Article

Dietary Intake in the Lifelines Cohort Study: Baseline Results from the Flower Food Frequency Questionnaire among 59,982 Participants

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Abstract: The role of nutrition in health and disease is well established. However, more research on this topic is needed to fill gaps in our current knowledge. The Lifelines cohort study, a large Dutch prospective cohort study, was established as a resource for international researchers, aiming to obtain insight into the aetiology of healthy ageing. The study started with 167,729 participants, covering three generations, aiming to follow them for thirty years. This article describes the habitual dietary intake, assessed using the Flower Food Frequency Questionnaire (FFQ), among Lifelines cohort study participants at baseline, stratified by sex and different categories of age, socioeconomic status (SES) and body mass index (BMI). A total of 59,982 adults (23,703 men and 36,279 women), who completed the Flower FFQ and reported plausible habitual dietary intake, were included in the analyses. Median daily energy intake was higher in men (2368 kcal) than in women (1848 kcal), as well as macronutrient intake. Energy and macronutrient intake decreased with increasing age and BMI categories; no differences were observed between SES categories. Intake of most micronutrients was higher in men than in women. Differences were observed between age categories, but not between SES and BMI categories. Food groups were consumed in different amounts by men and women; differences between age, SES and BMI categories were observed as well. The Lifelines cohort study provides extensive dietary intake data, which are generalisable to the general Dutch population. As such, highly valuable dietary intake data are available to study associations between dietary intake and the development of chronic diseases and healthy aging.

Keywords: dietary intake; micronutrients; macronutrients; food groups; nutrition survey

1. Introduction

Nutrition plays an important role in health status, and an unhealthy diet is one of the key determinants of non-communicable morbidity and mortality [1]. For example, dietary patterns consisting of energy-dense, high-fat diets, with low fruit and vegetable intakes, are associated with an increased risk of developing diet-related non-communicable diseases such as cardiovascular diseases, type 2 diabetes and some cancers [2]. Although the existence of a relationship between nutrition and health status is evident, more research on this topic is warranted to fill the gaps in knowledge. For instance, only few well-established clear links between nutrition and cancer exist. Future research might show further important risk factors or protective factors, for example specific food components or broader dietary patterns such as plant-based diets [3]. Regarding type 2 diabetes, several associations between dietary factors and this disease have been reported; however, only few of these associations were graded as high quality of evidence. More well-conducted research, with more detailed assessment of diet, is needed to achieve high quality of evidence for these associations and to be able to give strong dietary recommendations [4]. Moreover,
in a review article on diet and cardiovascular disease, it was concluded that future research is indispensable for furthering our understanding of the role of diet in this disease and for translating nutritional science into practice [5]. The above applies to many other diseases as well. Furthermore, many interactions with other factors, such as genetic background [6] or gut microbiome [7], have not yet been elucidated. Large epidemiological studies offer the opportunity to further investigate associations between nutrition and health status and interactions with other factors, and to disentangle underlying pathways [8].

The Lifelines cohort study, a multi-disciplinary prospective population-based cohort study in the north of The Netherlands, was established in 2006 as a resource for international researchers, aiming to obtain insight into the aetiology of healthy ageing [9]. It employs a broad range of investigative procedures in assessing the behavioural, socio-demographic, biomedical, physical and psychological factors which contribute to the health and disease of the general population, with a special focus on multi-morbidity and complex genetics. The study started with 167,729 participants, covering three generations, aiming to follow them for at least thirty years. Questionnaires on demographics, health and lifestyle, including dietary intake, are administered every eighteen months, and physical measurements as well as biological sampling are scheduled every five years. With this large body of data, the Lifelines database offers a unique opportunity to study complex interactions between environmental, phenotypic and genomic factors in the development of chronic diseases and healthy ageing, including diet–disease associations.

