is related to energy intake, though insufficient to express the average requirement per unit of energy intake.[45] In men, the median total habitual intake of vitamin B_1 was 0.13 mg/MJ.

In older women, the vitamin B_1 intake was lower than in men. The median habitual vitamin B_1 intake from foods only was 0.9 mg/day, and the 5th percentile value was 0.6 mg/day. Inclusion of dietary supplements resulted in a median intake of 1.1 mg/day, and a 5th percentile value of 0.7 mg/day. The median total intake in older women was at the level of the adequate intake[45], indicating that the prevalence of inadequate intake was probably low. In women, the median total habitual intake of vitamin B_1 expressed per unit of energy intake was 0.15 mg/MJ, which was higher than in men.

In men, the 95th percentile of the habitual vitamin B_1 intake distribution was 1.8 mg/day from foods only and 2.8 mg/day if the intake from dietary supplements was also considered, an increase of more than 50%. In women, the 95th percentile values were 1.5 mg/day and 6.6 mg/day (about 4 times higher), respectively. There is no tolerable upper intake level established for vitamin B_1. EFSA has concluded that evidence indicates that current levels of intake from vitamin B_1 from all sources do not represent a health risk for the general population.[50]

The food groups 'Meat and meat products' and 'Cereals and cereal products' were important sources of vitamin B_1 intake, with contributions of 23% and 16% respectively. In addition, dietary supplements contributed 11% on average to vitamin B_1 intake (see Table 6.20).

Conclusion

No public health problems are expected due to inadequate vitamin B_1 intake in older community-dwelling Dutch adults.

6.2.3 Vitamin B_2 (Riboflavin)

In older men, the median habitual intake of vitamin B_2 from foods was 1.5 mg/day and the 5th percentile value was 1.0 mg/day (Table 6.3). After taking the intake from dietary supplements into account, the median value increased to 1.6 mg/day, while the 5th percentile hardly changed. The proportion with a total vitamin B_2 intake below the average requirement of 1.1 mg [45] was 10% in men. Similar to vitamin B_1, there are indications that the

Table 6.3 Habitual intake distribution of vitamin B_2 by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI
Vitamin B_2 (mg/day)	Men	Foods only	1.6	1.0	1.3	1.5	1.8	2.2	1.1	12	11-20
	Men	Foods and supplements	2.0	1.0	1.3	1.6	1.9	3.6	1.1	10	6-14
	Women	Foods only	1.3	0.8	1.0	1.3	1.5	2.0	0.8	7	3-8
	Women	Foods and supplements	3.2	0.8	1.1	1.5	2.2	7.0	0.8	5	3-7
Vitamin B_2 (mg/MJ)	Men	Foods only	0.17	0.11	0.14	0.16	0.19	0.24			
	Men	Foods and supplements	0.24	0.11	0.15	0.17	0.22	0.40			
	Women	Foods only	0.18	0.12	0.15	0.17	0.20	0.25			
	Women	Foods and supplements	0.42	0.13	0.16	0.20	0.30	0.94			

[a] n=373 men; n=366 women

vitamin B_2 requirement is related to energy intake, though insufficient to express the average requirement per unit of energy intake.[45] In men, the median total habitual intake of vitamin B_2 was 0.17 mg/MJ.

In older women, the median habitual intake of vitamin B_2 was 1.3 mg/day from foods only, with the corresponding 5th percentile value being 0.8 mg/day. After inclusion of the contribution from dietary supplements, the median intake became 1.5 mg/day, whereas the 5th percentile was virtually unchanged. The average requirement of vitamin B_2 is 0.8 mg for women.[45] Five percent of the women had a total vitamin B_2 intake below the average requirement. In women, the median total habitual intake of vitamin B_2 was 0.20 mg/MJ.

Looking at the higher intake levels of vitamin B_2, it appears that the contribution of dietary supplements in women was much higher than in men. For women the 95th percentile of intake including dietary supplements became 7.0 mg/day and for men 3.6 mg/day, whereas the intake from foods only was 2.0 versus 2.2 mg/day. There is no tolerable upper intake level established for vitamin B_2. EFSA concluded that limited evidence indicates that current levels of intake from vitamin B_2 from all sources do not represent a health risk for the general population.[50]

'Dairy products' were the main source of vitamin B_2 intake, with a contribution of 41% on average (see Table 6.20). In addition, 'Meat and meat products', and 'Dietary supplements' contributed 13 and 10%, respectively.

Conclusion

A subgroup of community-dwelling older adult men (10%) and women (5%) had vitamin B_2 intakes below the average requirement. Potentially, the intake for this subgroup might be inadequate, and nutritional status research could be conducted to verify this. No public health problems are expected because of high vitamin B_2 intake in older Dutch adults.

6.2.4 Vitamin B_6

In men, the median habitual vitamin B_6 intake from foods was 2.0 mg/day and the 5th percentile value was 1.2 mg/day (Table 6.4). Inclusion of the vitamin B_6 intake from dietary supplements increased the median intake to 2.1 mg/day and the 5th percentile value to 1.3 mg/day. The proportion of men with total intake below the average requirement of 1.3 mg/day[46] was 6%.

In women, the median habitual vitamin B_6 intake from foods was 1.6 mg/day and the 5th percentile value was 1.0 mg/day. Inclusion of the vitamin B_6 intake from dietary supplements increased the median intake to 1.9 mg/day and the 5th percentile value to 1.1 mg/day. The proportion of women with total intake below the average requirement of 1.1 mg/day[46] was 6% (similar to men).

In men, the 95th percentile of intake was 3.0 mg/day, which increased by 50% to 4.8 mg/day when dietary supplements were included. In women, the 95th percentile of the intake distribution increased even more sharply when intake from dietary supplements was taken into consideration, i.e. from 2.5 mg/day to 16.8 mg/day. Two percent of the women, and 0% of the men were estimated as exceeding the tolerable upper intake level for vitamin B_6 intake of 25 mg/day.[50]

Table 6.4 Habitual intake distribution of vitamin B_6 by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI	UL	% with intake > UL	95% CI
Vitamin B_6 (mg/day)	Men	Foods only	2.0	1.2	1.6	2.0	2.3	3.0	1.3	7	6-13	25	0	0-0
	Men	Foods and supplements	2.5	1.3	1.7	2.1	2.6	4.8	1.3	6	4-9	25	0	0-1
	Women	Foods only	1.7	1.0	1.3	1.6	1.9	2.5	1.1	10	4-12	25	0	0-0
	Women	Foods and supplements	3.7	1.1	1.5	1.9	3.0	16.8	1.1	6	3-9	25	2	0-3

[a] n=373 men; n=366 women

Table 6.5 Habitual intake distribution of folate/folic acid by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI	UL	% with intake > UL	95% CI
Folate equivalents (µg/day)	Men	Foods only	357	192	268	337	424	591	200	6	5-13			
	Men	Foods and supplements	430	188	270	353	489	898	200	7	4-10			
	Women	Foods only	301	165	232	290	358	476	200	13	8-15			
	Women	Foods and supplements	423	179	261	347	507	928	200	9	6-11			
Folic acid (µg/day)	Men	Foods and supplements	97	0	0	55	140	324				1,000	0	0-1
	Women	Foods and supplements	96	0	1	58	138	335				1,000	0	0-0

[a] n=373 men; n=366 women

Three food groups and dietary supplements contributed on average more than 10% to vitamin B_6 intake. These were 'Meat and meat products' (20%), 'Fat' (12%), 'Potatoes and other tubers' (10%), and dietary supplements (11%). (See Table 6.20.)

Conclusion

A small proportion of community-dwelling older adult men and women (6%) had vitamin B_6 intakes below the average requirement. Potentially, the intake for this subgroup might be inadequate, and nutritional status research could be conducted to verify this. No public health problems are expected because of high vitamin B_6 intake in these older adults.

6.2.5 Folate/folic acid

Folate equivalents

In men, the median habitual folate equivalent intake from foods only was 337 µg/day, which increased to 353 µg/day when dietary supplements were also considered (Table 6.5). The difference between the habitual intake distributions with and without inclusion of dietary supplements was more than 40% at the 95th percentile of intake, i.e. 898 versus 591 µg/day. However, at the lower tail of the intake distributions, percentiles were similar (192-188 µg/day for the 5th percentile). The average requirement of folate equivalent intake for both men and women is 200 µg/day.[46] The proportions of men with folate equivalent intake below the average requirement remained about the same (6-7%) whether or not dietary supplements were considered.

In women, the median habitual folate equivalent intake from foods only was 290 µg/day, and the 5th percentile of intake was 165 µg/day. With inclusion of dietary supplements the median value became 347 µg/day, and the 5th percentile 179 µg/day. Nine percent of the women

Table 6.6 Habitual intake distribution of vitamin B_{12} by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI
Vitamin B_{12} (µg/day)	Men	Foods only	5.4	2.7	3.9	5.0	6.4	9.1	2.0	1	0-3
	Men	Foods and supplements	6.7	2.8	4.0	5.2	6.7	10.3	2.0	1	0-2
	Women	Foods only	4.3	2.3	3.2	4.1	5.2	7.3	2.0	2	0-4
	Women	Foods and supplements	8.8	2.4	3.5	4.5	6.4	25.3	2.0	2	1-3

[a] n=373 men; n=366 women

had a total folate equivalent intake below the average requirement of 200 µg/day. Even more so than for men, the difference between folate equivalent intake with and without inclusion of dietary supplements at the 95th percentile of intake was high (928 versus 476 µg/day).

The main sources of folate equivalent intake are shown in Table 6.20. 'Vegetables' (18%), 'Fat' (17%), and 'Cereals and cereal products' (15%) contributed more than 10%.

Folic acid

The tolerable upper intake level was based on the intake of folic acid only.[50] The median folic acid intake was 55-58 µg/day, and the 95th percentiles were 324 and 335 µg/day for men and women, respectively. No intakes above the tolerable upper intake level of 1,000 µg/day were observed.

Conclusion

About one in twelve community-dwelling older men and women had folate intakes below the average requirement. Potentially, intake for this subgroup might be inadequate, and nutritional status research could be conducted to verify this. No public health problems are expected because of a high intake of folic acid by these older adults.

6.2.6 Vitamin B_{12}

In men, the median habitual vitamin B_{12} intake from foods was 5.0 µg/day and the 5th percentile value was 2.7 µg/day (Table 6.6). Inclusion of the vitamin B_{12} intake from dietary supplements increased the median intake to 5.2 µg/day and the 5th percentile value to 2.8 µg/day. The average requirement of vitamin B_{12} is 2.0 µg/day.[46] One percent of the men had a vitamin B_{12} intake below 2.0 µg/day.

In women, the median habitual vitamin B_{12} intake from foods was lower than in men. The median intake was 4.1 µg/day and the 5th percentile value was 2.3 µg/day. Inclusion of the vitamin B_{12} intake from dietary supplements increased the median intake to 4.5 µg/day and the 5th percentile value to 2.4 µg/day. Two percent of the women had a vitamin B_{12} intake below the average requirement of 2.0 µg/day.

In men, the 95th percentile of intake was 9.1 µg/day, which increased to 10.3 µg/day when dietary supplements were included. In women, the 95th percentile of the intake distribution increased more when the intake from dietary supplements was taken into consideration, i.e. from 7.3 µg/day to 25.3 µg/day. There is no tolerable upper intake level established for vitamin B_{12}. EFSA has concluded that there is no evidence that current levels of intake of vitamin B_{12} from foods and supplements represent a health risk.[50]

Table 6.20 shows that three food groups with animal-based products contributed at least 10% to the total vitamin B_{12} intake. These were 'Dairy products' (35%), 'Meat and meat products' (29%) and 'Fish and shellfish' (12%).

Conclusion

It can be concluded that no public health problems relating to low vitamin B_{12} intakes are expected. However, it is known from the literature that older persons frequently have low vitamin B_{12} status levels due to food-cobalamin malabsorption rather than to a low intake of vitamin B_{12}.[46, 49] For this reason nutritional status research on vitamin B_{12} could be recommended.

6.2.7 Vitamin C

For men, the median habitual vitamin C intake was 96 mg/day if the intake from foods only was considered and 10 mg more if the intake from dietary supplements was added to this (Table 6.7). At 48-49 mg/day, the 5th percentile of vitamin C intake with and without consideration of dietary supplements was comparable. Based on the Nordic average requirement of 60 mg/day[49], 11% of older men had an inadequate total intake.

Table 6.7 Habitual intake distribution of vitamin C by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI
Vitamin C (mg/day)	Men	Foods only	101	48	74	96	124	171	60	12	8-21
	Men	Foods and supplements	129	49	78	106	142	237	60	11	5-15
	Women	Foods only	104	48	75	99	128	179	50	6	1-9
	Women	Foods and supplements	170	56	87	119	173	520	50	3	1-6

[a] n=373 men; n=366 women

Women had a median habitual vitamin C intake of 99 mg/day from foods only and 119 mg/day from foods and dietary supplements combined. The values for the 5th percentile of intake were 48 and 56 mg/day, respectively. When compared to the average requirement of 50 mg[49], 3% of women can be considered to have an inadequate total intake.

There is no tolerable upper intake level established for vitamin C. EFSA has concluded that the intake from food and supplements ranging up to about 1 g/day does not represent a cause for concern.[50] The 95th percentile values in older Dutch adults were 237 mg/day for men and 520 mg/day for women.

On average, four food groups each contributed more than 10% to vitamin C intake. These were 'Fruits, nuts and olives' (27%), 'Vegetables' (20%), 'Non-alcoholic beverages' (16%) and 'Potatoes and other tubers' (10%). In addition, dietary supplements contributed 11% on average to vitamin C intake.

Conclusion

For older women, no public health problems are expected relating to vitamin C intake. For about 1 in 10 older men, vitamin C intake was below the average requirement. Potentially, vitamin C intake is inadequate for this subgroup. Nutritional status research on vitamin C could be considered as follow up to these findings. Marginal vitamin C status may be reflected by decreased antioxidant capacity, fatigue and irritability.[49]

6.2.8 Vitamin D

The median habitual vitamin D intake from food was 4.3 µg/day for men, and the 5th percentile value was 2.3 µg/day. The median intake increased to 4.6 µg/day when intake from dietary supplements was also considered (Table 6.8). For older adults, the average requirement of vitamin D intake is set at 10 µg/day.[48] This is higher than the average requirement for other adults, because at advanced ages the human skin is less able to produce vitamin D from sunlight exposure. The majority of older men (95%) had total intake levels of vitamin D below the average requirement.

In women, median habitual intake levels of vitamin D without and with inclusion of dietary supplements were 3.3 and 4.1 µg/day, respectively. The 5th percentile of total vitamin D intake was 1.6-1.7 µg/day. Although the median levels were lower than in men, the opposite was the case for the 95th percentile of intake including dietary supplements. This illustrates the higher prevalence of vitamin D supplement use by older women compared with men. Nevertheless, 91% of older women had a habitual total vitamin D intake below the average requirement of 10 µg/day.

Although vitamin D supplementation was recommended[48, 61], taking dietary supplements containing vitamin D was practiced by only 18% of the men and 26% of the women (20% of men and 33% of women during winter and 18% of men and 27% of women during the rest of the year; see Table 4.9).

No habitual total vitamin D intakes above the tolerable upper intake level of 100 µg/day[51] were observed. In fact, the 95th percentiles of the habitual total vitamin D intake distributions were substantially lower than the tolerable upper intake levels, i.e. 9.9 µg/day for men and 12.5 µg/day for women.

The food group 'Fat' was the main source of vitamin D intake, with a contribution of 37% (see Table 6.20). Other contributions of more than 10% were observed for dietary supplements (12%), 'Meat and meat products' (12%) and 'Fish and shell fish' (11%).

Conclusion

For the majority of older men and women in this survey, vitamin D intake was inadequate. Research convincingly showed that older persons aged 70 and over require an

Table 6.8 Habitual intake distribution of vitamin D by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI	UL	% with intake > UL	95% CI
Vitamin D (µg/day)	Men	Foods only	4.6	2.3	3.3	4.3	5.6	8.0	10	99	96-99	100	0	0-0
	Men	Foods and supplements	5.2	2.2	3.4	4.6	6.3	9.9	10	95	92-98	100	0	0-0
	Women	Foods only	3.5	1.6	2.5	3.3	4.3	6.2	10	100	100-100	100	0	0-0
	Women	Foods and supplements	5.1	1.7	2.8	4.1	6.2	12.5	10	91	85-94	100	0	0-0

[a] n=373 men; n=366 women

Table 6.9 Habitual intake distribution of vitamin E by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI	UL	% with intake > UL	95% CI
Vitamin E (mg/day)	Men	Foods only	14.3	7.9	11.0	13.7	17.0	22.8	6	1	1-3	300	0	0-0
	Men	Foods and supplements	16.3	8.1	11.5	14.6	18.7	27.0	6	1	0-2	300	0	0-0
	Women	Foods only	11.4	5.9	8.5	10.9	13.7	18.9	5	2	0-3	300	0	0-0
	Women	Foods and supplements	19.6	6.5	9.5	12.6	17.7	45.9	5	1	0-2	300	0	0-0

[a] n=373 men; n=366 women

additional daily vitamin D supplement of 10 to 20 µg in order to reduce the risk of bone fractures. It is also likely that this additional dose of vitamin D reduces the risk of falling for fragile older persons.[48] Monitoring the use of vitamin D containing supplements and monitoring nutritional vitamin D status in Dutch older adults is recommended.

6.2.9 Vitamin E

In men, the median habitual vitamin E intake was 13.7 mg/day from foods and 14.6 mg/day from foods and dietary supplements combined (Table 6.9). In women, these median intakes were lower, i.e. 10.9 and 12.6 mg/day, respectively. The average requirement of vitamin E intake is set at 6 mg/day for men and 5 mg/day for women.[49] For both men and women, only 1% of the older adults was estimated as having a vitamin E intake below the average requirement. The 5th percentile of vitamin E intake was 6.5-8.1 mg/day.

No habitual vitamin E intakes above the tolerable upper intake level of 300 mg/day[50] were observed. The 95th percentile values of total vitamin E intakes were much lower, i.e. 27.0 mg/day for men, and 45.9 mg/day for women.

For vitamin E intake, the food group 'Fat' contributed 31% on average and 'Condiments and sauces' 10% (Table 6.20).

Conclusion

Overall, no public health problems due to inadequate or excessive vitamin E intake are expected for this age group.

6.3 Minerals and trace elements

The habitual intake distributions were estimated for calcium, copper, iodine, iron, magnesium, phosphorus, potassium, selenium, sodium and zinc. For sodium and iodine, these are intakes from foods and discretionary salt use, and for iodine also from dietary supplements. For the other minerals and trace elements, intake from foods and dietary supplements was considered.

6.3.1 Calcium

In men, the median habitual calcium intake from food was 995 mg/day and the 5th percentile of intake was 618 mg/day. These percentiles became slightly higher (1,005 mg/day and 627 mg/day) when dietary supplements were also considered (Table 6.10). The adequate intake of calcium for both men and women is 1,200 mg/day.[45] As the

Table 6.10 Habitual intake distribution of calcium by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	Adequate intake	Prevalence inadequate intake	UL	% with intake > UL	95% CI
Calcium (mg/day)	Men	Foods only	1,011	618	830	995	1,175	1,461	1,200	No statement	2,500	0	0-0
	Men	Foods and supplements	1,037	627	838	1,005	1,193	1,536	1,200	No statement	2,500	0	0-1
	Women	Foods only	921	529	734	900	1,084	1,386	1,200	No statement	2,500	0	0-0
	Women	Foods and supplements	1,009	543	770	964	1,195	1,640	1,200	No statement	2,500	0	0-0

[a] n=373 men; n=366 women

median intake was below this level, no statement about the adequacy of calcium intake can be made.

In women, the median habitual calcium intake from food was 900 mg/day and the 5th percentile of intake was 529 mg/day. After including the intake from dietary supplements, median intake was 964 mg/day and the 5th percentile was 543 mg/day. For women, too, no statement about the adequacy of calcium intake can be made, because the median total intake was below the adequate intake level of 1,200 mg/day.

The 95th percentile of the habitual total calcium intake distribution in men was 1,536 mg/day and no intakes above the tolerable upper intake level of 2,500 mg/day[52] were observed. The 95th percentile of the habitual total intake distribution in women was 1,640 mg/day, which was considerably higher than the same percentile for intake from foods only (1,386 mg/day). Less than 0.5% of the women exceeded the tolerable upper intake level of 2,500 mg/day.

Apart from the intake of dietary supplements, in particular antacids can contribute to calcium intake. According to information from the general questionnaire, about 14% of the men and 11% of the women used these medicines, which contain approximately 270 mg calcium per tablet (data not shown). The frequency of use and the number of tablets is not known.

The food group 'Dairy products' was the major source of calcium intake, with a contribution of 61%. Contributions of other food groups were all smaller than 10%, as can be seen in Table 6.20.

Conclusion

In both older men and women, the median total calcium intake was below the adequate intake level. Accordingly, no statement about calcium intake adequacy can be made.