Within the Lifelines cohort study, data on habitual dietary intake is collected using the Flower Food Frequency Questionnaire (FFQ) [10]. This FFQ was especially developed for the Lifelines cohort study as an alternative to the regular comprehensive FFQ, which is a long and time-consuming questionnaire. The Flower FFQ consists of one main questionnaire and three short complementary questionnaires that are administered at different time points during a five-year period, reducing the time for filling out the questionnaire per occasion and with that participant burden. This is important as participants of the Lifelines cohort study must fill out many other questionnaires and undergo several physical measurements. Based on the literature, stable food consumption patterns over time can be assumed [11]. As such, a valid long-term estimate of the habitual dietary intake of participants is obtained, including data on the intake of energy, several macro- and micronutrients, and food items. Both the breadth of available variables and the large sample size of the Lifelines cohort provide the opportunity to perform well-powered stratified analyses to thoroughly investigate associations between dietary intake and the development of chronic diseases and healthy aging. The purpose of this article is to describe dietary intake among Lifelines cohort study participants at baseline. Data are presented separately for men and women and stratified by different categories of age, socioeconomic status (SES) and body mass index (BMI).

2. Methods
2.1. Study Population

By the end of 2006, recruitment of participants for the Lifelines cohort study started among inhabitants of the northern three provinces of The Netherlands (Friesland, Groningen and Drenthe). All general practitioner’s practices in this area that used computerised patient records (over 80% of practices) were requested to help with the recruitment. Within these practices, all patients in the age range of 25–50 years were invited by their general practitioner. Exclusion criteria included having a severe mental or physical illness, limited life expectancy (<5 years), and insufficient knowledge of the Dutch language to complete a Dutch questionnaire. Eligible participants received a first questionnaire and were invited to a Lifelines research facility for a comprehensive health assessment. During this visit, participants were also asked to indicate whether family members would be willing to participate in the study, and in case of a positive response, family members were invited as well. Children were only allowed to participate if one of their parents was included in the study. In addition to this recruitment strategy, inhabitants of the three northern provinces
could also register themselves via the Lifelines website. In December 2013, the recruitment period was closed after reaching the target number of 165,000 participants. At that time, the total number of participants included was 167,729. A more detailed description of the total study population of the Lifelines cohort study can be found elsewhere [9].

The Lifelines cohort study is conducted according to the principles of the Declaration of Helsinki and in accordance with the research code of the University Medical Center Groningen (UMCG). The Lifelines cohort study is approved by the medical ethical committee of the UMCG, the Netherlands. All participants gave written informed consent.

2.2. Assessment of Dietary Intake

Dietary intake at baseline was assessed using the validated Flower FFQ (Figure 1) [10]. The name Flower FFQ is derived from its design. The FFQ consists of one main questionnaire, which symbolises the heart of the flower, and three complementary questionnaires, which symbolise the flower petals. The heart FFQ contains 110 food items used to estimate intakes of major food groups, energy, carbohydrates, fat, protein and alcohol, but not in much detail. The three petal FFQs ask for detailed information on the types of food consumed within the food groups of the heart FFQ and also for supplement intake, to be able to estimate the intake of specific (micro)nutrients and food components. Thus, the difference between the heart FFQ and the petal FFQs is the degree of detail requested. For example, the heart FFQ provides basic information about the total amount of bread consumed, without information about the type of bread. More detailed information about bread type is provided by the third FFQ petal, in which the question “Did you eat bread?” is followed by questions on the type of bread (e.g., white, whole wheat). The first petal FFQ contains 59 food items used to estimate intakes of different types of fatty acids and caffeine; the second petal FFQ contains 61 food items used to estimate intakes of B-vitamins, calcium and soy; the third petal FFQ contains 64 food items used to estimate intakes of vitamin A, vitamin C, vitamin E and dietary fibre. Combined, the heart FFQ and the three petal FFQs cover 212 food items.