A sufficient calcium intake among older adults is important to minimise reduction of bone mass with ageing. In 2009, the Health Council of the Netherlands concluded that no adverse health problems were expected in persons of Dutch origin. This was substantiated by the observation that the mean calcium intake was close to the adequate intake level and because the risk of bone fractures increases at intake levels of 400 mg or less among persons with increased risk of osteoporosis.[68] In the current survey the 5th percentiles of calcium intake were higher than 400 mg/day. To verify whether calcium intake is adequate, it is recommended to measure calcium status (e.g. bone mass) in the older adult population.

6.3.2 Copper

For men, the median habitual copper intake was 1.2 mg/day and the 5th percentile of intake was 0.8 mg/day (Table 6.11). This was the case if foods only were considered, as well as when the contribution of dietary supplements was included. The average requirement of copper is 0.7 mg/day.[49] One percent of the men had a total intake below the average requirement.

For women, the median habitual copper intake from foods was 1.0 mg/day. Inclusion of dietary supplements resulted in a slightly higher median intake of 1.1 mg/day. Five percent of the older women had a total copper intake below the average requirement of 0.7 mg.

At the 95th percentile of intake, however, the difference between the intake from foods and the intake from foods and dietary supplements was substantial (1.7 versus 2.3 mg/day for men; and 1.4 versus 2.0 mg/day for women). No copper intakes above the tolerable upper intake level of 5 mg/day[50] were observed.

Two plant-based food groups contributed more than 10% to copper intake. These were 'Cereals and cereal products'

Table 6.11 Habitual intake distribution of copper by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI	UL	% with intake > UL	95% CI
Copper (mg/day)	Men	Foods only	1.2	0.8	1.0	1.2	1.4	1.7	0.7	2	1-6	5.0	0	0-0
	Men	Foods and supplements	1.3	0.8	1.0	1.2	1.4	2.3	0.7	1	0-2	5.0	0	0-0
	Women	Foods only	1.0	0.7	0.8	1.0	1.1	1.4	0.7	8	3-10	5.0	0	0-0
	Women	Foods and supplements	1.2	0.7	0.9	1.1	1.3	2.0	0.7	5	2-8	5.0	0	0-0

[a] n=373 men; n=366 women

(27%) and 'Fruits, nuts and olives' (11%). (See Table 6.20 for more information.)

Conclusion
Based on the results of our study, no public health problems relating to a too low or too high copper intake are expected in community-dwelling older adults.

6.3.3 Iodine

For the estimation of the habitual intake of iodine, all different sources were taken into account: iodine naturally present in foods; iodine industrially added in foods; iodine in dietary supplements and iodine from salt used at mealtime or during cooking (method adapted from Verkaik et al[69]).

In men, the median habitual intake was 81 µg/day for iodine naturally present in foods, 94 µg/day for iodine industrially added through iodised salt, and 29 µg/day for discretionary added iodised salt (Table 6.12). Median iodine intake from dietary supplements was 0 µg/day; mean intake was 8 µg/day. Inclusion of the intake from all sources resulted in an intake distribution, with 216 µg/day as the median level, a 5th percentile of 126 µg/day and a 95th percentile of 326 µg/day.

Similarly, in women, the median habitual intake was 73 µg/day for iodine naturally present in foods and for iodine industrially added through iodised salt as well, and 31 µg/day for discretionary added iodised salt (Table 6.12). Also in women median iodine intake from dietary supplements was 0 µg/day; mean intake was 8 µg/day. Inclusion of the intake from all other sources resulted in an intake distribution with 182 µg/day as the median level, a 5th percentile of 110 µg/day and a 95th percentile of 265 µg/day.

The average requirement of iodine is 100 µg/day.[49] Based on the total iodine intake, 2% of the men and 3% of the women had a total intake below the average requirement. No iodine intakes above the tolerable upper intake level of 600 µg/day were observed.

'Cereals and cereal products' contributed half the iodine intake from foods. (See Table 6.20). Dairy products contributed on 18% on average.

Conclusion
Based on the results of our study, no public health problems relating to a too low or too high iodine intake are expected in community-dwelling older adults.

6.3.4 Iron

In men, the median habitual iron intake was 10.9 mg/day from foods (Table 6.13). Habitual intake of heme iron was considerably lower than that of non-heme iron, with median levels of 1.2 and 9.7 mg/day, respectively. Inclusion of intake of dietary supplements resulted in total iron distributions with median of 11.1 mg/day, 5th percentile of 7.8 mg/day, and 95th percentile of 18.5 mg/day. The average requirement of iron for men is 7 mg/day[49]. About 2% of the older men had a total iron intake below this average requirement.

In women, the median habitual iron intake was 9.1 mg/day from foods, which is lower than in men. Habitual intake of heme iron was considerably lower than that of non-heme iron, with median levels of 0.9 and 8.0 mg/day, respectively. Inclusion of intake of dietary supplements resulted in total iron distributions with median of 9.6 mg/day, 5th percentile of 6.1 mg/day, and 95th percentile 16.9 mg/day. Four percent of older women had a total iron intake below the average requirement of 6 mg/day.

There is no tolerable upper intake level established for iron. However, adverse gastrointestinal effects (i.e. nausea, epigastric discomfort, constipation) have been reported after short-term oral dosages of 50 to 60 mg daily of

Table 6.12 Habitual intake distribution of iodine by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	UL	% with intake > UL
Iodine (µg/day)	Men	Foods, naturally present	83	54	69	81	96	121				
	Men	Foods, industrially added iodised salt	96	14	70	94	121	169				
	Men	Discretionary added iodised salt	33	0	0	29	59	95				
	Men	Dietary supplements	8	0	0	0	0	50				
	Men	Total, all sources	220	126	177	216	258	326	100	2	600	0
	Women	Foods, naturally present	76	46	60	73	88	117				
	Women	Foods, industrially added iodised salt	73	16	56	73	90	120				
	Women	Discretionary added iodised salt	27	0	0	31	47	66				
	Women	Dietary supplements	8	0	0	0	0	58				
	Women	Total, all sources	184	110	152	182	214	265	100	3	600	0

[a] n=373 men; n=366 women

Table 6.13 Habitual intake distribution of iron by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI
Iron (mg/day)	Men	Foods only	11.2	7.4	9.3	10.9	12.8	16.1	7	3	2-8
	Men	Foods and supplements	12.0	7.8	9.6	11.1	13.0	18.5	7	2	1-3
	Women	Foods only	9.3	5.7	7.6	9.1	10.8	13.6	6	7	3-9
	Women	Foods and supplements	11.0	6.1	8.0	9.6	11.7	16.9	6	4	2-7
Heme iron (mg/day)	Men	Foods only	1.3	0.5	0.9	1.2	1.6	2.4			
	Women	Foods only	1.0	0.3	0.6	0.9	1.3	2.0			
Non-heme iron (mg/day)	Men	Foods only	9.9	6.5	8.2	9.7	11.4	14.4			
	Women	Foods only	8.3	5.0	6.6	8.0	9.7	12.4			

[a] n=373 men; n=366 women

supplemental non-heme iron preparations, particularly if taken without food.[50] In the current study, the reported dosages were smaller (data not shown).

Two food groups each contributed more than 10% of total iron intake (see Table 6.20). These were 'Cereal and cereal products' (24%) and 'Meat and meat products' (16%). The latter group was the main source of heme iron, with an average contribution of 86%. Non-heme iron was mainly derived from 'Cereals and cereal products' (29%), 'Non-alcoholic beverages' (11%) and 'Vegetables' (10%).

Conclusion

In community-dwelling older adults, no public health problems are expected related to inadequate iron intake.

6.3.5 Magnesium

In men, the median habitual magnesium intake from food and that from foods and dietary supplements were

Table 6.14 Habitual intake distribution of magnesium by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	Ade-quate intake	Prevalence inadequate intake	UL	% with intake > UL
Magnesium (mg/day)	Men	Foods only	346	241	296	340	390	473	350	No state-ment		
	Men	Foods and supplements	352	243	298	342	394	490	350	No state-ment		
	Men	Supplements only	10	0	0	0	0	73			250	0
	Women	Foods only	293	199	251	290	332	397	280	Low		
	Women	Foods and supplements	317	205	261	305	357	466	280	Low		
	Women	Supplements only	20	0	0	0	10	113			250	1

[a] n=373 men; n=366 women

comparable, i.e. 340-342 mg/day (Table 6.14). The 5th percentile of intake was about 100 mg less. The median intake level was just below the adequate intake of 350 mg/day[49], and therefore no conclusion about the adequacy of magnesium intake can be drawn.

In women, the median magnesium intake was 290 mg/day when food sources only were considered, and 305 mg/day when foods and dietary supplements were both taken into account. In women, too, the 5th percentile of intake was about 100 mg less than the median level. The adequate intake level of magnesium for women is 280 mg/day.[49] In contrast to men, the median level of women was higher than the adequate intake level. This indicates that the prevalence of inadequate intake is low among women.

The tolerable upper intake level for magnesium intake[50] is based on the intake of magnesium from dietary supplements alone. The 95th percentile of magnesium intake from dietary supplements alone was 73 mg/day for men and 113 mg/day for women. Less than 0.5% of men and 1% of women were estimated as exceeding the safe upper level of intake of 250 mg/day.

The main sources of magnesium intake for the older adults are 'Cereals and cereal products', 'Dairy products' and 'Non-alcoholic beverages', with average contributions of 23, 16, and 13% respectively (Table 6.20).

Conclusion

For women, no public health problems are expected in relation to inadequate magnesium intake. Although for older men, no conclusion about magnesium intake adequacy can be drawn, the medium intake was close to the adequate intake level. Magnesium is necessary for energy dependent membrane transport, gene regulation, sustained electrical potential in nerves and cell membranes and for the transmission of neuromuscular impulses.[49] Since the metabolism and requirement for magnesium are still rather poorly understood, research on the health effects associated with low magnesium intake is recommended. Moreover, nutritional status research of older men could be considered to verify whether their magnesium status is adequate.

6.3.6 Phosphorus

For men, the habitual phosphorus intake from foods only was comparable to the intake when dietary supplements were included (Table 6.15). Median levels were 1,503-1,511 mg/day, 5th percentiles 1,067-1,069 mg/day and 95th percentiles 2,039-2,055 mg/day. The average requirement of phosphorus is 450 mg/day.[49] Almost none of men had a phosphorus intake below the average requirement.

For women, habitual intake levels of phosphorus were lower than for men. Again, comparable levels were observed for the intake from foods only and from the combination of foods and dietary supplements. Median intake was 1,278-1,281 mg/day, 5th percentiles 868-878 mg/day and 95th percentiles 1,755-1,759 mg/day. For women, too, almost 0% were estimated as having an intake below the average requirement of 450 mg/day.

There is no tolerable upper intake level established for phosphorus. EFSA has concluded that evidence indicates that current levels of intake from phosphorus do not represent a health risk for the general population.[50]

Three food groups each contributed more than 10% to phosphorus intake (see Table 6.20). These were 'Dairy products' (35%), 'Cereals and cereal products' (17%) and 'Meat and meat products' (16%).

Table 6.15 Habitual intake distribution of phosporus by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI
Phosphorus (mg/day)	Men	Foods only	1,530	1,069	1,318	1,511	1,722	2,055	450	0	0-0
	Men [b]	Foods and supplements	1,522	1,067	1,313	1,503	1,709	2,039	450	0	0-0
	Women	Foods only	1,291	868	1,101	1,278	1,467	1,759	450	0	0-0
	Women	Foods and supplements	1,295	878	1,108	1,281	1,467	1,755	450	0	0-0

[a] n=373 men; n=366 women
[b] the slightly lower intake from foods and supplements as compared to foods only in men is possible due to model uncertainty.

Table 6.16 Habitual intake distribution of potassium by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	Adequate intake	Prevalence inadequate intake
Potassium (mg/day)	Men	Foods only	3,481	2,520	3,045	3,446	3,879	4,560	3,500	No statement
	Men	Foods and supplements	3,484	2,519	3,045	3,448	3,883	4,572	3,500	No statement
	Women	Foods only	3,015	2,132	2,641	3,005	3,378	3,928	3,100	No statement
	Women	Foods and supplements	3,035	2,166	2,669	3,025	3,392	3,939	3,100	No statement

[a] n=373 men; n=366 women

Conclusion
No public health problems are expected because of inadequate phosphorus intake.

6.3.7 Potassium

For men, the median habitual potassium intake from foods was 3,446 mg/day, with the 5th percentile at 2,520 mg/day, and 95th percentile at 4,560 mg/day (Table 6.16). The intake from dietary supplements had a minor effect on the habitual intake (median of 3,448 mg/day). The median potassium intake was just below the adequate intake level of 3,500 mg/day[49], which means that no statement about the prevalence of inadequate potassium intake can be made.

For women, the median habitual potassium intake from foods was 3,005 mg/day, with the 5th percentile at 2,132 mg/day, and 95th percentile at 3,928 mg/day. For women, too, the intake from dietary supplements had a minor effect on the habitual intake (median 3,025 mg/day). Similar to the situation in men, the median potassium intake was just below the adequate intake level (for women 3,100 mg/day[49]), which means that no statement about the prevalence of inadequate potassium intake can be made.

There is no tolerable upper intake level established for potassium. EFSA has concluded that evidence indicates that current levels of intake of potassium from food do not represent a health risk for healthy adults. However, supplemental potassium in doses of 5 to 7 g/day in addition to dietary intake has in a few cases been reported as causing conductive effects and compromising the heart function in apparently healthy adults. Older persons may be more vulnerable to adverse effects of potassium due to reduced physiological reserve in renal function or due to drugs affecting potassium balance [50].

Potassium was derived from many different sources in the diet. Seven food groups each contributed between 10 and 20% to total potassium intake (see Table 6.20). These were in descending order 'Dairy products' (16%), 'Non-alcoholic beverages' (14%), 'Meat and meat products' (13%), 'Potatoes and other tubers' and 'Vegetables' (11%), 'Fruits, nuts and olives' and 'Cereals and cereal products' (10%).

Conclusion
The results of the study are inconclusive with respect to adequacy of potassium intake. However, both for men and women, the median potassium intake levels were close to the adequate intake levels and may not be an immediate

Table 6.17 Habitual intake distribution of selenium by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI	UL	% with intake > UL	95% CI
Selenium (µg/day)	Men	Foods only	48	30	39	46	55	72	35	15	11-23	300	0	0-0
	Men	Foods and supplements	54	32	41	49	59	99	35	9	5-14	300	0	0-0
	Women	Foods only	41	25	33	40	47	61	30	16	7-20	300	0	0-0
	Women	Foods and supplements	49	27	35	43	54	91	30	11	6-16	300	0	0-0

[a] n=373 men; n=366 women

cause of concern. Clinical trials and population surveys showed that a diet rich in potassium alone, or in combination with calcium and magnesium, may have a favourable effect on blood pressure.[49] Accordingly, additional research on potassium status is recommended.

6.3.8 Selenium

The median habitual selenium intake from foods was 46 µg/day for men (Table 6.17). This increased to 49 µg/day when intake from dietary supplements was included, with 32 µg/day as the 5th percentile. The average requirement of selenium for men is 35 µg/day.[49] Nine percent of the men were estimated as having a total selenium intake below the average requirement.

In women the levels of intake from foods only were below that of men, with a median value of 40 µg/day. Including the contribution of dietary supplements resulted in higher intakes, with 43 µg/day as the median and 27 µg/day as the 5th percentile. In women, 11% were estimated as having an intake level below the average requirement. The average intake level for women is 30 µg/day.[49]

In men and women, the 95th percentiles of total selenium intake were 99 µg/day and 91 µg/day, respectively. No exceedance of the tolerable upper intake level of 300 µg/day[50] was observed in the older men and women.

Four food groups each contributed at least 10% to selenium intake (see Table 6.20). These were 'Meat and meat products' (27%), 'Dairy products' (15%), 'Cereals and cereal products' (14%) and 'Fish and shellfish' (11%).

Conclusion
About 1 in 10 older adults had a selenium intake below the average requirement. Potentially selenium intake might be inadequate for this subgroup. Sufficient selenium intake is important for the defence against oxidative stress and regulation of thyroid hormone action, as well as for the reduction and oxidation status of vitamin C and other molecules.[53] For this reason selenium status research could be considered to verify the adequacy of selenium intake.

6.3.9 Sodium

The sources of sodium are foods (naturally present and industrially added), dietary supplements, and kitchen salt used on a discretionary basis. The use of sodium containing dietary supplements was very low and its contribution to sodium intake was negligible. In section 3.9, information on discretionary salt use is presented. Table 6.18 shows the habitual intake of sodium and salt from foods only and including discretionary used salt. Salt intake was based on the sodium intake (1 gram sodium corresponding with 2,5 gram salt). Method to estimate habitual intake of sodium from all sources adapted from van Rossum et al.[70]

In men, the median habitual sodium intake from food only was 2,440 mg/day, with 1,182 mg/day and 5,028 mg/day as the 5th and 95th percentiles of intake, respectively. Inclusion of the intake from discretionary salt use resulted in a higher intake, with 3,149 mg/day as the median level, a 5th percentile of 1,662 mg/day and a 95th percentile of 5,753 mg/day.

In women, the habitual median sodium intake from foods was about one fifth lower than that in men, i.e. 1,828 mg/day. The median intake was 2,399 mg/day when discretionary salt use was included. The 5th percentile of sodium intake (from all sources) was 1,333 mg/day and the 95th percentile 4,146 mg/day.

For men, the median level of salt from foods only (6.1 g) was above the maximum level of 6 g/day, as recommended by the Health Council of the Netherlands[42], whereas this was not the case for women (median 4.6 g/day). When discretionary added salt was considered,

Table 6.18 Habitual intake distribution of sodium and salt by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	Guideline	% above guideline
Sodium (mg/day)	Men	Foods, only	2,688	1,182	1,813	2,440	3,283	5,028		
	Men	Foods and discretionary added salt	3,357	1,662	2,451	3,149	4,018	5,753		
	Women	Foods, only	1,982	935	1,390	1,828	2,401	3,550		
	Women	Foods and discretionary added salt	2,527	1,333	1,907	2,399	3,004	4,146		
Salt (g/day)	Men	Foods, only	6.7	3.0	4.5	6.1	8.2	12.6	<6	51
	Men	Foods and discretionary added salt	8.4	4.1	6.1	7.9	10.0	14.4	<6	77
	Women	Foods, only	5.0	2.3	3.5	4.6	6.0	8.9	<6	25
	Women	Foods and discretionary added salt	6.3	3.3	4.8	6.0	7.5	10.3	<6	51

[a] n=373 men; n=366 women

Table 6.19 Habitual intake distribution of zinc by Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

Nutrient	Sex[a]	Source	Mean	P5	P25	P50	P75	P95	AR	% with intake < AR	95% CI	UL	% with intake > UL	95% CI
Zinc (mg/day)	Men	Foods only	11.0	7.4	9.2	10.8	12.6	15.7	6	1	0-2	25	0	0-0
	Men	Foods and supplements	11.7	7.7	9.5	11.0	13.0	17.9	6	0	0-1	25	1	0-2
	Women	Foods only	9.2	5.8	7.5	8.9	10.6	13.3	5	1	0-2	25	0	0-0
	Women	Foods and supplements	10.4	6.0	7.9	9.6	11.9	17.7	5	1	0-2	25	1	0-3

[a] n=373 men; n=366 women

median daily salt intakes were 7.9 g and 6.0 g for men and women respectively. So, among women, the median salt intake was at the upper limit of the population guideline, and the mean salt intake (6.3 g/day) was close to the population guideline. 77% of the men and 51% of the women had a total salt intake above the guideline.

When the intake from foods only was considered, four food groups were the main sources of sodium intake as is shown in Table 6.20. These were 'Cereals and cereal products' (29%), 'Dairy products' (19%), 'Meat and meat products' (15%), and 'Soups, bouillon' (11%).

Conclusion

For both men and women, mean salt intake was above the guideline of maximally 6 g salt per day. For men the mean intake was considerably higher whereas for women the difference was relatively small (6.3 g/day). Three quarters of the older men and half of the older women had an intake of salt above the guideline. High salt consumption is associated with high blood pressure, and can lead to cardiovascular diseases[42]. Reduction of salt intake is therefore recommended, particularly for older men.

6.3.10 Zinc

In men, the median habitual zinc intake from foods was 10.8 mg/day (Table 6.19). Inclusion of the contribution

from dietary supplements slightly increased this to 11.0 mg/day. The 5th percentile of total zinc intake was 7.7 mg/day, with less than 0.5% of men estimated as having an intake below the average requirement of 6.0 mg/day.

In women, the median habitual zinc intake from foods was 8.9 mg/day, which was lower than that for men (Table 6.19). Inclusion of the contribution from dietary supplements increased this to 9.6 mg/day. The 5th percentile of total zinc intake was 6.0 mg/day, with 1% of women estimated as having an intake below the average requirement of 5.0 mg/day.

The 95th percentile of total habitual zinc intake was 17.9 mg/day for men and 17.7 mg/day for women. The tolerable upper limit of zinc is set by EFSA at 25 mg/day.[50] It was estimated that 1% of men and women had a habitual zinc intake above this upper limit.

Table 6.20 shows that 'Meat and meat products', 'Dairy products', and 'Cereals and cereal products' were the main sources of zinc intake, with average contributions of 29, 24 and 17% respectively.

Conclusion
No public health problems are expected because of inadequate or too high zinc intake in older community-dwelling adults.

6.4 Sources of micronutrients

6.4.1 Food sources of micronutrients

Table 6.20 shows the mean contribution of each food group and dietary supplements to the micronutrient intake. In the sections above, the most important food sources of micronutrients were presented. In this section, we present for each food group the micronutrients for which it was an important source. In this respect, only contributions of at least 10% are considered. Similar information for macronutrients can be found in Section 5.8.

- 'Potatoes and other tubers' contributed 10 to 11% on average to the intake of potassium, and vitamins B_6 and C.
- 'Vegetables' were a major source of beta-carotene, with a contribution of 59%. Other main contributions were to the intake of vitamin C (20%), folate equivalents (18%), vitamin A (16%), potassium (11%) and non-heme iron (10%).
- 'Fruit, nuts and olives' contributed 27% to the intake of vitamin C, 11% to copper intake and 10% to potassium intake.
- 'Dairy products' were a major source of calcium (61% contribution). They also contributed a substantial percentage for many other micronutrients: vitamin B_2 (41%), vitamin B_{12} (35%), phosphorus (35%), retinol (27%), zinc (24%), total vitamin A (20%) and sodium, iodine, magnesium, potassium and selenium (15-19%).
- 'Cereals and cereal products' were an important source of many micronutrients, including iodine (50%), sodium (29%), non-heme iron (29%), copper (27%), iron (24%), magnesium (23%), and zinc, phosphorus, vitamin B_1, folate, selenium and potassium (all 10%-17%).
- 'Meat and meat products' were the major source of heme iron intake, with an average contribution of 86%. There were many other micronutrients to which this food group contributed at least 10%: zinc (29%), vitamin B_{12} (29%), selenium (27%), vitamin B_1 (23%), vitamin B_6 (20%), and iron, phosphorus, sodium, retinol, potassium, vitamin B_2, total vitamin A and vitamin D (all 12-16%).
- Fish and fish products contributed 11 to 12% to the intake of vitamin B_{12}, selenium and vitamin D.
- The food group 'Fat' contributed at least 10% to the intake of various vitamins (vitamin D 37%, retinol 35%, vitamin E 31%, total vitamin A 26% and vitamin B_6 12%); its contributions to minerals and trace elements were very small. 71% of the folic acid contribution was by 'Fat', whereas the contribution to folate equivalents was 17%.
- 'Non-alcoholic beverages' contributed 11-16% to the intakes of vitamin C, potassium, magnesium, and non-heme iron.
- Condiments and sauces contributed 10% on average to the vitamin E intake.
- 'Soups, bouillon' were a main source of sodium intake, with an average contribution of 11%.
- Food groups that did not contribute at least 10% of any of the micronutrients were 'Legumes', 'Eggs and egg products'. 'Sugar and confectionary', 'Cakes', 'Alcoholic beverages', and 'Miscellaneous'.
- The contributions of dietary supplements to mineral intake were all less than 10%. Regarding vitamins, contributions of 10-12% were observed for vitamins B_1, B_2, B_6, C, and D, with the highest contribution for vitamin D intake. The contribution of dietary supplements to folic acid intake was 25%, although their contribution to the intake of folate equivalents remained below 10%.

6.4.2 Contribution of fortified foods and dietary supplements

The contribution of fortification was highest for folate equivalents, vitamins D, B_6 and E (all 15-18%). Fortified

Table 6.20 Average contribution of food groups (%) to the intake of micronutrients for Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Food groups based on Epic Soft Classification	Retinol	Beta-carotene	Retinol activity equivalents	Vitamin B_1	Vitamin B_2	Vitamin B_6	Folic acid	Folate equivalents	Vitamin B_{12}	Vitamin C	Vitamin D	Vitamin E	Calcium	Copper	Iodine[a]	Iron	Heme iron	Non-heme iron	Magnesium	Phosphorus	Potassium	Selenium	Sodium[a]	Zinc
01 Potatoes and other tubers	0	0	0	5	1	10	0	5	0	10	0	1	1	7	1	5	0	6	6	3	11	1	1	3
02 Vegetables	0	59	16	7	5	6	0	18	0	20	0	7	6	7	2	9	0	10	7	4	11	3	2	5
03 Legumes	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0
04 Fruits, nuts and olives	0	7	2	5	3	7	0	7	0	27	0	7	2	11	2	5	0	6	8	4	10	4	1	4
05 Dairy products	27	9	20	9	41	9	0	9	35	3	4	5	61	5	18	3	0	3	16	35	16	15	19	24
06 Cereals and cereal products	0	0	0	16	8	8	2	15	0	0	0	6	6	27	50	24	0	29	23	17	10	14	29	17
07 Meat and meat products	14	2	12	23	13	20	0	3	29	7	12	6	1	9	3	16	86	7	8	16	13	27	15	29
08 Fish and shellfish	1	0	0	2	2	3	0	1	12	0	11	2	1	1	5	2	7	1	2	4	2	11	4	1
09 Eggs and egg products	4	0	3	1	3	1	0	2	4	0	4	4	1	1	3	3	0	3	1	2	1	5	1	2
10 Fat	35	3	26	1	1	12	71	17	5	0	37	31	0	0	1	0	0	0	0	0	0	0	1	0
11 Sugar and confectionery	1	2	1	1	2	1	0	1	1	1	1	2	2	6	1	7	0	8	3	2	2	1	1	1
12 Cakes	7	3	5	2	2	1	0	2	1	0	7	7	2	4	3	5	0	5	3	4	2	4	5	3
13 Non-alcoholic beverages	0	3	1	7	6	7	0	7	1	16	0	2	9	9	4	9	0	11	13	2	14	3	2	2
14 Alcoholic beverages	0	0	0	0	1	2	0	1	0	0	0	0	1	2	2	4	0	4	3	1	2	0	0	0
15 Condiments and sauces	5	2	4	2	1	1	0	0	2	1	7	10	1	1	0	1	0	1	1	1	1	1	6	1
16 Soups, bouillon	0	9	2	5	1	2	0	2	2	3	2	2	1	2	0	2	4	2	3	2	3	2	11	2
17 Miscellaneous	1	0	1	1	1	1	1	1	1	0	2	1	1	1	1	1	3	1	1	1	1	1	2	1
20 Dietary supplements	6	2	7	11	10	11	25	9	7	11	12	9	5	6	4	4	0	0	3	0	0	7	0	6

[a] Iodine and sodium of added salt not included

foods contributed more than 10% of the total intake of retinol (14%) and retinol activity equivalents (11%). The smallest contribution of fortified foods was of selenium. Dietary supplements contributed most to the intake of vitamin D (12%), vitamin B_1, B_6 and vitamin C (all 11%), and vitamin B_2 (10%). Overall, fortified foods and dietary supplements contributed more to the intake of vitamins than to the intake of minerals (see Figure 6.1).

6.5 Intake by place of consumption

The average contribution of consumption at home was between 90 and 97% for all micronutrients (Table 6.21). Synthetic folic acid, which can only be derived from fortified foods or dietary supplements, had the highest average contribution from at-home consumption, whereas for heme iron and vitamin D, not-at-home consumption was relatively highest (10%).

6.6 Intake by food consumption occasions

Of the four food consumption occasions, dinner made the highest average contribution to the intake of most micronutrients (Table 6.22). This was by far the largest in the case of heme iron (61%), and beta-carotene (54%). As regards other micronutrients, calcium, iodine, retinol and sodium received greater contributions from lunch than from dinner. A quarter or more of the intake of vitamin C, magnesium, potassium, calcium, non-heme iron and vitamin B_2 was contributed by consumption in between the three main meals.

6.7 Conclusion on vitamin and mineral intake

Overall, men had higher habitual vitamin and mineral intakes from foods than women in the survey age group. However, more women than men used dietary

Table 6.21 Average contribution of place (%) to the intake of micronutrients for Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Nutrient	At home Mean %	Not at home Mean %
Retinol	91	9
Beta-carotene	92	8
Retinol activity equivalents	92	8
Vitamin B_1	91	9
Vitamin B_2	92	8
Vitamin B_6	92	8
Folate equivalents	93	7
Folic acid	97	3
Vitamin B_{12}	92	8
Vitamin C	94	6
Vitamin D	90	10
Vitamin E	91	9
Calcium	93	7
Copper	92	8
Iodine[a]	93	7
Iron	91	9
Heme iron	90	10
Non-heme iron	91	9
Magnesium	92	8
Phosphorus	92	8
Potassium	91	9
Selenium	91	9
Sodium[a]	91	9
Zinc	92	8

[a] Iodine and sodium of added salt not included

supplements. When the intake from dietary supplements was combined with the intake from foods, the intake at the 95th percentile was higher in women for most vitamins and some minerals (calcium and zinc).

The average contribution of dietary supplements was highest for vitamin D (12%), and the contribution of fortified foods was highest for folate equivalents and vitamin D (both 18%; see Figure 6.1).

From this study it can be concluded that among relatively vital older adults no public health problems are expected because of inadequate intake of vitamins B_1 and E (see overview Table 6.23), copper, iodine, iron, phosphorus and zinc (see overview Table 6.24).

Regarding vitamin B_{12} intakes, no public health effects are expected. A low status due to food cobalamin malabsorption cannot be excluded, however. For this reason nutritional status research on vitamin B_{12} could be recommended.

Potentially inadequate intakes for subgroups of older adults were observed for vitamin A, B_2, B_6, folate, selenium, and (for men only) for vitamin C. The size of the subgroups ranged from 5-14% of the studied older adults. It is unclear if the observed low intakes are associated with adverse health effects. Accordingly, there is no pressing cause of great concern regarding the population of relatively vital older adults. However, to verify nutritional adequacy for these micronutrients, it is recommended that nutritional status research be conducted into older adult populations (i.e. including more persons with functional impairments, chronic diseases, and lower education level).

No statement about intake adequacy can be made for the intake of calcium, potassium, and (for men only) magnesium. For these micronutrients, it might also be worth considering conducting nutritional status research into representative study populations of older adults. More knowledge about the requirements of these micronutrients is also needed. Further considerations about nutrient recommendations are given in Chapter 8.

Vitamin D intake by the majority of older men and women in this survey was low. Combined with other research on nutritional status [48], vitamin D intake of older adults can be considered to be inadequate. Monitoring the follow up of the recently adjusted recommendation on vitamin D supplementation for all older adults and monitoring nutritional vitamin D status in Dutch older adults is advisable.

Salt intake is too high in Dutch older adults, particularly in men. Three quarters of older men and half of older women had a salt intake above 6 g/day. Salt consumption can be reduced by substantial product reformulation, as well as by changes in dietary habits, favouring to a healthier and balanced diet. Monitoring the effects of the current policy on salt by the Ministry of VWS is recommended.

Apart from sodium intake, there are no indications of problems relating too high intakes of vitamins and minerals among older adults.

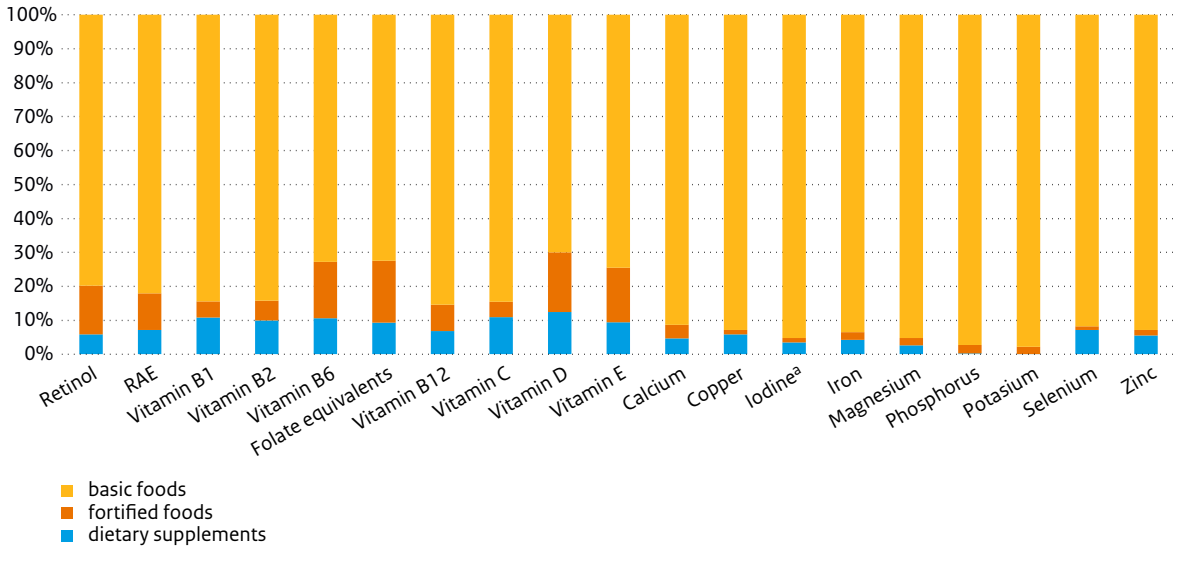
The older population has a heterogeneous composition and the conclusions here apply to relatively vital older adults (see Chapters 3 and 8). In Chapter 7, the consumption of micronutrients is presented for subgroups of older adults, to obtain insight into the possible effects of underrepresentation of older adults with functional impairment, chronic diseases and lower education. Moreover, uncertainties and methodological issues should be considered in interpreting the results on intake. This is done in Chapter 8.

Table 6.22 Average contribution of food consumption occasions (%) to the intake of micronutrients for Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Nutrient	Breakfast Mean %	Lunch[c] Mean %	Dinner[a] Mean %	In between Mean %
Retinol	21	33	28	18
Beta-carotene	6	28	54	13
Retinol activity equivalents	17	32	35	16
Vitamin B_1	14	29	40	18
Vitamin B_2	15	28	33	25
Vitamin B_6	15	28	41	17
Folate equivalents	21	29	35	16
Folic acid	40	36	17	6
Vitamin B_{12}	13	31	41	15
Vitamin C	14	21	38	27
Vitamin D	17	31	38	14
Vitamin E	16	27	39	18
Calcium	19	29	26	26
Copper	18	25	32	24
Iodine[b]	25	33	26	16
Iron	17	25	35	23
Heme iron	3	31	61	4
Non-heme iron	19	25	31	25
Magnesium	17	25	31	27
Phosphorus	16	29	35	20
Potassium	13	24	37	27
Selenium	13	29	42	16
Sodium[b]	17	34	33	16
Zinc	15	29	41	15

[a] Dinner is a main meal consumed late afternoon or in the evening, but not necessarily a hot meal
[b] Iodine and sodium of added salt not included
[c] lunch is a main meal consumed at noon and not necessarily a cold meal

Figure 6.1 Average contribution (%) of basic foods, fortified foods (with specific nutrients) and dietary supplements to nutrient intake, for Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted (n=739).



[a] Iodine of added salt not included

Table 6.23 Summary of the evaluation of vitamin intake adequacy in Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739).

Nutrient	Dietary reference value (per day)	Type of dietary reference value	Source dietary reference value	% inadequacy	Conclusion
Vitamin A (RAE)	610 µg men 520 µg women	AR	HC 2008	12% men 14% women	Potentially inadequate intake for subgroup of older adults
Vitamin B_1 (thiamin)	1.1 mg	AI	HC 2000	Low	No public health problem
Vitamin B_2 (riboflavin)	1.1 mg men 0.8 mg women	AR	HC 2000	10% men 5% women	Potentially inadequate intake for subgroup of older adults
Vitamin B_6	1.3 mg men 1.1 mg women	AR	HC 2003	6% men 6% women	Potentially inadequate intake for subgroup of older adults
Folate equivalents	200 µg	AR	HC2008	7% men 9% women	Potentially inadequate intake for subgroup of older adults
Vitamin B_{12}	2.0 µg	AR	HC 2003	1% men 2% women	No public health problem due to low intake
Vitamin C	60 mg men 50 mg women	AR	NCM 2004	11% men 3% women	Potentially inadequate intake for subgroup of older men No public health problem for women
Vitamin D	10 µg	AR	HC 2012	95% men 91% women	Inadequate intake
Vitamin E	6 mg TE men 5 mg TE women	AR	NCM 2004	1% men 1% women	No public health problem

NCM = Evaluation based on Nordic nutrition recommendations
HC = Evaluation based on Dutch nutrition recommendations
Low = When the median intake was above the adequate intake, the prevalence of inadequate intake was likely to be low

Table 6.24 Summary for the evaluation of mineral intake adequacy in Dutch older adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739).

Nutrient	Dietary reference value (per day)	Type of dietary reference value	Source dietary reference value	% inadequacy	Conclusion
Calcium	1200 mg	AI	HC 2000	No statement	Unclear
Copper	0.7 mg	AR	NCM 2004	1% men 5% women	No public health problem
Iodine	100 µg	AR	NCM 2004	2% men 3% women	No public health problem
Iron	Men 7 mg Women 6 mg	AR	NCM 2004	2% men 4% women	No public health problem
Magnesium	Men 350 mg Women 280 mg	AI	NCM 2004	No statement for men Low for women	Unclear for men No public health problem for women
Phosphorus	450 mg	AR	NCM 2004	0%	No public health problem
Potassium	3.5 g men 3.1 g women	AI	NCM 2004	No statement	Unclear
Selenium	Men 35 µg Women 30 µg	AR	NCM 2004	9% men 11% women	Potentially inadequate intake for subgroup of older adults
Sodium	2.4 g (6.0 g salt)	Guideline	HC 2006	Too high	Not optimal intake
Zinc	Men 6 mg Women 5 mg	AR	NCM 2004	0% men; 1% women	No public health problem

NCM = Evaluation based on Nordic nutrition recommendations
HC =Evaluation based on DRIs of the Health Council of the Netherlands
Low = When the median intake was above the adequate intake, the prevalence of inadequate intake was likely to be low
No statement = When the median intake was below the adequate intake, the adequacy could not be evaluated

7 Potential risk groups and selection bias

7.1 Introduction

In order to identify potential risk groups within the population of older adults, the most relevant dietary components are described by several socio-demographic, anthropometric, and lifestyle factors, and by a proxy variable for functionality (Section 7.2). Selected dietary components were intake of energy, protein, vitamin D, and drinks. This selection was made because inadequate intake of energy, protein, and drinks are often observed dietary problems among undernourished older adults[15] and a high prevalence of vitamin D inadequacy is a general problem of older adults.[48]

In Chapter 3, it was noted that the current study population is better educated, has less functional impairment, and fewer chronic diseases than community-dwelling older adults in general. For this reason, the effects of the observed selection bias on dietary intake were explored. The results of this exploration, adjusted for sex, are described in Section 7.3.

Finally, conclusions on potential risk groups for low intake of key dietary components by older adults and on the effects of selection bias on observed dietary intakes are given in Section 7.4.

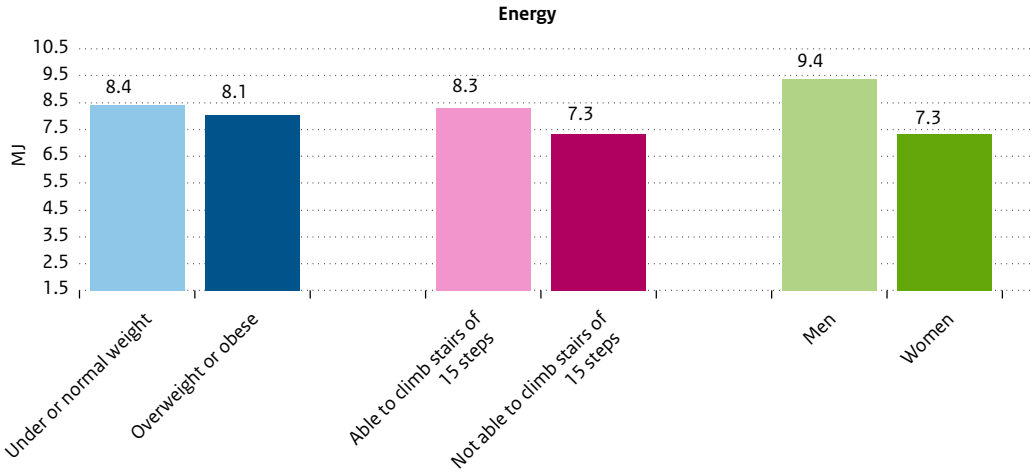
7.2 Risk groups

Various factors were investigated to identify risk groups for low intake of energy, protein, vitamin D, and fluids, based on socio-demographic background, lifestyle, anthropometry, and functionality. Age, sex, type of housing, marital status, education level and income status were used as indicators for the socio-demographic background. Use of home-delivered hot meals, smoking, physical activity and consumption of alcoholic beverages were considered as indicators of lifestyle. The anthropometric aspects considered were waist circumference, body mass index, and (risk of) undernutrition. The ability to climb stairs of 15 steps was taken as indicator of functionality. Prevalence of chronic diseases was selected as a proxy for health status. Time spent outdoors was considered specifically for vitamin D. The detailed findings are presented in Appendix E. All findings are adjusted for sex and weighted.

Energy

For most subgroups of older adults investigated, no statistically significant differences in mean energy intake were observed. The mean intake of energy did differ, however, by sex, BMI and the ability to climb stairs of 15 steps, as shown in Figure 7.1 and waist circumference. Women had a lower energy intake than men (7.3 MJ versus 9.4 MJ). Overweight or obese persons had a lower mean energy intake (8.1 MJ) than persons with a BMI less than

Figure 7.1 Intake of Energy (MJ) by socio-demographic and life style factors of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.