All adult participants of the Lifelines cohort study were invited to complete the Flower FFQ. The reference period of the heart and petal FFQs is one month, but it is assumed that food consumption patterns are stable over a longer period of time [11]. Therefore, the heart FFQ and the petal FFQs can be filled out at different moments during a study period. At the first assessment (between 2007 and 2013), participants received an invitation to fill out the heart FFQ. During three subsequent assessments (2011–2014, 2012–2015 and 2014–2017), they received an invitation to fill out one of the petal FFQs. The three petal FFQs were randomly distributed to adult participants during these subsequent assessments so that each participant received the petals in one out of six possible orders. Within the four different assessments, participants filled out the FFQs at time points that were fairly evenly distributed over the years and seasons. These four assessments are referred to as the baseline for dietary intake. At future assessments in the coming years, participants will be invited to complete the heart FFQ and the petal FFQs again, which will be referred to as follow-ups for dietary intake. Not all participants completed the four questionnaires. In this article, dietary intake from participants who completed the total Flower FFQ, i.e., the heart FFQ and all three petal FFQs, is described.

With combined data obtained from the heart FFQ and the three petal FFQs, the frequency of consumption of food items was assessed. Questions pertaining to frequency were completed by selecting answers ranging from “never” to “6–7 days per week”. Portion sizes were estimated using natural portions and commonly used household measures. In case a food item was reported in either only the heart FFQ or only in the petal FFQ, the food item was considered to be not consumed.
From data on food consumption obtained with the Flower FFQ, average daily intake of foods was calculated. The 212 food items were categorised into 30 food groups (Supplementary Table S1). Data on food consumption were also converted into daily energy and nutrient intake using data from the Dutch food composition database of 2011 [12].

To correct for potential under- or overreporting, we excluded participants with implausible habitual dietary intake, i.e., with energy intake <800 and >4200 kcal for men and <500 and >3500 kcal for women [13,14].

2.3. Assessment of Other Characteristics

Data on sex, age, ethnicity, SES, smoking and physical activity were obtained from questionnaires. Age was categorised into age groups used by the Health Council of the Netherlands for the recommendation of nutrients, as follows: 18–50 years, 51–70 years and >70 years [15]. SES was categorised based on education attainment, because education is more differentiating than income in the Dutch population [16], as follows: no education, primary education, lower vocational education, lower general secondary education (low); intermediate vocational education, higher general secondary education (moderate); higher vocational education and university education (high). Smoking was categorised as current, former and never smoker and included use of cigarettes, cigarillos, cigars and pipe tobacco. Physical activity was assessed with the short questionnaire to assess health-enhancing physical activity (SQUASH). The SQUASH has been shown to be substantially correlated with physical activity measured by accelerometry (correlation coefficient = 0.45) [17]. Using the SQUASH, the average number of minutes per week of various domains of physical
activity (e.g., commuting, work, household chores, leisure time including, e.g., gardening and sports) were assessed. Based on Ainsworth’s compendium of physical activities [18], metabolic equivalent of task (MET) values were assigned to the specific physical activities. Subsequently, the total number of minutes per week of moderate to vigorous physical activity (MVPA) was calculated, using MET values of ≥4.0 to <6.5 for moderate physical activity and MET values ≥6.5 for vigorous physical activity.

Anthropometric measurements were conducted by well-trained staff at Lifelines research facilities. Height and body weight were measured without shoes and heavy clothing. Height was measured using the SECA 222 stadiometer (Seca GmbH, Hamburg, Germany); body weight was measured using the SECA 761 scale (Seca GmbH, Hamburg, Germany). BMI was calculated as kg/m² and then categorised into normal weight (BMI < 25 kg/m²), overweight (25 ≤ BMI < 30 kg/m²) and obesity (BMI ≥ 30 kg/m²) [19].

2.4. Statistical Analyses

Data were first checked for normality using a Kolmogorov–Smirnov test and visual inspection of Q-Q normality plots. All continuous variables showed a skewed distribution and are therefore presented as medians with 25th–75th percentiles. Categorical variables are presented as numbers with percentages.

To explore potential selection bias, characteristics of participants who completed the total Flower FFQ and who did not complete the total Flower FFQ were compared first, using a Mann–Whitney U test for continuous variables and a Chi-square test for categorical variables, for men and women separately. Thereafter, analyses were performed among participants who completed the total Flower FFQ.

Daily energy and nutrient intake, as well as intake of food groups, were compared between men and women using a Mann–Whitney U test. Dietary intake was also compared between different categories of age, SES and BMI, using a Kruskal–Wallis test, for men and women separately. To identify which categories were different from each other, post hoc pairwise comparisons were performed, using a Bonferroni correction to adjust for multiple testing.

The results of all statistical tests were considered significant when the level of significance was lower than 5%, i.e., p < 0.05. Statistical analyses were performed with SPSS software (Version 25, IBM, Armonk, NY, USA).

3. Results

Figure 2 presents the participant flow. A total of 144,093 adults completed the heart FFQ. For 15,220 of these participants (11%), misreporting was highly likely because they reported unlikely low or high energy intake; 128,873 participants (89%) reported plausible habitual dietary intake. A total of 68,698 adults completed the total Flower FFQ. For 8716 of these participants (13%), misreporting was highly likely; 59,982 participants (87%) reported plausible habitual dietary intake. In this article, we primarily focus on the dietary intake data of these 59,982 participants (23,703 men and 36,279 women). Because of the large study population, almost all statistical tests were significant, even if differences were very small. Therefore, only striking and relevant differences are described.

Participants received an invitation to fill out the heart FFQ at the first assessment (between 2007 and 2013). During three subsequent assessments (2011–2014, 2012–2015 and 2014–2017), they received an invitation to fill out one of the petal FFQs. The three petal FFQs were randomly distributed to the participants during the follow-up so that each participant received the petals in one out of six possible orders.
3.1. Participant Characteristics

Table 1 presents characteristics of participants with plausible habitual dietary intake who completed the total Flower FFQ and who did not complete the total Flower FFQ. For participants who completed the total Flower FFQ, the median (25th–75th percentile) age was 47 (39–56) years for men and 46 (38–54) years for women. The majority of the participants were of white or east/west European ethnicity (98% for men, 97% for women). The distribution over the northern three provinces and over the three SES categories was approximately equal. The median (25th–75th percentile) MVPA was 285 (120–627) minutes per week for men and 245 (115–520) minutes per week for women, and the median (25th–75th percentile) BMI was 25.9 (23.9–28.2) kg/m$^2$ for men and 24.8 (22.5–27.9) kg/m$^2$ for women.

Compared to participants who did not complete the total Flower FFQ, the median age of participants who completed the total Flower FFQ was a little higher. Accordingly, for completers, the percentage of participants was lower in the 18–50 years age category and higher in the 51–70 years age category compared to non-completers. However, in both groups, most participants were classified in the 18–50 years age group. In general, completers had a higher SES compared to non-completers, and this difference was more pronounced in men than in women. Among completers, less current smokers but more former smokers were present than among non-completers, and completers were slightly more physically active than non-completers. The distribution of participants over the northern three provinces of the Netherlands, and the median BMI was comparable between the two groups. Data on ethnicity were missing for a large number of participants who did not complete the total Flower FFQ, and it is therefore hard to compare ethnicity between the two groups.
Table 1. Characteristics of participants with plausible habitual dietary who completed the total Flower FFQ (n = 59,982) and who did not complete the total Flower FFQ (n = 68,891).