25 kg/m² (8.4 MJ). When considering men and women separately, this was only the case for men (data not shown). Furthermore, mean energy intake was lower among those unable to climb stairs of 15 steps than among those who were. This might indicate that persons with a functional impairment had a lower intake of energy. Differences in energy intake by BMI, ability to climb stairs, and sex also emerged in multivariate analyses, and could thus not be explained by confounding due to any of the investigated characteristics (see Appendix E).

Protein

The average daily intake of protein (in g/kg body weight) by relevant related factors is presented in Figure 7.2. It shows that besides the energy intake, the intake of protein was also significantly lower among persons with a larger BMI (0.96 g/kg) and among those with no undernutrition (1.02 g/kg). Furthermore, the average intake of protein per kg body weight was lower among participants who consumed home-delivered hot meals, and among those who were not able to climb stairs of 15 steps. In addition, the average protein intake in g/kg body weight was lower for persons who had never smoked, and for those who consumed alcoholic drinks on 6 or 7 days a week. In multivariate analyses only differences between subgroups of BMI, home-delivered meals and alcoholic drinks remained statistically significant (see Appendix E).

When protein intake in g/day rather than g/kg body weight /day was considered, differences between subgroups of BMI, consumption of home-delivered hot meals, and undernutrition were small and not statistically significant (data not shown). Apparently, differences in body weight rather than differences in protein intake were relevant for these subgroups. However, persons with an impaired functionality indicated by the inability to climb stairs had a lower mean protein intake in g/day as well as in g/kg body weight compared with persons who were able to climb stairs of 15 steps.

Vitamin D

The intake of vitamin D from foods and supplements was lower in women compared with men (3.5 versus 4.7 µg/day), as well as for persons aged 80 years and over, i.e. 3.3 µg versus 4.2 or 4.6 µg in 70-74 and 75-79 year-olds (Figure 7.3). For vitamin D also the time spent outdoors was considered, because sunlight exposure is required for vitamin D production by the skin. There was a clear association between vitamin D intake and time spent outdoors. The lowest mean vitamin D intake (3.4 µg) was observed in the subgroup of men and women who did not go outdoors on a daily basis. Furthermore, vitamin D intake was lower among moderately educated persons (3.7 µg) and older adults with normal waist circumference (3.6 µg). These differences also emerged in multivariate analyses, except for the time spent outdoors and education (see Appendix E).

Drinks

Sufficient liquid is also an important dietary factor for older adults. Figure 7.4 presents the consumption of non-alcoholic and alcoholic beverages (similar to the definition of 'drinks' used in Chapter 4). It shows that the older adults aged 70-74 years drunk about 1 glass of beverage more compared with those aged 75 years and

Figure 7.2 Intake of protein per kg body weight (g/kg) by socio-demographic and life style factors of Dutch adults 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

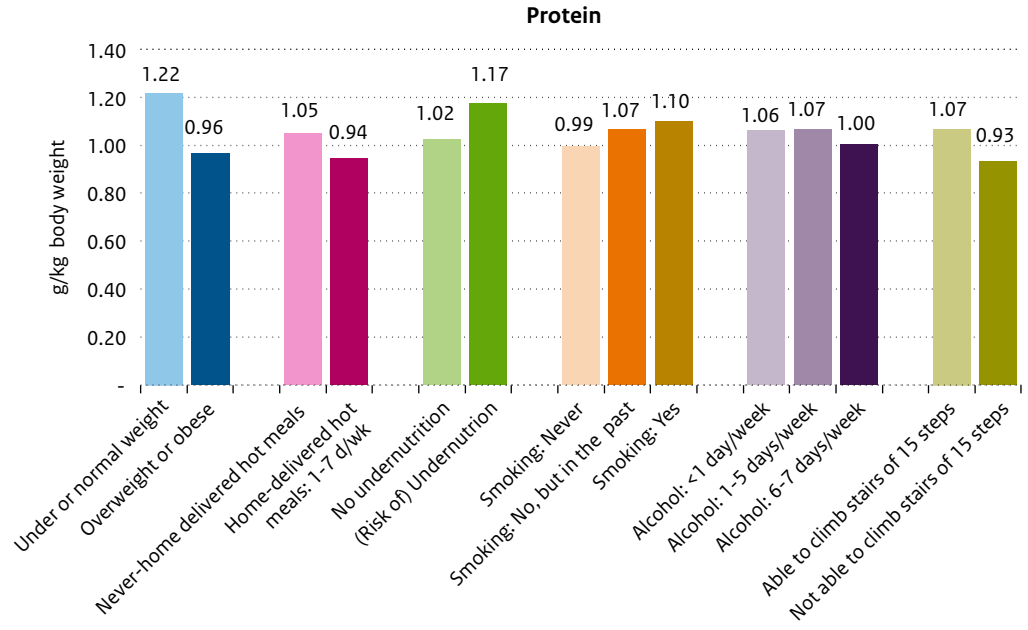
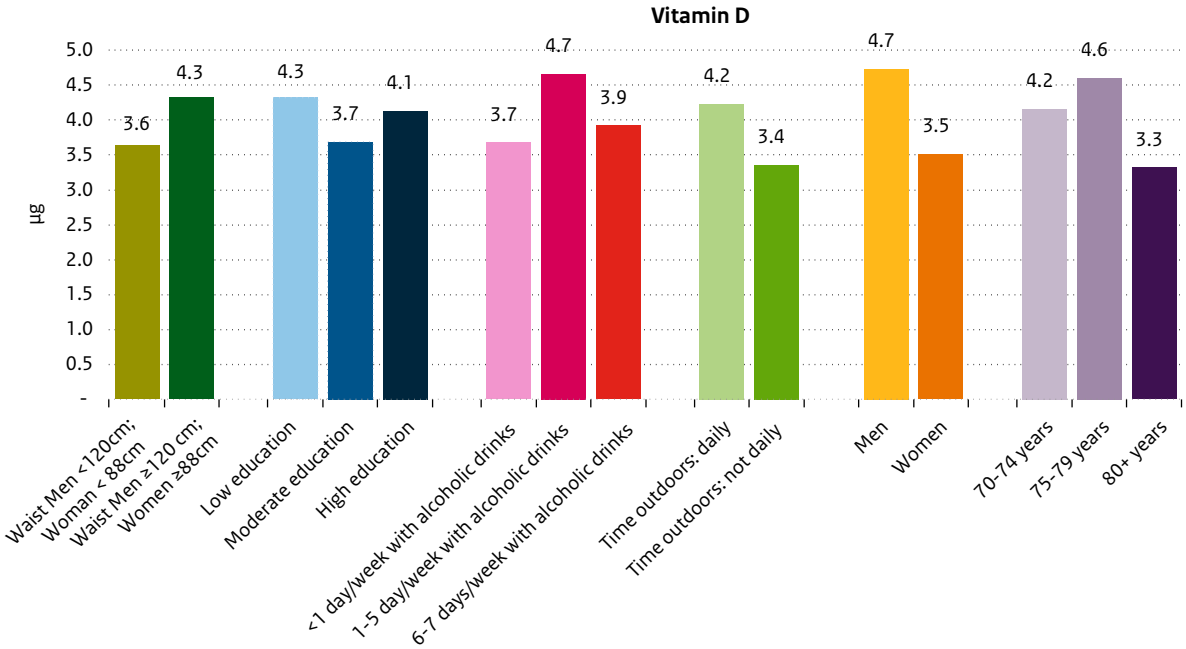
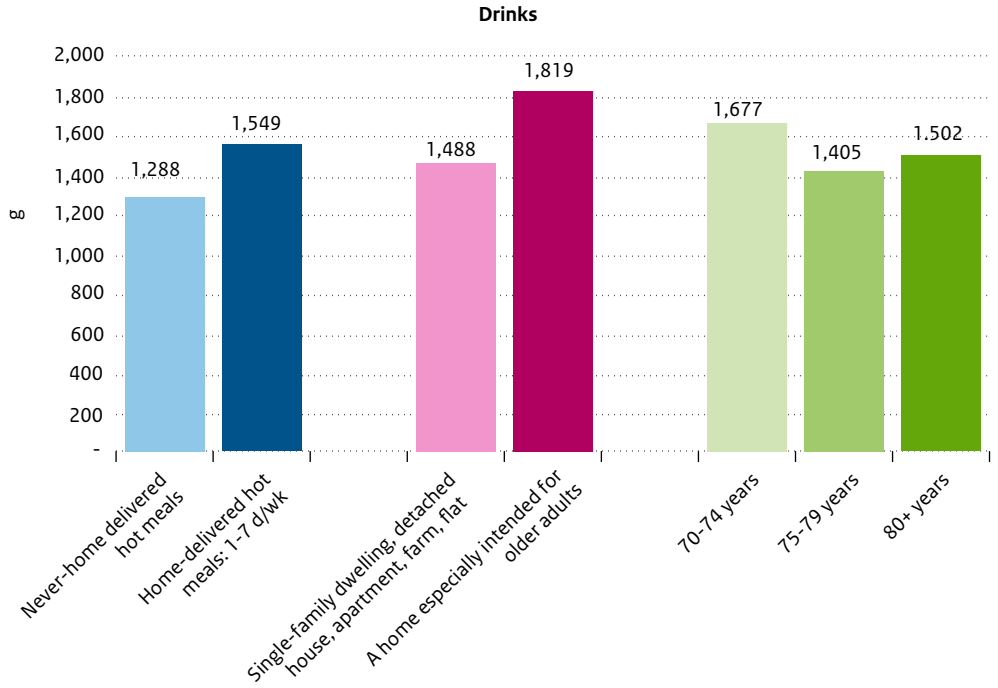


Figure 7.3 Intake of vitamin D (from foods and supplements in µg) by socio-demographic and life style factors of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.



older. For this definition of 'drinks', according to the Dutch Nutrition Centre, dairy drinks are not taken into account. However, inclusion of dairy beverages showed similar associations with intakes that were about 300 g higher. The consumption of beverages was higher among men and women living in a home, especially intended for older adults and those who consumed home-delivered hot meals. These differences were also observed in multivariate analyses (see Appendix E).

Figure 7.4 Consumption of drinks[a] (g) by socio-demographic and life style factors of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.



[a] See appendix B.

7.3 Effect of selection bias

In this section, the differences in dietary intake between older adults in different classes of age, education, health and functionality are described. The descriptions provide insight into the effects of the observed selection bias towards higher education, better functionality and health risk on dietary intake. In addition, as the responses differed by age, the differences by age group are presented as well. For this exploration, various relevant dietary factors were compared for older adults in different age ranges and with different levels of education, functionality and number of chronic diseases. The ability to climb stairs was used as proxy variables for functionality. The chosen dietary components were those components for which intake levels were not optimal or could not be evaluated, as described in Chapters 4 to 6. Protein intake was considered as g protein/kg body weight (Protein/BW).

The differences in the main dietary factors between the subgroups are illustrated by spider charts. The axes of the charts represent the ratio of mean intake of the particular subgroup divided by the mean intake of the total study population. Dietary components for which the differences were statistically significantly different are shown in capital letters. Detailed findings underlying the presented figures are given in Appendix F.

Age

Figure 7.5 shows the differences in dietary intake by age. The oldest age group consumed relatively less vegetables, less alcohol, less vitamin D and minerals, but they derived more energy from saturated fat and trans-fatty acids. The largest difference was observed for alcohol intake, with a mean intake of 15 g/day for 70-74 year-olds, and 8 g/day for ages of 80 and above.

Education level

Figure 7.6 shows the main dietary factors by education level. It shows that for most dietary factors no differences by education were observed. Education level was only associated with the intake of vitamin B_1, vitamin D, and alcohol. Lower educated older adults consumed less alcohol and more vitamin B_1. Furthermore, the mean intake of vitamin D was the lowest in people with a moderate education level, whereas people with a low and high education level had higher mean vitamin D intakes.

Chronic diseases

Figure 7.7 shows the association between dietary factors and the prevalence of chronic diseases. The dietary pattern did not differ much by this factor. The alcohol consumption was almost twice as high among healthy persons compared with those with one or more chronic diseases. Furthermore, the vegetable consumption and

Figure 7.5 Intake of main dietary factors (mean intake/ population mean) by age groups of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

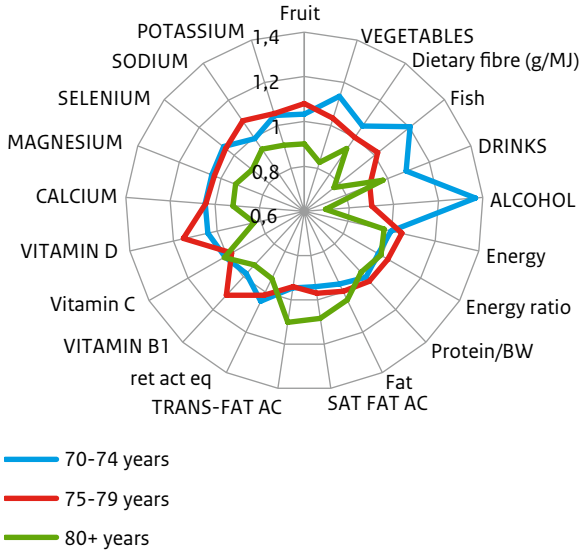


Figure 7.6 Intake of main dietary factors (mean intake/ population mean) by education level of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

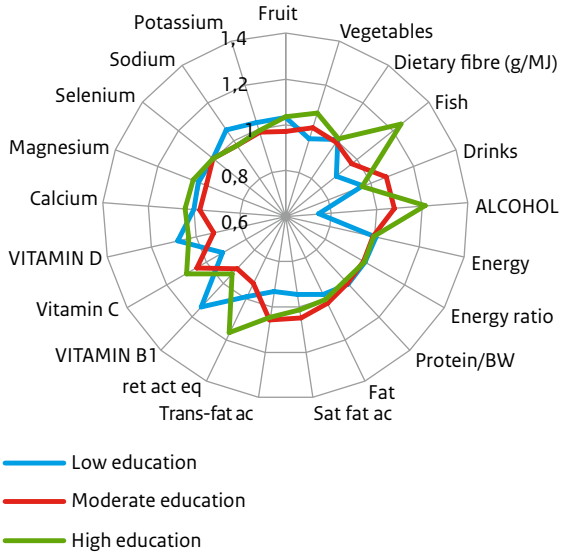


Figure 7.7 Intake of main dietary factors (mean intake/ population mean) by prevalence of chronic diseases of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

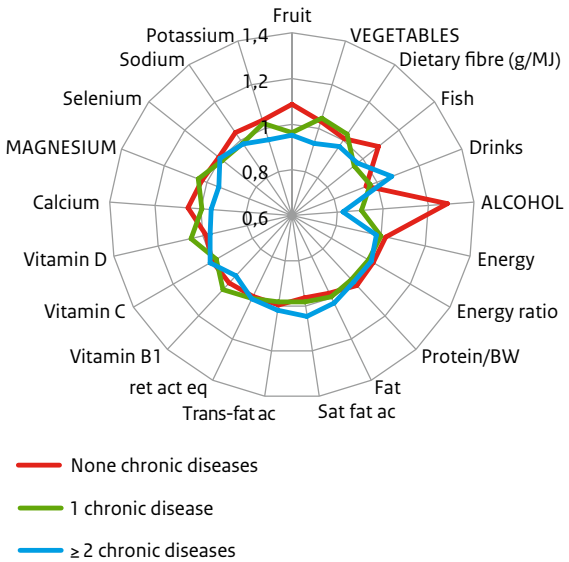
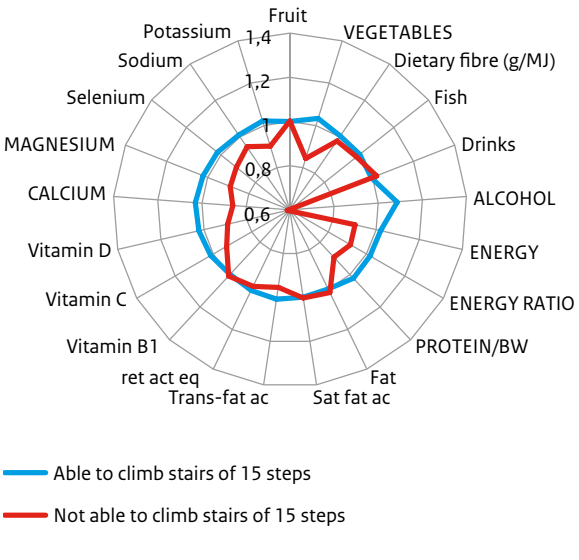


Figure 7.8 Intake of main dietary factors (mean intake/ population mean) by ability to climb stairs of 15 steps, of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted..



magnesium intake was lower among those with two or more chronic diseases.

Impaired functionality

Figure 7.8 shows the dietary factors by subgroups of older adults that are able to climb stairs of 15 steps and those who cannot. Inability to climb stairs was used as a proxy for impaired functionality. This figure shows that those with impaired functionality consumed on average less energy, protein, magnesium and calcium, fewer vegetables, and less alcohol.

7.4 Conclusion

This chapter shows that some subgroups could be identified as potential risk groups for specific dietary factors. Risk groups for a low energy intake comprised persons who were unable to climb stairs of 15 steps and persons who were overweight or obese. Risk groups for a low protein intake per kg bodyweight were overweight or obese persons, persons with no undernutrition, and those who were not able to climb stairs. For the first two risk groups, this can be explained by higher body weight. Moreover, a low protein intake was associated with never having smoked, and drinking alcohol on more than 6 days a week. Risk groups for low vitamin D intake were the oldest age group and/or those not going outside daily. Low consumption of beverages among older adults was associated with never consuming home-delivered hot meals and living in housing not specifically intended for older adults.

The findings in Section 7.3 indicate that the selection bias towards higher education, and health was limited. In particular, the selection bias due to better functionality might have affected the results. The intake of energy, protein, calcium, magnesium, vegetables, and alcohol is probably higher in this relatively vital population than for the general population of older adults.

8 Discussion

8.1 Introduction

In the previous chapters the results of the DNFCS of community-dwelling older adults have been set out. In this chapter the various findings are collectively considered and interpreted. Furthermore, some general methodological issues are discussed. Finally, recommendations and conclusions are given.

8.2 Study population

The study population of DNFCS-Older adults consisted of community-dwelling older adults aged 70 years and above. On 1 January 2012, about 773,000 men and 1,069,000 women in this age range lived in the Netherlands.[71] The larger part of these older adults (96% of the men, and 92% of the women) lived independently. In the next decades, the number of older adults will sharply increase. A recent prognosis for population development by Statistics Netherlands estimated there will be 2.0 million persons over 70 in 2015 and 3.1 million in 2030.[71] Because of this, insight into the food consumption of community-dwelling older adults is relevant and needed now.

Persons with cognitive impairment (MMSE scores below 18), and persons receiving substantial care (care intensity level 5 or above) were excluded from the study population. This resulted in a study population of older adults with little serious cognitive or functional impairment. In addition, the response rate by DNFCS-Older adults was low. Overall, only one in four invited older adults participated in the food consumption survey. Often mentioned reasons for non-response were 'lack of time' and 'too burdensome', besides 'not interested'. The response rate was considerably lower than in the LASA study, where an initial response rate of 60% was achieved in 1992, and of 55% for an additional cohort in 2002/2003.[34] Data of the LASA study were therefore considered more representative, and together with data of CBS were used as reference data to obtain insight in the representativeness of DNFCS-Older adults.[c] Based on this comparison, described in Chapter 3, a self-selection of older adults with a higher education level, better functionality, and less obesity (in women only) and chronic diseases appeared to be the case. Generally, the proportion of older adults in the highest category of education, best functionality, normal body weight, and no chronic diseases was 5 to 10 percentage points higher in this food consumption survey compared to Dutch reference data. The study population was therefore a population of relatively vital older adults. The study design

[c] 2012 data of the Health Monitor Older Adults, for which some municipal health services collect data on several dietary aspects, were not available in time to use as reference data

allowed adjustments to be made for differential non-response by gender, age, region and level of urbanisation by using weighting factors.

Because of the apparent selection bias, differences in dietary intake between older adults with different levels of education, health and functionality were further analysed, with the results described in Chapter 7. Strikingly, the dietary intake of persons that had difficulties climbing stairs differed in many respects from the intake of those that did not have difficulties doing this. The intake of energy, protein, alcohol, vegetables, magnesium, and calcium was significantly lower in the group that had difficulties climbing stairs. Overall, this might imply that the DNFCS survey overestimates the intake of energy, protein, alcohol, magnesium, and calcium by Dutch community-dwelling older adults in general, and thus underestimates the prevalence of inadequate intake for the nutrients in question. As regards the prevalence of inadequate intakes of protein, magnesium, and calcium, the results only refer to the relatively more vital older adults.

8.3 Undernutrition and overweight

In 2011, the Health Council of the Netherlands concluded that undernutrition in older adults appeared to be a substantial problem in the Netherlands. Depending on the criteria used and whether adults with or without home care were considered, the estimated prevalence ranged between 7-17% for community-dwelling adults aged 65 years and older.[15] The estimate of 12% in the present study according to SNAQ^{65+} criteria fits in this range. However, current scientific insights are considered inadequate for assessing the value of prevalence data. Weight loss and thinness are associated with mortality, morbidity and delayed recovery risks, but it is unclear whether this is a causal relationship.[15] Considering the above, the extent and seriousness of the problem of undernutrition remain unclear.