|                  | Men (n = 53,026) | Women (n = 75,847) |
|------------------|------------------|--------------------|
|                  | Completed (n = 23,703) | Did Not Complete (n = 29,323) | Completed (n = 36,279) | Did Not Complete (n = 39,568) |
| **Median/n**     | **25th–75th Percentile/%** | **Median/n**     | **25th–75th Percentile/%** | **Median/n**     | **25th–75th Percentile/%** |
| **Age (years)**  | 47 39–56          | 44 34–51          | 46 38–54          | 43 33–50          |
| **Age category** |                  |                   |                  |                   |
| 18–50 years      | 14,890 62.8       | 21,550 73.5       | 24,361 67.1       | 30,199 76.3       |
| 51–70 years      | 8144 34.3         | 6738 23.0         | 11,185 30.8       | 8344 21.1         |
| >70 years        | 669 2.8           | 1035 3.5          | 733 2.0           | 1025 2.6          |
| **Province**     |                  |                   |                  |                   |
| Friesland        | 8743 36.9         | 10,847 37.0       | 13,562 37.4       | 14,683 37.1       |
| Groningen        | 7461 31.5         | 8679 29.6         | 11,246 31.0       | 11,555 29.2       |
| Drenthe          | 6991 29.5         | 8820 30.1         | 10,641 29.3       | 11,978 30.3       |
| Other            | 502 2.1           | 725 2.5           | 812 2.2           | 1055 2.7          |
| Unknown          | 6 0.0             | 252 0.9           | 15 0.0            | 297 0.8           |
| **Ethnicity**    |                  |                   |                  |                   |
| White, East/West European | 23,232 98.0 | 20,286 69.2 | 35,167 96.9 | 28,212 71.3 |
| Other            | 308 1.3           | 448 1.5           | 628 1.7           | 789 2.0           |
| Unknown          | 163 0.7           | 8589 29.3         | 484 1.3           | 10,567 26.7       |
| **SES**          |                  |                   |                  |                   |
| Low              | 6590 27.8         | 8515 29.0         | 10,500 28.9       | 11,475 29.0       |
| Moderate         | 8563 36.1         | 11,317 38.6       | 14,314 39.5       | 16,167 40.9       |
| High             | 8143 34.4         | 8781 29.9         | 10,861 29.9       | 11,047 27.9       |
| Unknown          | 407 1.7           | 710 2.4           | 604 1.7           | 879 2.2           |
| **Smoking**      |                  |                   |                  |                   |
| Current smoker   | 4468 18.8         | 7435 25.4         | 5876 16.2         | 8718 22.0         |
| Former smoker    | 8722 36.8         | 9198 31.4         | 2480 34.4         | 11,737 29.7       |
| Never smoker     | 10,359 43.7       | 12,452 42.5       | 17,681 48.7       | 18,769 47.4       |
| Unknown          | 154 0.6           | 238 0.8           | 242 0.7           | 344 0.9           |
| Physical activity: MVPA (minutes per week) | Men (≈ 53,026) | Women (≈ 75,847) |
|------------------------------------------|----------------|------------------|
| **Completed** Total Flower FFQ (n = 23,703) | **Did Not Complete** Total Flower FFQ (n = 29,323) | **Completed** Total Flower FFQ (n = 36,279) | **Did Not Complete** Total Flower FFQ (n = 39,568) |
| Median/n 25th–75th Percentile/% | Median/n 25th–75th Percentile/% | Median/n 25th–75th Percentile/% | Median/n 25th–75th Percentile/% |
| Physical activity category | Physical activity category | Physical activity category | Physical activity category |
| MVPA performance | 19,562 82.5 23,179 79.0 | 31,361 86.4 32,707 82.7 | **** |
| No MVPA performance | 2246 9.5 3252 11.1 | 2743 7.6 4036 10.2 | *** |
| Unknown or unreliable | 1895 8.0 2892 9.9 | 2175 6.0 2825 7.1 | *** |
| BMI (kg/m²) | BMI (kg/m²) | BMI (kg/m²) | BMI (kg/m²) |
| Normal weight | 8875 37.4 10,868 37.1 | 18,608 51.3 19,595 49.5 | **** |
| Overweight | 11,690 49.3 13,909 47.4 | 12,198 33.6 13,048 33.0 | *** |
| Obesity | 3138 13.2 4546 | 5472 15.1 6925 17.5 | *** |
| Unknown | 15.5 1 0.0 | 1 0.0 | *** |

SES, socioeconomic status; MVPA, moderate to vigorous physical activity; BMI, body mass index. Continuous data are presented as median (25th–75th percentile), categorical data are presented as n (%). * Significant difference between participants who completed the total Flower FFQ and who did not complete the total Flower FFQ. ** * < 0.01, *** * < 0.001.
3.2. Energy and Nutrient Intake

Daily energy and nutrient intake are presented in Table 2. Median energy intake was higher in men (2368 kcal) than in women (1848 kcal), as well as absolute macronutrient and micronutrient intake, except for vitamin C, of which the intake was higher in women. In terms of energy percentage (En%), macronutrient intake in men and women were comparable, except for alcohol, of which the intake was 2.2 En% in men and 0.9 En% in women.

Table 3 presents daily energy and nutrient intake per age category. In general, median energy and macronutrient intake was highest in the lowest age category and decreased subsequently in the middle and highest age categories, both in men and women. A clear exception on the above concerns alcohol intake, which was highest in the middle age category, both in men and women. For micronutrient intake in general, no clear trend was observed with increasing age categories. In higher age categories, both in men and women, intake of retinol equivalents, vitamin C and calcium was a little higher compared to lower age categories, and in women only, this was true for folate, folate equivalents and vitamin B12 intake. On the other hand, intake of vitamin B6 and vitamin E was a little lower in higher age categories compared to lower age categories, particularly in men.

Table 4 presents daily energy and nutrient intake per SES category. No striking differences in daily energy and nutrient intake were observed among different categories of SES, except for alcohol intake in women, of which the intake was lowest in the low SES category and increased subsequently in the moderate and high SES categories.

Table 5 presents daily energy and nutrient intake per BMI category. A striking observation is that intake of energy and macronutrients was highest in participants with a normal weight and decreased with increasing BMI categories, both in men and women. An exception also concerns alcohol intake here, which was comparable in different BMI categories in men, whereas in women, alcohol intake was lower among obese participants compared to overweight participants and participants with a normal weight. Regarding micronutrient intake, no striking differences were observed among different categories of BMI.

3.3. Food Intake

Daily food intake, categorised into food groups, is presented in Table 6. Intake of food groups was different for men and women. Striking differences were that men consumed more alcoholic beverages, bread, coffee, fat, oils and sauces, meat, potatoes, ready-made products, savoury snacks, soft drinks and sweets, whereas women consumed more fruits, tea, vegetables and water.

Table 7 presents daily food intake per age category. Both in men and women, intake of the following food groups decreased with increasing age categories: artificially sweetened beverages, bread, fat, oils and sauces, fruit juice, meat, pasta, ready-made products, rice, savoury snacks and soft drinks. On the other hand, intake of cheese, dairy, eggs, fruits, tea and vegetables increased with increasing age categories.

Table 8 presents daily food intake per SES category. Both in men and women, participants with a higher SES consumed more fruit juice, ready-made products, savoury snacks and vegetables, compared to participants with a lower SES. A difference observed in women only was that participants with a higher SES consumed more alcoholic beverages compared to participants with a lower SES.