In the present study, the percentage older adults at risk from undernutrition was low, i.e. 0.6 %. Since this risk of undernutrition is partly based on the ability to climb stairs, a criterion for functionality, the prevalence of persons at risk for undernutrition is underestimated in this population of relatively vital older adults. Similarly, the prevalence of inadequate protein intake might be underestimated and the mean energy level overestimated (see section 8.5).

The older adult population is heterogeneous. Apart from a subgroup with undernutrition, there is also a subgroup with high body weight. About 20% of the relatively vital older adults had a BMI over 30 kg/m^2 (and no recent weight loss); in LASA the prevalence of a BMI above 30 kg/m^2 was estimated as 27% (see Appendix C). Older adults with a BMI above 30 kg/m^2 have a 10% higher risk of mortality compared to normal weight adults.[57] Moreover, such a high BMI increases the risk of physical problems and functional impairment.[58]

8.4 Dietary characteristics and consumption of foods

Older adults consume most food at home. For many food groups, over 85% of food consumption took place in people's own homes. Exceptions were alcoholic beverages and cakes, i.e. foods usually consumed at social events. Those foods were more often consumed away from home.

More than half of the older women and about one fifth of the older men prepared their own hot meals each day. For most of the other men, someone else in the household usually prepared the meal. Home-delivered meals were seldom consumed by this study population of relatively vital community-dwelling older adults. Two to three in ten older adults were on a specific diet, such as a diet for diabetes or hypertension.

For most food groups, older men on average consumed more or similar amounts compared to older women. Mean consumption of fruit and beverages was higher for women, however.

Sufficient consumption of fruit is important as a source of vitamin C, minerals, dietary fibre, and bioactive compounds. The average fruit consumption in this older adult population (about 1.5 pieces of fruit a day) was lower than the recommended two pieces a day.

Sufficient consumption of vegetables is important for the intake of various vitamins, minerals, dietary fibre and bioactive components. The mean consumption of vegetables just equalled the recommended amount of three serving spoons per day; for almost half the men and women the consumption of vegetables was lower. The recommended vegetable consumption for older adults is lower than for other adults.

Sufficient consumption of fish is particularly important as a source of n-3 fish fatty acids. The guideline to eat fish twice a week was not followed by most of the older adults. The more ecologically friendly recommendation, for achieving the beneficial health effect, is to eat fish once a week and choose oily fish.[59] Six in ten older adults consumed (oily and lean) fish at least once a week. This

means, though, that at least 40% of the older adults did not consume oily fish every week.

Drinking sufficiently is important for older adults. It is recommended to drink 1.5-2.0 L/day. Median consumption of beverages (1.4 L) was just below this guideline. Low consumption of beverages among older adults was associated with not consuming home-delivered hot meals and living in housing not specifically intended for older adults.

About 70% of older adults consumed fortified foods on one or both of the survey days. 45% of the survey group used dietary supplements. Dietary supplements were more often consumed in the winter than in the summer, and more women than men took them.

8.5 Energy and nutrients

Average energy intake was below the average requirement for this group of relatively vital older adults. This might be explained by an underestimation of energy intake (see Section 8.6); at the individual level it was not possible to evaluate energy intake. However, the observation that about a quarter of the older women had an energy intake below 6.3 MJ/day might indicate that for some of them it could be problematic to obtain sufficient essential nutrients.[63] Risk group for a lower energy intake were persons unable to climb stairs. This is consistent with the literature.[15] As indicated in Section 8.3, energy intake by this study population of relatively vital older adults is probably higher than the energy intake of community-dwelling older adults in general.

Protein intake was sufficient for the majority in this population of older adults. Subgroups with a low protein intake per kg body weight were persons without undernutrition and those with a high waist circumference or BMI, which could be explained by a higher body weight. Another subgroup with a low protein intake/kg bodyweight were persons not able to climb stairs. Hence, especially persons with functional impairments are probably at risk for low protein intake (the inability to climb stairs being used as a proxy for the impairment). Since people with functional impairment were underrepresented, the prevalence of inadequate protein intake is probably higher in all community-dwelling older adults aged 70 years and older. Moreover, there are indications that the average requirement of 0.66 g/kg body weight as set by EFSA might be too low.[72]

Reference intake ranges for macronutrients apply to ranges of intakes that are adequate for maintaining health and that are associated with a low risk of selected chronic diseases.[73] Average carbohydrate intake was below the reference intake range and total fat intake was just within the reference intake range for sedentary living populations. Moreover, for one fifth of the women and two fifths of the men, alcohol intake was too high. In addition, intake of dietary fibre was much lower than recommended. With regard to the fatty acid composition of the diet, intake of trans-fatty acids, linoleic acid and alpha-linolenic acid was appropriate, whereas intake of saturated fatty acids was too high and intake of n-3 fish fatty acids was low. These suboptimal macronutrient intakes are similar to what was observed for adults below the age of 70.[74]

An adequate fluid intake is important for older adults since renal concentrating capacity decreases with age, as does thirst sensitivity.[62] The water intake of women in this study appeared sufficient, whereas for men this was unclear since median water intake was just below the adequate intake level.

Previous studies of older adults showed that the intake of several vitamins might be inadequate. Particularly low intakes or status have been reported for vitamins B_2, B_6, B_{12}, folic acid, vitamin C and D.[63, 64] In this study, only the intake of vitamin D was clearly inadequate, the results supporting the need for supplementation of vitamin D for all older adults. The advice to take dietary supplements containing vitamin D daily, was followed by only part of the population: about 25% of the women and 20% of the men. At the time of the data collection, the recommended daily dose of the vitamin D supplements was 10 µg for older adults with a light skin that spent enough time outdoors, and 20 µg for other older adults.[61] After the data collection, the Health Council of the Netherlands recommended in 2012 that all persons aged 70 and above should take 20 µg vitamin D daily.[48] It is therefore not surprising that the 95th percentile of total vitamin D intake was less than 20 µg. Older adults that did not go outdoors daily, a proxy for exposure to sunlight, had a lower vitamin D intake from foods and dietary supplements than those that did go out.
For the vitamins A, B_2, B_6, folate and vitamin C (men only), potentially inadequate intakes were observed for subgroups of older adults. The proportions of older adults with potentially inadequate intakes were below 15% for each of these vitamins, and intake levels were not that low. There are no indications of problems with excessively high intakes of vitamins among older adults.

For minerals, too, inadequate intakes have frequently been observed in studies among older adults, particularly regarding calcium and iron.[63, 64] In the current study, the adequacy of calcium intake was unclear, but for iron there seemed to be no problem. In addition, selenium intake

was potentially inadequate for about 10% of older adults and for potassium, and magnesium (men only) adequacy was unclear. By contrast, the intake of other minerals and trace elements was sufficient and no related public health problems are expected among older adults. With regard to overconsumption, sodium intake was too high , particularly in men. In other age groups, too, sodium or salt intake was much higher than recommended.[70] There were no indications of excessively high intakes of other minerals by older adults.

8.6 Methodological aspects with regard to dietary assessment and evaluation

Dietary assessment among the population of community-dwelling older adults was conducted using two non-consecutive food diaries combined with a 24-hour dietary recall interview. The food diary served as a memory aid since it is known that short-term memory declines with age among older adults. To our knowledge this approach has only been used before with children.[75, 76] The 24-hour dietary recalls were conducted with EPIC-Soft©, developed by IARC. This software has been used widely and has been validated, including for older adults.[23, 77, 78] It was expected that the combination with the food diaries would increase the quality of the dietary assessment, although this might have been counteracted by the possibility that participants changed their dietary habits because of keeping the food diary.[79] Moreover, self-reported dietary assessment is never without error.[80]

Various quality checks and systematic quality controls of interviewers and collected dietary data were conducted during the fieldwork and data handling. However, it is still possible that misreporting, underreporting or overreporting occurred. Gross underreporting of energy intake was evaluated by means of the ratio of the reported energy intake and estimated energy requirements for basal metabolic rate. On average, energy intake was underestimated by 10%. This underestimation might have partly counteracted the overestimation of energy intake because of selection bias.

Quality controls showed that interviewers differed in average ratio of observed energy intake and expected energy requirement for basal metabolic rate. There were six of the 25 interviewers who observed statistically significant lower energy ratios (ranging from 1.13-1.28), whereas 1.6 was expected for the moderately active older adults. A low average ratio might be explained by poor interview quality, but other factors as well might explain this finding. If, for example, less active participants were interviewed, energy ratios would also be lower. Other quality controls (audio taped interviews and interview exercises) did not confirm that the quality of these interviewers was inadequate.

This study followed the guidelines of EFSA for conducting a national food consumption survey in the view of a pan-European dietary survey.[81] The availability of harmonised and detailed food consumption data at European level has been widely recognised as essential in order to improve the consistency and reliability of exposure assessments carried out by EFSA Panels and other experts in Europe.

The 24-hour recall data contain a great amount of detail, which makes the results suitable for a wide range of research questions and for underpinning policy measures. Since interviews took place in the homes of the participants, detailed product information could often be obtained from packaging, etc. For this reason, the data collected were judged suitable for quantifying the contribution of fortified products and dietary supplements to micronutrient intake. When specific brand and product names of dietary supplements were not known (about 10% of the reported supplements), the composition of comparable supplements was used. Intake of antacids may influence calcium intake.[82] Because of limited use and insufficient information on amounts of intake antacids were not taken into account. For iodine and sodium the contributions from discretionary used salt was estimated using information on frequency and type of salt use from the general questionnaire. However, the amounts of added salt had to be assumed, and might have introduced error.

The quality of nutrient intake data also depends on the quality of the versions of the Dutch food composition database (NEVO[30]) and the Dutch supplement database (NES[31]) used. Limitations of the NEVO database are that not all its data are based on (recent) laboratory analyses, and for some foods values of nutrients were incomplete. For energy and 27 nutrients 0-1% of the values were missing, for ten nutrients 2-5%, and for four nutrients 10-19% of the values were missing (these usually concerned the foods consumed less often). For most nutrients, random error rather than systematic bias is therefore expected because of the limitations of the food composition database. For β-carotene, vitamin E, copper, and selenium, with the most missing values, some underestimation might be expected.
Data in the NES database are not based on laboratory analyses, but on information published by manufacturers. This is label information that is subject to the regulatory requirement to reflect the minimum contents of nutrients, including at the end of shelf life. Accordingly, label values

are usually thought to tend toward overages, and therefore overestimations of nutrient intakes from dietary supplements might occur.[83]

A strength of the current study is that the habitual intake of foods and nutrients was assessed, instead of the mean intake over two independent days. As a result, the percentages of the population with inadequate or excessive intake were estimated without a bias due to the day-to-day variation. By using SPADE for the estimation of habitual intake[84], the combined intake of nutrients through food and dietary supplements could also be estimated appropriately. For these analyses, not only the information on supplement use collected during recall, but also that from the additional questionnaire was used to obtain better estimates. Similarly, for sodium and iodine, intake from foods, dietary supplements (for iodine), and added salt could be estimated using a multipart model, with information from 24-hour dietary recalls and from the general questionnaire. The low number of participants in DNFCS Older adults was sometimes a limiting factor in modelling usual intake.

To evaluate dietary intake, intake distributions were compared with dietary reference values. For some nutrients, the dietary reference values set by the Health Council of the Netherlands had been determined several decades ago. The Health Council plans to evaluate whether newer dietary reference values from EFSA or the Nordic Council of Ministers are more appropriate than older Dutch dietary reference values (personal communication R. Weggemans from HC). In anticipation of this evaluation, and in case the Dutch values were derived prior to the year 2000, we applied EFSA (first priority) and Nordic dietary reference (second priority) values as reference values. Compared to reference values of other European countries, the Nordic values in particular are considered as being derived more transparently[85], and being more appropriate for Europe than, say, American values are.

It should be noted that for several nutrients scientific insight into requirement is limited. This explains the large variation among the dietary reference values set by different institutes.[85] This also results in certain dietary reference values (adequate intakes) that can only be evaluated qualitatively. (See Chapter 2 for more information.)

8.7 Comparison with results of other national surveys

Appendix G presents selective results from DNFCS-Older adults 2010-2012 and persons aged 51-69 years in DNFCS-Core survey 2007-2010.[74] The dietary assessment method was somewhat different in both studies (i.e. including or not including a food diary as memory aid, and telephone versus face-to-face interviews). Accordingly, only large differences should be considered.
Compared to men and women aged 51-69 years, the median consumption of the food groups 'Alcoholic beverages', 'Non-alcoholic beverages', 'Meat and meat products', 'Condiments and sauces' and 'Cereals and cereal products' was at least 10% lower by adults aged 70 years and older. Whereas consumption of the groups 'Fruit nuts, and olives', 'Sugar and confectionary', and 'Fat' was at least 10% higher by adults aged 70 years and older. Median consumption of fish was zero for both groups, but mean consumption of fish was about 10% higher among adults over 70 years versus those aged 51-69 years. Consumption of vegetables was almost the same in both groups. However, for adults aged 70 years and older it was closer to the lower guideline.

In the oldest age group, more food was consumed at home compared with the 50-69 years olds.

As regards the older adults, median energy intake was about 8% lower than energy intake for adults aged 50-69 years. Intake of most macronutrients showed a similar difference, while for protein and unsaturated fatty acids the difference was somewhat larger. Intake of fish fatty acids by older adults was considerably higher (35%) compared to adults aged 50-69 years. This was partly due to higher fish consumption, but for the most part because older adults consumed more oily fish than the younger age group.

Although intake of energy by this population of relatively vital older adults was lower than by adults aged 51-69 year, this was not the case for all vitamins. For folate, and vitamins C and D, median intakes were actually 4-9% higher among adults aged 70 year and over compared to adults of 51 to 69 years. For vitamins B_1 and B_2, 9-13% lower intakes were observed among these relatively vital older adults. For the older adults, the intake of minerals and trace elements was 3-11% lower than in the population of adults aged 51-69 years. The smallest differences were observed for iodine (from foods only) and copper, and the largest differences for magnesium, phosphor, and sodium (from foods only).

Although national dietary surveys are conducted in many European countries, it is not currently possible to carry out a quantitative EU-wide analysis or country-to-country comparisons on food consumption, due to differences in how information is collected. For this reason, EFSA coordinates the project EU Menu in cooperation with member states of the EU. This project aims to harmonise data collection on food consumption across Europe. The current study followed these guidelines.[81] Based on the available European data, the nutrition and health situation was described in 2009 in the European Nutrition and health report (ENHR).[86] Our findings are in line with the reported dietary habits. A more detailed comparison is limited due to differences in the age categories used for older adults and in the dietary assessment methods between EU countries.

8.8 Recommendations

Based on the findings from this survey, recommendations can be made on possible improvements to the diet of Dutch relatively vital older adults. This would then result in a diet more in accordance with the guidelines for a healthy diet.[42] To achieve this, improvements have to be made in the food supply, in the way foods are promoted, and to the settings where foods are offered or sold, as well as in the food behaviour of consumers. It is outside the scope of this report to set priorities for these possible improvements and the way in which they could be achieved.

The diet of older community-dwelling adults can be improved as regards the following aspects:

- Vitamin D
  - Increase the all-year-round use of dietary supplements with 20 µg vitamin D.[48]

- Healthy lifestyle and dietary habit
  In general, encouragement of a healthier lifestyle earlier in life as well as in older adults is important to postpone functional impairment and morbidity of chronic diseases. This includes:
  - Stimulation of increased consumption of *basic foods* like bread, potatoes, rice or pasta, in particular wholemeal products, to increase carbohydrate/polysaccharide and dietary fibre intake.
  - Stimulation of increased consumption of *dairy products* to increase intake of B-vitamins, vitamin A and calcium,
  - Stimulation of increased consumption of *spreads and cooking fat*. This will improve the intake of vitamins A, D and E and folate.
  - Stimulation of higher consumption of *fruit* and maintenance of sufficient *vegetable* consumption. By increasing consumption of these foods, the dietary concentration of essential micronutrients will be improved, as well as the dietary sodium/potassium balance and dietary fibre intake. Moreover, this will help reduce energy density and would facilitate the maintenance of a healthy energy balance.
  - Stimulation of more *oily fish* consumption, at least once a week.
  - Stimulation of increased use of foods with a more *favourable fatty-acid profile*, for example in the food group 'fat', in order to reduce the intake of saturated fatty acids.
  - Reduction of the intake of *sodium* by diminishing the use of kitchen salt, continuation of the reformulation of foods to achieve lower sodium levels and stimulation of the use of low-sodium foods.
  - In the case of *alcohol* consumption, limitation of alcohol consumption to modest amounts.
  - Stimulation of sufficient *fluid* consumption.

The above recommendations are in line with the recommendations for a healthy diet[42] and the food based dietary guidelines[29].

For persons not at risk for undernutrition and insufficient body weight, additional recommendations to improve the energy balance are:

- Decrease consumption of energy dense and low-nutrient-dense foods such as sugar and confectionery, cakes, and snacks.
- Limit the use of sugar sweetened drinks.
- Stimulate the use of low-fat choices from the food groups 'Dairy products' and 'Meat and meat products' and 'Fat'.

For older adults with (risk of) undernutrition, the recommendations of the Dutch malnutrition steering group [17] to increase energy intake, are applicable as well. These include to:

- Increase the number of food consumption occasions.
- Use energy and nutrient dense foods; do not use light products or skimmed products.
- Drink at least 1.5 L and use energy-containing beverages.
- Use large portions of fat (with a favourable fatty acid profile) for food preparation and as spread.
- From other research it is also known that not only the content of meals is important, but also the taste, proper mastication, convenience, the ambiance of eating and of the company of other people.

Apart from these dietary recommendations, engaging in sufficient and feasible physical activity is an important component for a healthy energy balance both for people with and without (risk of) undernutrition.

More research is recommended:

- For vitamin D, *monitoring* dietary supplement use and nutritional status is important in order to evaluate the effect of the current vitamin D supplement advice[48] and supporting activities.
- For the vitamins A, B_2, B_6, folate, C (men only), and for calcium, magnesium (men only), potassium, selenium, and fish fatty acids nutritional status research is recommended[d]. This is needed because the food consumption data indicated possible inadequate intake levels among subgroups of older adults, and because adequacy of intake could not be evaluated. As intake levels do not appear alarmingly low, this nutritional status research does not have a high urgency for the relatively vital older adults. If nutritional status research confirms low intakes for vitamins A, B_2, B_6, folate, C (men only), and for calcium, magnesium, potassium and selenium, follow-up research on the health effects of these levels of intake is recommended.
- For sodium, continued monitoring of urinary excretion is recommended to evaluate the effects of current efforts to reduce sodium contents in foods. Because iodine intake is related to sodium intake, monitoring of iodine excretion is also recommended.
- Obtain dietary reference values with a sufficiently scientific basis. The EURRECA Network of Excellence assigned priorities for those recommendations most in need of alignment. The ranking was based on three criteria: (A) the amount of new scientific evidence, particularly from randomised controlled trials; (B) the public health relevance of micronutrients; (C) variations in current micronutrient recommendations. The ten highest ranked micronutrients were vitamin D, iron, folate, vitamin B_{12}, zinc, calcium, vitamin C, selenium, iodine and copper.[68] With this broader perspective, re-evaluation of dietary reference values for calcium, folate, vitamin C and selenium have the highest priority for interpretation of the results of the current food consumption survey among older adults.
- It is recommended not to wait too long to collect new food consumption data, in order to monitor the current trends in the diet of community-dwelling older adults. The increasing population of older adults in the next decades, combined with the policy objective to keep older adults living independently as long as possible (http://www.rijksoverheid.nl/onderwerpen/ouderen-zorg/langer-zelfstandig-wonen) underpin this recommendation.
  Among this age group, it is questionable, however, whether detailed data collection such as in the present study, is feasible as regards a representative study population. For this reason, another, two-part approach could be considered for the future.
  - Part one consists of continued collection of detailed food consumption data. It should be recognised in advance that the study population will probably again contain relatively vital older adults. For 70-79 year olds, such data collection is already on-going, integrated in the Dutch National Food Consumption Survey 2012-2016.
  - Part two consists of a less burdensome or time consuming data collection in a representative population. Additionally or alternatively, a data collection in settings where those groups of older adults that are most at risk of acquiring nutritional problems can be assessed and interested for the study.

8.9 Conclusions

DNFCS-Older adults 2010-2012 provides insight into the food consumption of relatively vital community-dwelling older adults.

Based on the study findings, we conclude that the same issues for improvement of the diet apply to the community-dwelling adults aged 70 years and older, as to the rest of the Dutch population. The older adults consume more saturated fatty acid and sodium, and consume less whole grain products, fruit and fish, than the amounts recommended in the dietary guidelines. One in five older adults has serious overweight. A healthy diet and sufficient exercise early in life as well as at older ages are important to prevent chronic diseases and functional impairments. This can be achieved by changes in both food supply and consumer behaviour.