Table 9 presents daily food intake per BMI category. A striking observation is that consumption of cake and cookies, fat, oils and sauces, savoury snacks, soft drinks and sweets was highest in participants with a normal weight and decreased with increasing BMI categories, whereas consumption of artificially sweetened beverages was lowest in participants with a normal weight and increased with increasing BMI categories, both in men and women.
Table 2. Daily energy and nutrient intake, obtained from the Flower FFQ ($n = 59,982$).

|                      | Men ($n = 23,703$) | Women ($n = 36,279$) |
|----------------------|--------------------|----------------------|
|                      | Median             | 25th–75th Percentile | Median             | 25th–75th Percentile |
| Energy (kcal)        | 2368               | 1974–2812            | 1848               | 1551–2179            | *** |
| Total carbohydrates (g) | 255               | 209–308              | 203               | 167–242              | *** |
| (En%)                | 45.3               | 41.6–49.2            | 45.6               | 41.9–49.4            | *** |
| Mono- and disaccharides (g) | 108              | 83–138              | 89               | 69–112              | *** |
| Polysaccharides (g)  | 144               | 117–175             | 112               | 91–133              | *** |
| Total fat (g)        | 95                | 76–120              | 73                | 58–91               | *** |
| (En%)                | 36.7               | 32.5–41.5            | 35.7               | 31.6–40.0            | *** |
| Saturated fatty acids (g) | 33              | 26–41               | 26                | 20–32               | *** |
| Monounsaturated fatty acids (g) | 34              | 26–42               | 25                | 20–32               | *** |
| Polyunsaturated fatty acids (g) | 20              | 15–27               | 14                | 11–19               | *** |
| Eicosapentaenoic acid (EPA) (g) | 0.04            | 0.01–0.09           | 0.04               | 0.01–0.09           | *** |
| Docosahexaenoic acid (DHA) (g) | 0.06            | 0.02–0.13           | 0.06               | 0.02–0.12           | *** |
| Total protein (g)    | 84                | 71–98               | 71                | 60–81               | *** |
| (En%)                | 14.9               | 13.6–16.4           | 15.8              | 14.3–17.4           | *** |
| Vegetable protein (g) | 37                | 30–44               | 29                | 24–35               | *** |
| Animal protein (g)   | 47                | 38–56               | 41                | 34–49               | *** |
| Alcohol (g)          | 6.8                | 2.6–15.3            | 2.6               | 0.4–6.9             | *** |
| (En%)                | 2.2                | 0.8–4.4             | 0.9               | 0.1–2.8             | *** |
| Fibre (g)            | 25                | 20–30               | 21                | 17–25               | *** |
| (En%)                | 2.0                | 1.7–2.3             | 2.2               | 1.9–2.5             | *** |
| Retinol equivalents (µg) | 1146             | 868–1542            | 960               | 744–1232            | *** |
| Vitamin B2 (mg)      | 1.5                | 1.2–1.8             | 1.3               | 1.1–1.6             | *** |
| Vitamin B6 (mg)      | 1.5                | 1.3–1.8             | 1.3               | 1.1–1.5             | *** |
| Folate (present in food by nature) (µg) | 253          | 210–303             | 229               | 190–272             | *** |
| Folate equivalents (µg) | 261              | 214–317             | 234               | 193–282             | *** |
| Vitamin B12 (µg)     | 4.0                | 3.1–5.4             | 3.4               | 2.6–4.5             | *** |
| Vitamin C (mg)       | 92                 | 66–123              | 96                | 69–127              | *** |
| Vitamin E (mg)       | 13                 | 10–17               | 11                | 9–14                | *** |
| Calcium (mg)         | 986                | 786–1236            | 920               | 731–1134            | *** |

* Significant difference between men and women. *** $p < 0.001$. 
Table 3. Daily energy and macronutrient intake per age category, obtained from the Flower FFQ (n = 59,982).