Compared with adults of younger ages, older adults consume a diet with a lower energy content and a slightly different composition. The relatively vital older adults consume less alcoholic and non-alcoholic beverages, meat, sauces and cereal products, whereas their consumption of fruit, sugar and confectionery, and fat is higher. Moreover, foods are more often consumed at home.

One in four persons aged 70 years and older follows the advice of taking dietary supplements containing vitamin D. Sufficient vitamin D reduces the risk of falls and bone fractures. These findings support the need for older adults to take vitamin D supplements, as recommended by the Health Council of the Netherlands[48] and along the lines of the activities subsequently proposed by the Dutch Nutrition Centre for implementing this recommendation.

[d] Nutritional status research and research on health effects of low status is recommended for vitamin B_{12} [68], even though the intake of vitamin B12 was adequate in vital older adults. Among older adults, a low vitamin B_{12} status may occur because of reduced absorption in the stomach despite dietary intake being perceived as adequate.

Older adults cannot be considered as a single homogeneous group. Older adults with functional impairments and multimorbidity were not represented adequately in this study. The older adults with the least functionality had a lower intake of energy, protein and many dietary components as compared to well-functioning older adults. This underpins the problem of undernutrition among some older adults.

Monitoring the diet and supplement use of older adults can contribute to adequate food policies and recommendations. Given the increasing population of older adults in the next decades it is recommended not to wait too long to collect new food consumption data. New data collection should include representative groups of older adults that are most at risk of acquiring nutritional problems.

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List of Abbreviations

ADC	Relative Address Density Classes
AI	Adequate Intake
ALA	Alpha Linolenic Acid
AR	Average Requirement
AOW	General old-age pension
BMI	Body Mass Index
BMR	Basal Metabolic Rate
CBS	Statistics Netherlands (Centraal Bureau voor de Statistiek)
CI	Confidence Interval
DHA	DocosaHexaenoic Acid
DNFCS	Dutch National Food Consumption Survey
DRI	Dietary Reference Intake
EFSA	European Food Safety Authority
ENHR	European Nutrition and Health Report
En%	Procentual contribution to the total daily energy intake
EPA	EicosaPentaenoic Acid
EPIC	European Prospective Investigation into Cancer and nutrition
EURRECA	European Micronutrient Recommendations Aligned
GBA	Municipal Personal Records Database
GfK	Market Research Agency GfK Panel Services
HC	Health Council of the Netherlands (Gezondheidsraad)
IARC	International Agency for Research on Cancer
IOM	US Institute Of Medicine
LASA	Longitudinal Aging Study Amsterdam
LDL	Low Density Lipoproteins
LOAEL	Lowest Observed Adverse Effect Level
MET	Metabolic Equivalent
METC	Medical ethics committee (Medisch Ethische ToetsingsCommissie)
MMSE	Mini Mental State Examination

MUFA	Mono Unsaturated Fatty Acids
NCM	Nordic Council of Ministers
NES	Dutch Supplement Database (NEderlands Supplementenbestand)
NEVO	Dutch Food Composition Database (NEderlands VOedingsstoffenbestand)
NOAEL	No Observed Adverse Effect Level
PAL	Physical Activity Level
PUFA	Poly Unsaturated Fatty Acids
RAE	Retinol Activity Equivalent
RDA	Recommended Dietary Allowance
RI	Recommended Intake for a population
RIVM	Dutch National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu)
SCP	Netherlands Institute of Social Research (Sociaal Cultureel Planbureau)
SD	Standard Deviation
SFA	Saturated Fatty Acids
SNAQ	Short Nutritional Assessment Questionnaire
SPADE	Statistical Program to Assess Dietary Exposure
SQUASH	Short QUestionnaire to ASsess Health enhancing physical activity
TE	Tocoferol Equivalents
TFA	Trans-Fatty Acids
UL	Tolerable Upper intake Level
VWS	Dutch Ministry of Health, Welfare and Sport (Ministerie van Volksgezondheid, Welzijn en Sport)
WC	Waist Circumference
WHO	World Health Organization

Appendices

Appendix A List of experts

Ministry of Health, Welfare and Sports:
C.A. Boot, MSc (until 2010)
E.N. Blok, MSc (from 2010)
A. Sellis, MSc

Members of expert-panel:
Dr P.E. Boon (until 2013)
Dr J.J.M. Castenmiller
Dr M.C.J.M. van Dongen
Prof. C.P.G.M. de Groot
A. Kruizinga, MSc
Dr G. Molleman (from 2012)
Prof. P. van 't Veer (chairman)
Prof. M. Visser
Dr J.H.M. de Vries
Dr A.M. Werkman (until February 2013)

Institute of Public Health and the Environment (RIVM):
Dr E.J. de Boer
Dr M.C. Ocké
Dr C.T.M. van Rossum

Appendix B Dutch food-based dietary guidelines[a] and food groups within EPIC-Soft

Vegetables and fruit

For the assessment of the consumption of vegetables and fruit, the total vegetable and fruit consumption was taken into account, including specific fruit juices, soups and sauces with a high percentage of vegetables. According to the food-based dietary guidelines, these juices, soups and sauces could only contribute up to a maximum of 50% of the recommended daily amounts for consumption. The following classifications were used.

The group 'Vegetables and vegetable products' contained:

- Foods from EPIC-Soft food group 02 'Vegetables' for which the matrix is intact. Excluded are 'Onions deep fried' (NEVO-code 1484).
- Vegetable juices (a selection from EPIC-Soft subgroup 1301 'Fruit and vegetable juices', based on their name), if they met the following criteria: a maximum of 1.1 g saturated fat , 0.1 g trans-fat and 100 mg sodium per 100 g, and containing at least 0.75 g dietary fibre per 100 kcal. No products fulfilled the criteria.
- Vegetable soups, if they contained at least 2 mg vitamin C and 4 µg folate equivalents and/or 15 µg RAE per 100 ml. 20% of these soups counted as vegetables. Included were 'Soup clear with vegetables and noodles' (NEVO-code 757), 'Soup clear with vegetables' (NEVO-code 759), 'Soup clear with meat and vegetables' (NEVO-code 761), 'Soup thickened with vegetables' (NEVO-code 763), 'Soup thickened with meat and vegetables'(NEVO-Code 792), and 'Soup vegetable based tinned prepared' (NEVO-code 800). In addition, all vegetables as ingredients of main course soups were included.
- Sauces, if they contained at least 5 mg vitamin C and 13 µg folate equivalents or 50 µg RAE per 100 g. 66% of these sauces counted as vegetables. The only sauce included was 'Sauce tomato ready-made, jar' (NEVO-code 1524).

The group 'Fruit and fruit juices' contained:

- EPIC-Soft food groups 0401 'Fruit' and 0403 'Mixed fruits' without 'Elitehaver' (NEVO-code 205).
- Fruit juices (a selection of EPIC-Soft subgroup 1301 'Fruit and vegetable juices', based on their name), if they met the following criteria: a maximum of 1.1 g saturated, 0.1 g trans-fat and 100 mg sodium per 100 g, and at least 0.75 g dietary fibre per 100 kcal. The juices included are 'Juice redcurrant' (NEVO-code 388), 'Juice grapefruit' (NEVO-code 664) and 'Juice orange with pulp' (NEVO-code 1932).

Bread

The group 'Bread' contained:

- EPIC-Soft food groups 0603 'Bread, crispbread, rusks' and 0604 'Breakfast cereals'.
- Bread substitutes from EPIC-Soft food group 12 'Cakes' if they contained carbohydrates, and at least 20 µg folate and 0.14 mg vitamin B6 and/or 0.7 mg iron per 100 g, and were baked with iodized salt and marketed as a bread substitute. NEVO-codes 2876 'Bread brioche' and 'Croissant chocolate-'(NEVO-code 2400), 'Croissant prepared with butter' (NEVO-code 2801) and 'Croissant average' (NEVO-code 2818) satisfied these criteria.

Potatoes (or rice, pasta or legumes)

This group contained:

- EPIC-Soft food groups 0101 'Potatoes', 0102 'Other tubers', 0301 'Legumes' and 0602 'Pasta, rice, other grain'.

[a] http://www.voedingscentrum.nl/Assets/Uploads/Documents/Voedingscentrum/Actueel/00_Richtlijnen%20voedselkeuze%202011.pdf.

Dairy products

The group 'Dairy products' contained:

- EPIC-Soft food groups 0500 'Unclassified', 0501 'Milk', 0502 'Milk beverages', 0503 'Yogurt', 0504 'Fromage blanc, petit suisse', 0506 'Cream desserts, puddings (milk based)', 0507 'Dairy and non-dairy creams', 0508 'Milk for coffee and creamers'.
- A selection from EPIC-Soft food group 1701 'Soya products', if they contained protein and at least 80 mg calcium and 0.25 µg vitamin B_{12} per 100 gram. The NEVO-codes included were 'Dessert soya Alpro' (NEVO-code 1380), 'Milk soya Natural Fresh Alpro' (NEVO-code 1381), 'Milk soya several flavours Alpro' (NEVO-code 1602), 'Soya based yoghurt Yofu soja Alpro' (NEVO-code 1953), 'Milk soya natural Fresh light Alpro' (NEVO-code 2858) and 'Soya based yoghurt Yofu soja Alpro naturel' (NEVO-code 2888).

Cheese

The group 'Cheese' contained:

- EPIC-Soft food group 0505 'Cheeses (including fresh cheeses)'.
- A selection from EPIC-Soft food group 1701 'Soya products', if they contained protein and at least 80 mg calcium and 0.25 µg vitamin B_{12} per 100 gram. No cheese replacement products satisfied the criteria.

Meat (products), fish, chicken, egg or other meat replacement products

This group contained:

- EPIC-Soft food group 07 'Meat and meat products'.
- EPIC-Soft food group 08 'Fish and shellfish'.
- EPIC-Soft food group 09 'Eggs and egg products'.
- A selection from EPIC-Soft food group 1700 'Unclassified' or 1701 'Soya products', if they contained protein and at least 0.7 mg iron and 0.13 µg vitamin B_{12} and/or 0.06 mg vitamin B_1 per 100 g. The NEVO-codes included were 'Tahoe soya curd ' (NEVO-code 687), 'Hamburger vegetarian unprepared' (NEVO-code 1511), 'Schnitzel vegetarian unprepared' (NEVO-code 1512), 'Vegetarian mincemeat balls unprepared' (NEVO-code 2046), 'Mincemeat vegetarian unprepared' (NEVO-code 2047), 'Vegetarian schnitzel Valess unprepared' (NEVO-code 2282), 'Vegetable burger vegetarian unprepared' (NEVO-code 2286), 'Pate vegetarian' (NEVO-code 2542) and 'Vegetarian prod with cheese Valess unprepared' (NEVO-code 3040).

Spread

The group 'Spread' contained:

- A selection from EPIC-Soft food groups 1002 'Butter' and 1003 'Margarines', if they were consumed together with bread (food group 0603 or 0604).

Cooking fat

The group 'Cooking fat' contained:

- EPIC-Soft food group 10 'Fat', if the product was not already included in the group 'Spread'.

Drinks

The group 'Drinks' contained:

- EPIC-Soft food group 13 'Non-alcoholic beverages'.
- EPIC-Soft food group 14 'Alcoholic beverages'.
- EPIC-Soft food group 1104 'Syrup', without NEVO-codes 'Syrup keukenstroop' (NEVO-code 378), 'Syrup sugar' (NEVO-code 381), 'Syrup apple' (NEVO-code 427), 'Syrup ahorn' (NEVO-code 3063), 'Syrup apple enriched with iron' (NEVO-code 3064) and 'Syrup, ginger' (EPIC-Soft number 2108) (syrups not used for drinks).

Appendix C Characteristics of participants in the LASA study[a]

Observational cycle 2008/2009; selection of community-dwelling participants aged 70 years and older

	Total		Men		Women	
	n[b]	%	n	%	n	%
Age	**827**		**353**		**474**	
70 - 74 years	281	34.0	130	36.8	151	31.9
75 - 79 years	235	28.4	97	27.5	138	29.1
80 - 84 years	183	22.1	76	21.5	107	22.6
85 years and older	128	15.5	50	14.2	78	16.5
	mean	SD	mean	SD	mean	SD
Age (years)	78.7	6.2	78.4	6.1	78.9	6.2
	n	%	n	%	n	%
Marital status	**827**		**353**		**474**	
Married or registered partnership, living together	439	53.1	257	72.8	182	38.4
Unmarried or never been married	35	4.2	14	4.0	21	4.4
Divorced or living apart	48	5.8	18	5.1	30	6.3
Widow/ widower	305	36.9	64	18.1	241	50.8
Living together	**826**		**353**		**473**	
No	371	44.9	89	25.2	282	59.6
Yes, with partner, children or other person(s)	455	55.1	264	74.7	191	40.4
Highest completed education	**827**		**353**		**474**	
Primary education	250	30.2	64	18.1	186	39.2
Lower vocational or advanced elementary education	287	34.7	117	33.1	170	35.9
Intermediate vocational or higher secondary education	158	19.1	88	24.9	70	14.8
Higher vocational education or university	132	16	84	23.8	48	10.1
Smoking	**771**		**332**		**439**	
No, never used tobacco	266	34.5	32	9.6	234	53.3
No, but did use tobacco in the past	434	56.3	260	78.3	174	39.6
Yes	71	8.6	40	12.0	31	7.1
Number of days with alcoholic drinks	**768**		**330**		**438**	
No alcohol	169	22.0	43	13.0	126	28.8
< 1 day/week	175	22.8	57	17.3	118	26.9
1-4 days/week	197	25.7	99	30.0	98	22.4
5-7 days per week	227	29.6	131	39.7	96	21.9
Supplement use	**583**		**262**		**321**	
During seasons other than winter	232	39.8	91	34.7	141	43.9
Prevalence of undernutrition in accordance with screening instrument SNAQ65+	**819**		**351**		**468**	
At risk of undernutrition	71	8.7	23	6.6	48	10.3
Unintended weight loss (≥4 kg in last 6 months)	**759**		**331**		**428**	
Yes	16	2.1	9	2.7	7	1.6
No	743	97.9	322	97.3	421	98.4
Able to climb stairs	**818**		**351**		**467**	
No	124	15.2	30	8.5	94	20.1

Appendix C continued.

	Total		Men		Women	
	mean	SD	mean	SD	mean	SD
Anthropometry						
Height (cm), n=742	166.8	8.8	174	6.6	161.4	6.0
Weight (kg), n=751	77.4	13.6	81.9	12.3	74	13.5
Waist circumference (cm), n=723	99.9	11.7	102.9	10.6	97.6	12.0
BMI (kg/m^2), n=741	27.8	4.4	27	3.5	28.4	4.9
	n	%	n	%	n	%
Evaluation of weight status based on BMI	**741**		**319**		**422**	
Underweight (BMI <20 kg/m^2)	12	1.6	5	1.6	7	1.7
Normal weight (BMI 20-25 kg/m^2)	197	26.6	87	27.3	110	26.1
Overweight (BMI 25-30 kg/m^2)	331	44.7	164	51.4	167	39.6
Obesitas (BMI ≥30 kg/m^2)	201	27.1	63	19.7	138	32.7
Evaluation of weight status based on waist circumference	**723**		**313**		**410**	
Men WC <79 cm /Women WC < 68 cm	4	0.6	2	0.6	2	0.5
Men WC 79-102 cm /Women WC 68-88 cm	222	30.7	148	47.3	74	18.0
Men WC ≥102 cm /Women WC ≥88 cm	497	68.7	163	52.1	334	81.5
MMSE: Orientation to time						
Year	**827**		**353**		**474**	
Correctly answered	787	95.2	336	95.2	451	95.1
Season	**827**		**353**		**474**	
Correctly answered	792	95.8	335	94.9	457	96.4
Month of the year	**827**		**353**		**474**	
Correctly answered	799	96.6	336	95.2	463	97.7
Date	**820**		**350**		**470**	
Correctly answered	635	77.4	262	74.9	373	79.4
Day of the week	825		352		473	
Correctly answered	796	96.5	335	95.2	461	97.5
MMSE: Orientation to place						
Province	**827**		**353**		**474**	
Correctly answered	820	99.2	352	99.7	468	98.7
Place	**826**		**353**		**473**	
Correctly answered	805	97.6	349	98.9	456	96.4
Street	**826**		**352**		**474**	
Correctly answered	790	95.6	330	93.8	460	97.0
MMSE: Word immediate recall	**824**		**353**		**471**	
3 out of 3 correctly answered	758	92	313	88.7	445	94.5
2 out of 3 correctly answered	55	6.7	32	9.1	23	4.9
1 out of 3 correctly answered	8	1.0	5	1.4	3	0.6
All false/ no answer	3	0.4	3	0.8	0	0
MMSE: Calculation exercise	**814**		**352**		**462**	
All correctly answered	464	57.0	215	61.1	249	53.9
All false/ no answer	10	1.2	3	0.9	7	1.5
MMSE: Word delayed recall	**822**		**352**		**470**	
3 out of 3 correctly answered	421	51.2	171	48.6	250	53.2
2 out of 3 correctly answered	256	31.1	117	33.2	139	29.6
1 out of 3 correctly answered	96	11.7	44	12.5	52	11.1
All false/ no answer	49	6.0	20	5.7	29	6.2

[a] Huisman, M., J. Poppelaars, et al. (2011). "Cohort profile: the Longitudinal Aging Study Amsterdam." International Journal of Epidemiology 40(4): 868-876.Definitions of shown characteristics are comparable with DNFCS-Older adults; MMSE total score was not comparable.

[b] bold numbers represent number of participants for which information is available.

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Appendix D Food consumption data (main food groups and all subgroups)

Table D.1 Food consumption in g/day (food groups and all subgroups) of Dutch men aged 70 years and older (DNFCS-Older adults 2010-2012, n=373), weighted.

	Men								
						On consumption days			
Food groups based on EPIC-Soft Classification	Mean	Median	P5	P95	% Consumption days	Mean	Median	P5	P95
01. Potatoes and other tubers	**116**	**101**	**0**	**306**	**72**	**165**	**140**	**60**	**332**
0101. Potatoes	116	101	0	306	71	166	140	60	334
0102. Other tubers	0	0	0	0	0	.	.	.	.
02. Vegetables	**148**	**136**	**22**	**288**	**93**	**170**	**160**	**39**	**344**
0201. Leafy vegetables (except cabbages)	31	0	0	132	29	108	92	10	262
0202. Fruiting vegetables	46	26	0	166	48	105	85	10	267
0203. Root vegetables	17	0	0	102	16	100	100	4	229
0204. Cabbages	24	0	0	120	21	142	143	5	278
0205. Mushrooms	2	0	0	12	7	22	17	3	54
0206. Grain and pod vegetables	4	0	0	18	5	92	73	1	220
0207. Onion, garlic	10	0	0	45	30	38	26	2	100
0208. Stalk vegetables, sprouts	2	0	0	3	5	50	16	1	211
0209. Mixed salad, mixed vegetables	12	0	0	75	11	99	77	17	260
03. Legumes	**4**	**0**	**0**	**37**	**5**	**107**	**78**	**7**	**248**
0301. Legumes	4	0	0	37	5	107	78	7	248
04. Fruits, nuts and olives	**155**	**141**	**0**	**386**	**83**	**189**	**165**	**32**	**435**
0401. Fruits	147	140	0	381	80	188	165	34	418
0402. Nuts and seeds (+nut spread)	7	0	0	35	18	34	25	7	79
0403. Mixed fruits	1	0	0	0	2	55	27	14	142
0404. Olives	0	0	0	0	2	12	6	2	36
05. Dairy products	**374**	**345**	**91**	**752**	**99**	**386**	**364**	**57**	**776**
0500. Unclassified	0	0	0	0	0	100	100	100	100
0501. Milk	165	111	0	495	62	280	241	38	558
0502. Milk beverages	16	0	0	110	7	217	201	116	374
0503. Yoghurt	75	38	0	257	40	199	170	51	511
0504. Fromage blanc, petit suisse	10	0	0	74	8	134	124	19	229
0505. Cheese (including fresh cheeses)	35	33	0	77	78	45	42	12	93
0506. Cream desserts, puddings (milk based)	60	0	0	228	30	185	165	70	340
0507. Dairy and non-dairy creams	1	0	0	8	10	16	10	3	39
050701. Dairy creams	1	0	0	7	9	16	10	3	37
050702. Non-dairy creams	0	0	0	0	1	21	11	3	52
0508. Milk for coffee and creamers	12	3	0	44	45	24	19	4	55
06. Cereals and cereal products	**188**	**177**	**77**	**323**	**100**	**185**	**170**	**68**	**371**
0601. Flour, flakes, starches, semolina	1	0	0	5	7	17	6	1	81
0602. Pasta, rice, other grain	31	0	0	131	19	136	122	36	245
0603. Bread, crisp bread, rusks	143	134	57	253	99	147	139	55	275
060301. Bread	137	127	50	245	98	143	136	51	260
060302. Crispbread, rusks	6	0	0	24	37	16	10	3	40
0604. Breakfast cereals	5	0	0	33	17	31	27	4	80
0605. Salty biscuits, aperitif biscuits, crackers	4	0	0	19	15	21	19	3	63
0606. Dough and pastry (puff, shortcrust, pizza)	4	0	0	13	3	127	97	24	268

Table D1 Continued

Food groups based on EPIC-Soft Classification	Men								
						On consumption days			
	Mean	Median	P5	P95	% Consumption days	Mean	Median	P5	P95
07. Meat and meat products	**99**	**89**	**30**	**200**	**95**	**108**	**98**	**20**	**236**
0701.Fresh meat	43	33	0	131	49	95	80	20	217
070100. Unclassified	6	0	0	45	11	71	68	11	146
070101. Beef	19	0	0	88	22	90	80	20	167
070102. Veal	0	0	0	0	0	112	81	48	145
070103. Pork	16	0	0	89	17	105	91	17	219
070104. Mutton/Lamb	0	0	0	0	0	78	68	66	106
0702. Poultry	12	0	0	57	15	74	75	16	133
070200. Unclassified and other poultry	0	0	0	0	0	.	.	.	.
070201. Chicken, hen	11	0	0	56	14	75	75	16	135
070202. Turkey, young turkey	0	0	0	0	1	72	58	29	92
070203. Duck	0	0	0	0	0	51	44	42	57
070205. Rabbit (domestic)	0	0	0	0	0	.	.	.	.
0703. Game	0	0	0	0	0	.	.	.	.
0704. Processed meat	44	32	0	113	75	58	40	9	146
0705. Offals	1	0	0	0	0	90	42	7	166
08. Fish and shellfish	**22**	**0**	**0**	**98**	**17**	**118**	**98**	**34**	**227**
0801. Fish	19	0	0	89	15	112	96	34	226
0802. Crustaceans, molluscs	1	0	0	0	1	84	47	10	177
0803. Fish products, fish in crumbs	2	0	0	0	2	118	98	2	212
09. Eggs and egg products	**13**	**0**	**0**	**54**	**25**	**49**	**50**	**6**	**99**
0901. Egg	13	0	0	54	25	49	50	6	99
10. Fat	**34**	**32**	**9**	**70**	**100**	**34**	**31**	**6**	**72**
1000. Unclassified	1	0	0	7	16	7	6	1	20
1001. Vegetable oils	4	0	0	14	32	11	7	1	27
1002. Butter	4	0	0	23	24	16	13	2	43
1003. Margarines	25	21	0	62	89	28	25	2	68
1004. Deep frying fats	1	0	0	4	2	18	17	6	32
1006. Other animal fat	0	0	0	0	0	10	5	4	18
11. Sugar and confectionery	**51**	**41**	**0**	**149**	**86**	**55**	**41**	**7**	**155**
1100. Unclassified	0	0	0	0	1	5	2	0	11
1101. Sugar, honey, jam	26	19	0	83	69	36	28	4	96
1102. Chocolate, candy bars, paste, chocolate confetti/flocks	10	0	0	43	35	26	19	6	63
1103. Confectionery non-chocolate	2	0	0	13	22	13	10	1	32
1104. Syrup	6	0	0	31	23	25	20	8	61
1105. Ice cream, water ice	7	0	0	48	6	94	73	48	150
110500. Unclassified	0	0	0	0	0	96	96	96	96
110501. Ice cream	6	0	0	37	6	87	73	48	149
110502. Sorbet	0	0	0	0	1	57	50	50	83
110503. Water ice	0	0	0	0	0	62	50	50	95
12. Cakes	**46**	**37**	**0**	**120**	**78**	**58**	**45**	**9**	**144**
1201. Cakes, pies, pastries, etc.	28	19	0	96	44	61	46	18	151
1202. Dry cakes, biscuits	18	15	0	57	60	30	24	7	73

Table D1 Continued

Food groups based on EPIC-Soft Classification	Men								
						On consumption days			
	Mean	Median	P5	P95	% Consumption days	Mean	Median	P5	P95
13. Non-alcoholic beverages	**1,295**	**1,234**	**633**	**2,137**	**100**	**1,298**	**1,212**	**605**	**2,290**
1300. Unclassified	6	0	0	0	1	302	193	11	643
1301. Fruit and vegetable containing drinks	60	0	0	237	31	174	145	21	385
1302. Carbonated/soft/isotonic drinks, diluted syrups	76	0	0	461	21	295	206	98	727
1303. Coffee, tea and herbal teas	808	773	269	1,482	100	825	765	296	1,516
130301. Coffee	467	445	73	948	97	501	462	134	985
130302. Tea	293	192	0	1,069	64	455	362	124	1,102
130303. Herbal tea	48	0	0	323	13	373	300	4	879
130304. Chicory, substitutes	0	0	0	0	0	78	78	78	78
1304. Waters	345	284	0	1,038	82	431	326	70	1,181
14. Alcoholic beverages	**189**	**96**	**0**	**804**	**56**	**346**	**247**	**56**	**995**
1400. Unclassified	0	0	0	0	0	86	61	24	118
1401. Wine	82	0	0	370	33	254	182	84	726
1402. Fortified wines (sherry, port, vermouth)	5	0	0	15	4	90	81	3	199
1403. Beer, cider	84	0	0	516	17	518	317	248	1,139
1404. Spirits, brandy	17	0	0	95	20	80	71	31	173
1405. Aniseed drinks (pastis, ouzo)	0	0	0	0	0	31	25	25	49
1406. Liqueurs	1	0	0	0	2	50	42	13	124
15. Condiments and sauces	**29**	**20**	**0**	**81**	**66**	**39**	**29**	**3**	**108**
1501. Sauces	28	18	0	80	61	41	30	5	109
150100. Unclassified and other sauces	19	12	0	62	44	40	34	5	106
150101. Tomato sauces	3	0	0	10	4	43	16	2	135
150102. Dressing sauces	2	0	0	12	13	16	12	3	40
150103. Mayonnaises and similars	4	0	0	25	12	27	20	3	55
150104. Dessert sauces	0	0	0	0	1	33	24	15	43
1502. Yeast	0	0	0	0	1	4	2	1	5
1504. Condiments	1	0	0	6	13	7	5	1	20
16. Soups, bouillon	**94**	**0**	**0**	**370**	**32**	**282**	**244**	**138**	**528**
1601. Soups	79	0	0	308	29	270	244	141	495
1602. Bouillon	15	0	0	166	6	223	198	5	417
17. Miscellaneous	13	0	0	71	9	112	81	44	240
1700. Unclassified	0	0	0	0	0	169	169	169	169
1701. Soya products	2	0	0	0	2	126	100	65	245
1702. Dietetic products	4	0	0	0	1	209	173	30	244
170200. Unclassified	4	0	0	0	1	209	173	30	244
170201. Artificial sweeteners	0	0	0	0	0	.	.	.	.
1703. Snacks	8	0	0	61	6	92	71	38	186

Table D.2 Food consumption in g/day (food groups and all subgroups) of Dutch women aged 70 years and older (DNFCS-Older adults 2010-2012, n=366), weighted.

	Women								
						On consumption days			
Food groups based on EPIC-Soft Classification	Mean	Median	P5	P95	% Consumption days	Mean	Median	P5	P95
01. Potatoes and other tubers	**82**	**70**	**0**	**174**	**73**	**117**	**104**	**36**	**221**
0101. Potatoes	81	70	0	174	72	116	104	39	221
0102. Other tubers	0	0	0	0	0	120	120	120	120
02. Vegetables	**141**	**128**	**26**	**273**	**91**	**162**	**152**	**28**	**324**
0201. Leafy vegetables (except cabbages)	26	0	0	107	30	85	60	15	197
0202. Fruiting vegetables	38	22	0	147	48	92	66	5	238
0203. Root vegetables	16	0	0	90	16	96	83	2	227
0204. Cabbages	34	1	0	118	29	123	134	4	240
0205. Mushrooms	2	0	0	15	6	33	28	1	80
0206. Grain and pod vegetables	3	0	0	13	4	78	48	1	218
0207. Onion, garlic	9	0	0	43	28	34	21	2	123
0208. Stalk vegetables, sprouts	4	0	0	24	6	70	24	0	277
0209. Mixed salad, mixed vegetables	8	0	0	60	8	92	76	13	200
03. Legumes	**3**	**0**	**0**	**20**	**3**	**89**	**89**	**2**	**214**
0301. Legumes	3	0	0	20	3	89	89	2	214
04. Fruits, nuts and olives	**169**	**164**	**0**	**365**	**86**	**204**	**191**	**30**	**420**
0401. Fruits	162	154	0	365	83	203	186	34	421
0402. Nuts and seeds (+nut spread)	5	0	0	25	23	25	20	5	50
0403. Mixed fruits	1	0	0	0	3	72	47	19	168
0404. Olives	0	0	0	0	1	19	17	1	51
05. Dairy products	**331**	**306**	**60**	**735**	**99**	**327**	**312**	**31**	**736**
0500. Unclassified	0	0	0	0	0	.	.	.	.
0501. Milk	160	128	0	508	59	247	211	27	589
0502. Milk beverages	10	0	0	84	5	222	197	119	369
0503. Yoghurt	71	40	0	251	44	172	150	52	333
0504. Fromage blanc, petit suisse	11	0	0	73	11	123	122	20	235
0505. Cheese (including fresh cheeses)	34	28	1	73	80	39	29	12	88
0506. Cream desserts, puddings (milk based)	34	0	0	139	24	149	139	48	276
0507. Dairy and non-dairy creams	1	0	0	8	9	15	10	3	38
050701. Dairy creams	1	0	0	8	9	15	10	3	38
050702. Non-dairy creams	0	0	0	0	0	12	12	12	12
0508. Milk for coffee and creamers	10	3	0	35	47	21	16	4	46
06. Cereals and cereal products	**141**	**139**	**70**	**231**	**100**	**141**	**130**	**59**	**248**
0601. Flour, flakes, starches, semolina	1	0	0	3	8	11	4	1	37
0602. Pasta, rice, other grain	17	0	0	80	17	106	90	16	264
0603. Bread, crisp bread, rusks	116	115	52	188	99	115	105	43	193
060301. Bread	108	104	46	175	97	109	104	35	188
060302. Crispbread, rusks	8	3	0	31	42	17	13	5	44
0604. Breakfast cereals	3	0	0	20	13	26	20	5	55
0605. Salty biscuits, aperitif biscuits, crackers	2	0	0	12	14	19	14	4	59
0606. Dough and pastry (puff, shortcrust, pizza)	2	0	0	0	2	83	60	18	158
07. Meat and meat products	**81**	**77**	**7**	**161**	**86**	**92**	**85**	**12**	**192**
0701.Fresh meat	45	38	0	148	50	84	77	19	179
070100. Unclassified	4	0	0	31	6	52	42	10	112
070101. Beef	27	0	0	140	28	89	83	25	186

Table D2 Continued

Food groups based on EPIC-Soft Classification	Women								
						On consumption days			
	Mean	Median	P5	P95	% Consumption days	Mean	Median	P5	P95
070102. Veal	0	0	0	0	1	69	72	9	109
070103. Pork	12	0	0	56	16	78	76	8	161
070104. Mutton/Lamb	1	0	0	0	1	84	71	31	111
0702. Poultry	11	0	0	60	10	97	80	9	246
070200. Unclassified and other poultry	0	0	0	0	0	.	.	.	.
070201. Chicken, hen	10	0	0	60	10	97	80	8	254
070202. Turkey, young turkey	0	0	0	0	0	112	112	112	112
070203. Duck	0	0	0	0	0	76	76	76	76
070205. Rabbit (domestic)	0	0	0	0	0	102	102	102	102
0703. Game	0	0	0	0	0	264	264	264	264
0704. Processed meat	26	15	0	78	60	43	29	10	118
0705. Offals	0	0	0	0	1	89	108	7	123
08. Fish and shellfish	**22**	**0**	**0**	**100**	**18**	**122**	**111**	**22**	**209**
0801. Fish	18	0	0	100	15	117	100	19	216
0802. Crustaceans, molluscs	1	0	0	0	2	72	61	14	147
0803. Fish products, fish in crumbs	3	0	0	0	2	121	111	62	200
09. Eggs and egg products	**11**	**0**	**0**	**39**	**26**	**39**	**49**	**4**	**72**
0901. Egg	11	0	0	39	26	39	49	4	72
10. Fat	**25**	**24**	**8**	**51**	**99**	**25**	**22**	**6**	**54**
1000. Unclassified	1	0	0	7	17	7	6	1	20
1001. Vegetable oils	2	0	0	11	25	9	6	1	31
1002. Butter	6	0	0	27	30	17	12	3	39
1003. Margarines	16	16	0	41	82	20	18	2	45
1004. Deep frying fats	0	0	0	0	1	13	11	1	27
1006. Other animal fat	0	0	0	0	0	1	1	1	1
11. Sugar and confectionery	**30**	**22**	**1**	**83**	**88**	**36**	**27**	**5**	**100**
1100. Unclassified	0	0	0	0	2	11	5	1	28
1101. Sugar, honey, jam	13	10	0	44	62	23	20	3	53
1102. Chocolate, candy bars, paste, chocolate confetti/flocks	6	3	0	21	41	17	13	4	46
1103. Confectionery non-chocolate	2	0	0	8	23	8	6	3	21
1104. Syrup	5	0	0	27	21	23	18	8	60
1105. Ice cream, water ice	4	0	0	36	6	75	69	23	118
110500. Unclassified	0	0	0	0	1	46	38	32	49
110501. Ice cream	4	0	0	36	5	79	72	24	119
110502. Sorbet	0	0	0	0	0	47	39	32	49
110503. Water ice	0	0	0	0	0	52	50	50	54
12. Cakes	**46**	**35**	**0**	**120**	**86**	**50**	**40**	**8**	**143**
1201. Cakes, pies, pastries, etc.	29	19	0	104	51	53	39	19	136
1202. Dry cakes, biscuits	16	13	0	45	65	25	19	6	59
13. Non-alcoholic beverages	**1,510**	**1,368**	**768**	**2,582**	**100**	**1,497**	**1,369**	**714**	**2,582**
1300. Unclassified	2	0	0	0	2	175	117	100	276
1301. Fruit and vegetable containing drinks	69	0	0	285	39	187	165	32	409
1302. Carbonated/soft/isotonic drinks, diluted syrups	26	0	0	176	11	218	180	83	398
1303. Coffee, tea and herbal teas	844	746	234	2,091	100	848	768	282	1,810
130301. Coffee	347	323	0	751	89	400	373	85	829

Table D2 Continued

Food groups based on EPIC-Soft Classification	Women								
						On consumption days			
	Mean	Median	P5	P95	% Consumption days	Mean	Median	P5	P95
130302. Tea	428	291	0	1,727	73	567	464	146	1,353
130303. Herbal tea	67	0	0	403	19	374	328	76	920
130304. Chicory, substitutes	2	0	0	0	2	168	91	2	427
1304. Waters	569	501	0	1,511	92	601	499	99	1,497
14. Alcoholic beverages	**61**	**0**	**0**	**268**	**32**	**170**	**127**	**28**	**376**
1400. Unclassified	0	0	0	0	0	.	.	.	.
1401. Wine	41	0	0	230	21	184	141	65	373
1402. Fortified wines (sherry, port, vermouth)	8	0	0	70	7	110	85	38	234
1403. Beer, cider	8	0	0	0	1	386	329	29	567
1404. Spirits, brandy	2	0	0	10	3	43	28	24	86
1405. Aniseed drinks (pastis, ouzo)	0	0	0	0	0	.	.	.	.
1406. Liqueurs	2	0	0	0	3	61	54	4	130
15. Condiments and sauces	**23**	**14**	**0**	**63**	**63**	**36**	**24**	**2**	**107**
1501. Sauces	22	14	0	62	59	38	25	2	108
150100. Unclassified and other sauces	13	2	0	53	42	36	24	2	104
150101. Tomato sauces	2	0	0	2	4	35	14	3	84
150102. Dressing sauces	1	0	0	6	10	10	9	1	25
150103. Mayonnaises and similars	6	0	0	53	12	36	17	2	106
150104. Dessert sauces	0	0	0	0	1	26	18	9	29
1502. Yeast	0	0	0	0	0	10	10	10	10
1504. Condiments	0	0	0	3	10	5	3	0	12
16. Soups, bouillon	**84**	**0**	**0**	**319**	**33**	**247**	**231**	**105**	**487**
1601. Soups	78	0	0	290	29	258	256	114	488
1602. Bouillon	6	0	0	25	5	147	172	4	260
17. Miscellaneous	**11**	**0**	**0**	**65**	**9**	**138**	**102**	**32**	**329**
1700. Unclassified	0	0	0	0	1	72	74	28	92
1701. Soya products	6	0	0	26	5	184	143	35	393
1702. Dietetic products	2	0	0	0	1	145	71	2	318
170200. Unclassified	2	0	0	0	1	213	134	125	345
170201. Artificial sweeteners	0	0	0	0	0	4	2	2	6
1703. Snacks	3	0	0	31	3	82	69	60	135

Appendix E Intake of protein, energy, vitamin D and drinks by various characteristics of older adults

Table E.1 Intake of energy by various characteristics of older adults of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

		Energy (MJ)						Energy ratio[a]
		Model 1		Model 2		Model 3		Model 1
		(Adjusted for sex)		(Adjusted for sex and age)		(Adjusted for other factors shown)		(Adjusted for sex)
	n	Mean	P-value	Mean	P-value	Mean	P-value	Mean
Body mass index								
Under- or normal weight	186	8.4	0.03	8.4	0.02	8.4	0.03	1.5
Overweight or obese	523	8.1		8.0		8.1		1.3
Waist circumference								
Men <102cm; Women <88cm	267	8.4	0.05	8.4	0.04			1.5
Men ≥102cm; Women ≥88cm	456	8.0		8.0				1.3
Home-delivered hot meals								
Home-delivered hot meals: 1-7 days/week	37	8.6	0.42	8.7	0.33			1.4
Never home-delivered hot meals	701	8.1		8.1				1.4
Undernutrition								
No undernutrition	657	8.1	0.18	8.1	0.07			1.4
(Risk of) undernutrition	75	8.3		8.3				1.5
Type of housing								
Single-family dwelling, detached house, apartment, farm, flat	654	8.2	0.12	8.2	0.21			1.4
Service flat, elderly commune, flat for elderly/ pensioners/old people or living self-reliantly near a rest home	85	7.8		7.9				1.3
Marital status								
Married, registered cohabitation contracts, living together	454	8.1	0.77	8.0	0.41			1.4
Unmarried or never been married/ divorced or living apart/ widow/widower	285	8.2		8.3				1.4
Education level								
Low education	293	8.2	0.87	8.2	0.91			1.4
Moderate education	250	8.1		8.1				1.4
High education	256	8.1		8.1				1.4
Income								
Low	83	8.0	0.29	8.0	0.27			1.3
Moderate/high	647	8.2		8.2				1.4
Smoking								
Never smoked	253	8.1	0.98	8.1	0.73			1.4
Smoked in the past	410	8.1		8.2				1.4
Currently smokes	76	8.1		8.0				1.4

Table E.1 Continued

		Energy (MJ)						Energy ratio[a]
		Model 1		Model 2		Model 3		Model 1
		(Adjusted for sex)		(Adjusted for sex and age)		(Adjusted for other factors shown)		(Adjusted for sex)
	n	Mean	P-value	Mean	P-value	Mean	P-value	Mean
Use of alcohol								
<1 day/week with alcoholic drinks	293	7.9	0.06	7.9	0.10			1.3
1-5 days/week with alcoholic drinks	195	8.4		8.4				1.4
6-7 days/week with alcoholic drinks	251	8.3		8.3				1.4
Physical activity								
Inactive	158	7.7	0.06	7.7	0.07			1.3
Norm-active	580	8.3		8.2				1.4
Ability to climb stairs								
Able to climb stairs of 15 steps	610	8.3	0.02	8.3	0.03	8.5	0.05	1.4
Not able to climb stairs of 15 steps	128	7.3		7.4		7.5		1.3
Prevalence of chronic diseases								
None	227	8.3	0.27	8.2	0.55			1.4
1 chronic disease	250	8.1		8.1				1.4
≥2 chronic diseases	262	8.0		8.0				1.4
Sex								
Men	373	9.4	<0.001	9.3	<0.001	9.3	<0.001	1.4
Women	366	7.3		7.3		7.4		1.4
Age								
70-74 years	289	8.1	0.11			7.4	0.94	1.4
75-79 years	225	8.5				8.5		1.4
80+ years	225	7.8				7.5		1.4

[a] Energy intake/BMR

Table E.2 Intake of protein by various characteristics of older adults of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739).

		Protein (g/kg)						Protein (g/day)
		Model 1		Model 2		Model 3		Model 1
		(Adjusted for sex)		(Adjusted for sex and age)		(Adjusted for other factors shown)		(Adjusted for sex)
	n	Mean	P-value	Mean	P-value	Mean	P-value	Mean
Body mass index								
Under- or normal weight	186	1.22	<0.001	1.22	<0.001	1.20	<0.001	79
Overweight or obese	523	0.96		0.96		0.97		77
Waist circumference								
Men <102cm; Women <88cm	267	1.20	<0.001	1.20	<0.001			79
Men ≥102cm; Women ≥88cm	456	0.97		0.96				77
Home-delivered hot meals								
Home-delivered hot meals: 1-7 days/week	37	0.94	0.03	0.96	0.08	0.95	0.03	74
Never home-delivered hot meals	701	1.05		1.05		1.05		77
Undernutrition								
No undernutrition	657	1.02	<0.001	1.02	<0.001	1.04	0.08	77
(Risk of) undernutrition	75	1.17		1.19		1.09		78
Type of housing								
Single-family dwelling, detached house, apartment, farm, flat	654	1.05	0.29	1.05	0.82			77
Service flat, elderly commune, flat for elderly/pensioners/old people or living self-reliantly near a rest home	85	1.03		1.04				76
Marital status								
Married, registered cohabitation contracts, living together	454	1.03	0.47	1.02	0.24			77
Unmarried or never been married/ divorced or living apart/ widow/widower	285	1.06		1.07				77
Education level								
Low education	293	1.05	0.77	1.05	0.66			78
Moderate education	250	1.04		1.05				77
High education	256	1.03		1.02				76
Income								
Low	83	1.05	0.94	1.05	0.94			79
Moderate/high	647	1.05		1.05				77
Smoking								
Never smoked	253	0.99	0.03	0.99	0.02	1.03	0.69	75
Smoked in the past	410	1.07		1.07		1.05		78
Currently smokes	76	1.10		1.09		1.07		77

Table E.2 Continued

		Protein (g/kg)						Protein (g/day)
		Model 1		Model 2		Model 3		Model 1
		(Adjusted for sex)		(Adjusted for sex and age)		(Adjusted for other factors shown)		(Adjusted for sex)
	n	Mean	P-value	Mean	P-value	Mean	P-value	Mean
Use of alcohol								
<1 day/week with alcoholic drinks	293	1.06	0.03	1.06	0.02	1.05	0.001	77
1-5 days/week with alcoholic drinks	195	1.07		1.06		1.09		81
6-7 days/week with alcoholic drinks	251	1.00		1.00		0.99		73
Physical activity								
Inactive	158	0.97	0.19	0.98	0.21			72
Norm-active	580	1.06		1.06				78
Ability to climb stairs								
Able to climb stairs of 15 steps	610	1.07	0.04	1.07	0.08	1.06	0.17	79
Not able to climb stairs of 15 steps	128	0.93		0.94		0.97		68
Prevalence of chronic diseases								
None	227	1.06	0.71	1.06	0.68			79
1 chronic disease	250	1.03		1.03				77
≥2 chronic diseases	262	1.04		1.05				75
Sex								
Men	373	1.02	0.53	1.02	0.47			84
Women	366	1.06		1.06				73
Age								
70-74 years	289	1.05	0.06					80
75-79 years	225	1.07						80
80+ years	225	1.02						71

Table E.3 Intake of vitamin D by various characteristics of older adults of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739).

		Vitamin D from foods and dietary supplements (µg)					
		Model 1		Model 2		Model 3	
		(Adjusted for sex)		(Adjusted for sex and age)		(Adjusted for other factors shown)	
	n	Mean	P-value	Mean	P-value	Mean	P-value
Body mass index							
Under- or normal weight	186	3.8	0.56	3.9	0.62		
Overweight or obese	523	4.1		4.1			
Waist circumference							
Men <102cm; Women <88cm	267	3.6	0.02	3.6	0.01	3.7	0.02
Men ≥102cm; Women ≥88cm	456	4.3		4.3		4.3	
Home-delivered hot meals							
Home-delivered hot meals: 1-7 days/week	37	4.4	0.46	4.8	0.17		
Never home-delivered hot meals	701	4.0		4.0			
Undernutrition							
No undernutrition	657	4.0	0.91	4.0	0.33		
(Risk of) undernutrition	75	3.9		4.1			
Type of housing							
Single-family dwelling, detached house, apartment, farm, flat	654	4.1	0.06	4.1	0.17		
Service flat, elderly commune, flat for elderly/pensioners/old people or living self-reliantly near a rest home	85	3.4		3.6			
Marital status							
Married, registered cohabitation contracts, living together	454	4.2	0.13	4.0	0.68		
Unmarried or never been married/ divorced or living apart/ widow/widower	285	3.8		3.9			
Education level							
Low education	293	4.3	0.02	4.3	<0.05	4.2	0.15
Moderate education	250	3.7		3.7		3.9	
High education	256	4.1		4.0		4.0	
Income							
Low	83	3.5	0.13	3.5	0.13		
Moderate/high	647	4.1		4.1			
Smoking							
Never smoked	253	4.2	0.61	4.2	0.50		
Smoked in the past	410	3.9		3.9			
Currently smokes	76	3.8		3.6			

Table E.3 Continued

	n	Vitamin D from foods and dietary supplements (µg)					
		Model 1 (Adjusted for sex)		Model 2 (Adjusted for sex and age)		Model 3 (Adjusted for other factors shown)	
		Mean	P-value	Mean	P-value	Mean	P-value
Use of alcohol							
<1 day/week with alcoholic drinks	293	3.7	0.04	3.7	0.03	3.8	0.04
1-5 days/week with alcoholic drinks	195	4.7		4.7		4.7	
6-7 days/week with alcoholic drinks	251	3.9		3.8		4.0	
Physical activity							
Inactive	158	3.7	0.05	3.7	0.07		
Norm-active	580	4.1		4.1			
Time outdoors							
Every day outdoors	536	4.2	0.03	4.2	0.06	4.1	0.24
Not every day outdoors	203	3.4		3.5		3.8	
Ability to climb stairs							
Able to climb stairs of 15 steps	610	4.1	0.08	4.0	0.25		
Not able to climb stairs of 15 steps	128	3.6		3.7			
Prevalence of chronic diseases							
None	227	3.9	0.69	3.8	0.46		
1 chronic disease	250	4.2		4.2			
≥2 chronic diseases	262	3.9		4.0			
Sex							
Men	373	4.7	<0.01	4.7	0.01	4.8	0.02
Women	366	3.5		3.6		3.6	
Age							
70-74 years	289	4.2	<0.001			4.1	0.002
75-79 years	225	4.6				4.6	
80+ years	225	3.3				3.5	

Table E.4 Consumption of drinks by various characteristics of older adults of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739).

		Drinks in g/day[a]					
		Model 1		Model 2		Model 3	
		(Adjusted for sex)		(Adjusted for sex and age)		(Adjusted for other factors shown)	
	n	Mean	P-value	Mean	P-value	Mean	P-value
Body mass index							
Under- or normal weight	186	1,577	0.81	1,592	0.72		
Overweight or obese	523	1,544		1,534			
Waist circumference							
Men <102cm; Women <88cm	267	1,588	0.67	1,605	0.60		
Men ≥102cm; Women ≥88cm	456	1,532		1,523			
Home-delivered hot meals							
Home-delivered hot meals: 1-7 days/week	37	1,288	0.01	1,337	0.10	1,254	0.07
Never home-delivered hot meals	701	1,549		1,547		1,551	
Undernutrition							
No undernutrition	657	1,509	0.30	1,502	0.23		
(Risk of) undernutrition	75	1,778		1,820			
Type of housing							
Single-family dwelling, detached house, apartment, farm, flat	654	1,488	0.01	1,484	<0.01	1,480	< 0.01
Service flat, elderly commune, flat for elderly/pensioners/old people or living self-reliantly near a rest home	85	1,819		1,840		1,861	
Marital status							
Married, registered cohabitation contracts, living together	454	1,521	0.35	1,503	0.16		
Unmarried or never been married/ divorced or living apart/ widow/widower	285	1,561		1,582			
Education level							
Low education	293	1,481	0.25	1,491	0.15		
Moderate education	250	1,652		1,645			
High education	256	1,475		1,465			
Income							
Low	83	1,513	0.82	1,537	0.96		
Moderate/high	647	1,547		1,543			
Smoking							
Never smoked	253	1,437	0.06	1,427	0.02		
Smoked in the past	410	1,624		1,626			
Currently smokes	76	1,450		1,470			

Table E.4 Continued

	n	Drinks in g/day[a]					
		Model 1 (Adjusted for sex)		Model 2 (Adjusted for sex and age)		Model 3 (Adjusted for other factors shown)	
		Mean	P-value	Mean	P-value	Mean	P-value
Use of alcohol							
<1 day/week with alcoholic drinks	293	1,462	0.01	1,478	0.01		
1-5 days/week with alcoholic drinks	195	1,510		1,490			
6-7 days/week with alcoholic drinks	251	1,690		1,681			
Physical activity							
Inactive	158	1,459	0.08	1,457	<0.05		
Norm-active	580	1,561		1,562			
Ability to climb stairs							
Able to climb stairs of 15 steps	610	1,531	0.58	1,528	0.47		
Not able to climb stairs of 15 steps	128	1,572		1,589			
Prevalence of chronic diseases							
None	227	1,463	0.11	1,453	0.02		
1 chronic disease	250	1,490		1,481			
≥2 chronic diseases	262	1,649		1,666			
Sex							
Men	373	1,487	0.20	1,484	0.07		
Women	366	1,573		1,575			
Age							
70-74 years	289	1,677	0.02			1,681	0.02
75-79 years	225	1,405				1,430	
80+ years	225	1,502				1,478	

[a] See definition in Appendix B.

Appendix F Intake of main dietary factors by potential factors of selection bias.

Table F.1 Mean intake of main dietary factors by age groups of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Dietary factor	Unit	70-74 years n=289	75-79 years n=225	80+ years n=225	P-value
Fruit	g	164	171	142	0.47
Vegetables	g	173	158	126	<0.001
Dietary fibre	g/MJ	2.2	2.1	1.9	0.12
Fish	g	26	22	17	0.23
Drinks	g	1,677	1,405	1,502	0.02
Alcoholic beverages	g	15	10	8	<0.01
Energy	MJ	8.1	8.5	7.8	0.11
Energy ratio	(Energy intake/BMR)	1.36	1.42	1.37	0.68
Protein	g/kg body weight	1.05	1.07	1.02	0.06
Protein	g	80	80	71	<0.01
Total Fat	En%	33.4	34.7	36.2	0.14
Saturated fatty acids	En%	13.1	13.5	15.1	<0.01
Trans-fatty acids	En%	0.6	0.6	0.7	<0.001
Retinol activity equivalents	µg	948	922	848	0.50
Vitamin B1	mg	1.0	1.2	1.0	<0.05
Vitamin C	mg	103	100	103	0.66
Vitamin D	µg	4.2	4.6	3.3	<0.01
Calcium	mg	1,022	1,021	901	<0.01
Magnesium	mg	325	320	289	<0.001
Selenium	µg	48	47	40	<0.01
Potassium	mg	3,323	3,351	2,880	<0.001
Sodium [a]	mg	2,310	2,535	2,178	<0.01

[a] Sodium of added salt not included

Table F.2 Mean intake of main dietary factors by education level of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=699), weighted.

Dietary factor	Unit	Low education n=293	Moderate education n=250	High education n=156	P-value
Fruit	g	163	154	164	0.91
Vegetables	g	146	153	163	0.07
Dietary fibre	g/MJ	2.1	2.1	2.1	0.96
Fish	g	19	21	27	0.49
Drinks	g	1,481	1,652	1,475	0.25
Alcoholic beverages	g	8	12	13	0.03
Energy	MJ	8.2	8.1	8.1	0.87
Energy ratio	Energy intake/BMR	1.38	1.37	1.38	0.98
Protein	g/kg body weight	1.05	1.04	1.03	0.77
Protein	g	78	77	76	0.77
Total Fat	En%	34.0	35.5	34.9	0.56
Saturated fatty acids	En%	13.1	14.6	14.1	0.25
Trans-fatty acids	En%	0.6	0.7	0.7	0.45
Retinol activity equivalents	µg	896	838	1,055	0.50
Vitamin B1	mg	1.2	0.9	1.0	<0.001
Vitamin C	mg	94	107	112	0.15
Vitamin D	µg	4.3	3.7	4.1	0.02
Calcium	mg	979	955	1,018	0.42
Magnesium	mg	314	303	322	0.10
Selenium	µg	45	45	45	1.00
Potassium	mg	3,270	3,124	3,149	0.17
Sodium [a]	mg	2,460	2,270	2,268	0.07

[a] Sodium of added salt not included

Table F.3 Mean intake of main dietary factors by prevalence of chronic diseases of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=739), weighted.

Dietary factor	Unit	No chronic diseases n=227	1 chronic disease n=250	≥2 chronic diseases n=262	P-value
Fruit	g	172	152	151	0.48
Vegetables	g	157	159	142	<0.01
Dietary fibre	g/MJ	2.1	2.1	2.0	0.29
Fish	g	24	21	21	0.70
Drinks	g	1,463	1,490	1,649	0.11
Alcoholic beverages	g	14	10	9	0.04
Energy	MJ	8.3	8.1	8.0	0.27
Energy ratio	(Energy intake/BMR)	1.40	1.36	1.38	0.71
Protein	g/kg body weight	1.06	1.03	1.04	0.71
Protein	g	79	77	75	0.51
Total Fat	En%	33.9	34.5	35.6	0.63
Saturated fatty acids	En%	13.4	13.6	14.5	0.55
Trans-fatty acids	En%	0.7	0.7	0.7	0.93
Retinol activity equivalents	µg	900	907	910	0.99
Vitamin B1	mg	1.0	1.1	1.0	0.25
Vitamin C	mg	102	100	104	0.75
Vitamin D	µg	3.9	4.2	3.9	0.69
Calcium	mg	1,035	974	935	0.45
Magnesium	mg	318	324	294	< 0.01
Selenium	µg	45	44	45	0.81
Potassium	mg	3,294	3,252	3,008	0.17
Sodium[a]	mg	2,419	2,289	2,280	0.46

[a] Sodium of added salt not included

Table F.4 Mean intake of main dietary factors by ability to climb stairs of 15 steps, of Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012, n=738), weighted.

Dietary factor	Unit	Able to climb stairs of 15 steps n=610	Not able to climb stairs of 15 steps n=128	P-value
Fruit	g	158	158	0.98
Vegetables	g	158	128	0.04
Dietary fibre	g/MJ	2.1	2.0	0.17
Fish	g	22	22	0.93
Drinks	g	1,531	1,572	0.58
Alcoholic beverages	g	12	6	0.02
Energy	MJ	8.3	7.3	0.02
Energy ratio	(Energy intake/BMR)	1.40	1.26	0.03
Protein	g/kg body weight	1.07	0.93	<0.05
Protein	g	79	68	0.03
Total Fat	En%	34.6	35.2	0.32
Saturated fatty acids	En%	13.9	13.9	0.95
Trans-fatty acids	En%	0.7	0.6	0.39
Retinol activity equivalents	µg	909	890	0.84
Vitamin B1	mg	1.0	1.0	0.92
Vitamin C	mg	104	95	0.38
Vitamin D	µg	4.1	3.6	0.08
Calcium	mg	1,008	843	0.02
Magnesium	mg	318	277	0.03
Selenium	µg	46	41	0.15
Potassium	mg	3,241	2,868	0.07
Sodium[a]	mg	2,354	2,201	0.16

[a] Sodium of added salt not included

Appendix G Comparison DNFCS-Older adults and DNFCS-Core survey[a]

Table G.1 Food consumption of Dutch adults aged 51-69 years (DNFCS-Core survey 2007-2010), and Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

		DNFCS-Core Survey		DNFCS-Older adults	
		Men	Women	Men	Women
		n=351	n=353	n=373	n=366
Food groups based on		51-69 years	51-69 years	70 years and older	70 years and older
EPIC-Soft Classification		Median g/day	Median g/day	Median g/day	Median g/day
1	Potatoes and other tubers	97	72	104	71
2	Vegetables	126	138	136	143
3	Legumes	0	0	0	0
4	Fruits, nuts and olives	102	134	141	167
5	Dairy products	378	298	345	328
6	Cereals and cereal products	198	153	179	137
7	Meat and meat products	118	80	89	74
8	Fish and shellfish	0	0	0	0
9	Eggs and egg products	0	0	0	2
10	Fat	30	20	32	24
11	Sugar and confectionery	31	20	41	23
12	Cakes	35	35	37	39
13	Non-alcoholic beverages	1431	1662	1250	1359
14	Alcoholic beverages	180	60	96	0
15	Condiments and sauces	22	16	20	13
16	Soups, bouillon	0	0	0	0
17	Miscellaneous	0	0	0	0

[a] Van Rossum C.T.M., Fransen H.P., Verkaik-Kloosterman J., Buurma-Rethans E.J.M., and Ocké M. Dutch National Food Consumption Survey. Diet of children and adults aged 7 to 69 years. Bilthoven: RIVM, 2011, RIVM report 350050006/2011.

Table G.2 Intake of energy and macronutrients of Dutch adults aged 51-69 years (DNFCS-Core survey 2007-2010), and Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	DNFCS-Core Survey		DNFCS-Older adults	
	Men	Women	Men	Women
	51-69 years	51-69 years	70 years and older	70 years and older
	n=351	n=353	n=373	n=366
Nutrient	Median	Median	Median	Median
Energy (kcal/day)	**2,390**	**1,849**	**2,176**	**1,743**
Protein (g/day)	**95**	**74**	**82**	**70**
Vegetable protein (g/day)	33	26	30	25
Animal protein (g/day)	62	47	55	45
Fat (g/day)	**92**	**70**	**83**	**67**
Saturated fatty acids (g/day)	35	27	32	26
Unsaturated fatty acids-cis (g/day)	50	37	44	34
Poly unsaturated fatty acids (g/day)	18	13	16	12
Trans-fatty acids (g/day)	2	1	1	1
Alpha linolenic acid (g/day)	2	2	2	2
EPA and DHA (mg/day)	110	107	170	142
Linoleic acid (g/day)	15	11	13	10
Carbohydrates (g/day)	**240**	**195**	**230**	**190**
Mono- and disaccharides (g/day)	103	90	105	93
Polysaccharides (g/day)	136	103	123	96
Dietary fibre (g/day)	**21**	**19**	**22**	**19**
Alcohol (g/day)	**21**	**9**	**13**	**2**

Table G.3 Intake of micronutrients of Dutch adults aged 51-69 years (DNFCS-Core survey 2007-2010) and Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	DNFCS-Core Survey		DNFCS-Older adults	
	Men 51-69 years n=351	Women 51-69 years n=353	Men 70 years and older n=373	Women 70 years and older n=366
Nutrient	Median	Median	Median	Median
Retinol activity equivalents (µg/day)	891	742	946	722
Vitamin B1 (mg/day)	1.2	1.0	1.1	0.9
Vitamin B2 (mg/day)	1.7	1.4	1.5	1.3
Vitamin B6 (mg/day)	2.2	1.7	2.0	1.6
Folate equivalents (µg/day)	309	262	337	290
Vitamin B12 (µg/day)	5.4	4.2	5.0	4.1
Vitamin C (mg/day)	90	94	96	99
Vitamin D (µg/day)	4.1	3.2	4.3	3.3
Vitamin E (mg/day)	14.0	11.5	13.7	10.9
Calcium (mg/day)	1,099	985	995	900
Copper (mg/day)	1.2	1.1	1.2	1.0
Iodine from foods (µg/day)	173	146	169	141
Iron (mg/day)	11.6	10.1	10.9	9.1
Magnesium (mg/day)	380	316	340	290
Phosphorus (mg/day)	1,719	1,364	1,511	1,278
Potassium (mg/day)	3,823	3,200	3,446	3,005
Selenium (µg/day)	52	42	46	40
Sodium from foods (mg/day)	2,850	2,243	2,537	2,034

Table G.4 Average contribution of consumption not at home to the food consumption of Dutch adults aged 51-69 years (DNFCS-Core survey 2007-2010) and Dutch adults aged 70 years and older (DNFCS-Older adults 2010-2012), weighted.

	DNFCS-Core Survey		DNFCS-Older adults	
	Men 51-69 years n=351	Women 51-69 years n=353	Men 70 years and older n=373	Women 70 years and older n=366
Food groups based on EPIC-Soft Classification	Mean %	Mean %	Mean %	Mean %
01. Potatoes and other tubers	13	13	3	10
02. Vegetables	15	16	4	9
03. Legumes	12	23	9	2
04. Fruits, nuts and olives	25	17	4	5
05. Dairy products	16	15	5	7
06. Cereals and cereal product	22	19	5	5
07. Meat and meat products	20	19	7	13
08. Fish and shellfish	32	40	8	21
09. Eggs and egg products	18	16	8	10
10. Fat	20	17	4	8
11. Sugar and confectionery	22	23	10	11
12. Cakes	33	42	19	23
13. Non-alcoholic beverages	26	23	10	10
14. Alcoholic beverages	30	27	20	41
15. Condiments and sauces	19	20	7	16
16. Soups, bouillon	29	22	10	15
17. Miscellaneous	33	24	23	23

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Community-dwelling Dutch adults over the age of 70 consume more unhealthy saturated fatty acids and more salt than recommended, and less wholemeal products, fruit and fish than recommended. This group is therefore advised to comply with the same recommendations for diet improvement as the general Dutch population. One in five older adults has serious overweight. A healthy diet and sufficient physical exercise are important for all ages to prevent chronic diseases and disabilities. One in four Dutch adults over the age of 70 complies with the recommendation to take vitamin D supplements. A sufficient intake of vitamin D reduces the risk of falling and fractures.

These are some of the results of a diet survey conducted by the Dutch National Institute for Public Health and the Environment (RIVM) among some 700 community-dwelling adults over the age of 70. Most of the respondents were relatively vital.

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