|                     | Men (n = 23,703) |                     | Women (n = 36,279) |
|---------------------|-----------------|---------------------|-------------------|
|                     | 18–50 Years (n = 14,890) | 51–70 Years (n = 8144) | >70 Years (n = 669) | 18–50 Years (n = 24,361) | 51–70 Years (n = 11,185) | >70 Years (n = 733) |
| Energy (kcal)       | Median: 2476 | 25th–75th Percentile: 2071–2921 | Median: 2215 | 1856–2633 | Median: 2014 | 1704–2368 | Median: 1892 | 1584–2222 | Median: 1777 | 1494–2084 | Median: 1679 | 1418–1956 |
|                     | 25th–75th Percentile: 2071–2921 | Median: 2021–2871 | Median: 2215 | 1856–2633 | Median: 2100 | 178–249 |Median: 2100 | 178–249 | Median: 1777 | 1494–2084 | Median: 1679 | 1418–1956 |
| Total carbohydrates (g) | Median: 271 | 25th–75th Percentile: 224–324 | Median: 232 | 192–279 | Median: 213 | 178–251 | Median: 210 | 174–249 | Median: 190 | 157–226 | Median: 183 | 153–212 |
| (En%)              | Median: 46.1 | 25th–75th Percentile: 42.4–49.8 | Median: 44.1 | 40.3–48.0 | Median: 44.0 | 39.7–47.7 | Median: 46.2 | 42.6–49.9 | Median: 44.4 | 40.5–48.1 | Median: 44.7 | 40.4–48.5 |
| Mono- and disaccharides (g) | Median: 113 | 25th–75th Percentile: 87–145 | Median: 99 | 76–127 | Median: 99 | 79–124 | Median: 91 | 71–115 | Median: 85 | 67–106 | Median: 88 | 71–108 |
| Polysaccharides (g) | Median: 154 | 25th–75th Percentile: 127–185 | Median: 131 | 108–158 | Median: 111 | 93–133 | Median: 116 | 96–138 | Median: 103 | 85–123 | Median: 93 | 76–109 |
| Total fat (g)       | Median: 99 | 25th–75th Percentile: 79–123 | Median: 89 | 71–113 | Median: 82 | 64–105 | Median: 75 | 59–93 | Median: 69 | 55–86 | Median: 65 | 51–81 |
| (En%)              | Median: 36.7 | 25th–75th Percentile: 32.6–41.3 | Median: 36.8 | 32.3–42.1 | Median: 36.2 | 32.0–41.6 | Median: 36.9 | 32.0–40.2 | Median: 35.1 | 30.9–39.7 | Median: 34.4 | 30.0–39.1 |
| Saturated fatty acids (g) | Median: 34 | 25th–75th Percentile: 27–42 | Median: 31 | 24–39 | Median: 29 | 23–37 | Median: 26 | 21–33 | Median: 25 | 20–31 | Median: 24 | 19–31 |
| Monounsaturated fatty acids (g) | Median: 35 | 25th–75th Percentile: 28–44 | Median: 31 | 24–40 | Median: 28 | 22–36 | Median: 26 | 21–33 | Median: 24 | 19–30 | Median: 21 | 17–27 |
| Polyunsaturated fatty acids (g) | Median: 21 | 25th–75th Percentile: 16–27 | Median: 19 | 14–25 | Median: 17 | 13–24 | Median: 15 | 11–19 | Median: 14 | 10–18 | Median: 13 | 9–17 |
| Eicosapentaenoic acid (EPA) (g) | Median: 0.04 | 25th–75th Percentile: 0.01–0.08 | Median: 0.06 | 0.02–0.10 | Median: 0.05 | 0.03–0.09 | Median: 0.03 | 0.01–0.08 | Median: 0.06 | 0.02–0.10 | Median: 0.05 | 0.01–0.09 |
| Docosahexaenoic acid (DHA) (g) | Median: 0.05 | 25th–75th Percentile: 0.02–0.11 | Median: 0.08 | 0.03–0.15 | Median: 0.08 | 0.04–0.13 | Median: 0.05 | 0.01–0.11 | Median: 0.08 | 0.03–0.15 | Median: 0.05 | 0.01–0.09 |
| Total protein (g)    | Median: 86 | 25th–75th Percentile: 73–100 | Median: 81 | 69–94 | Median: 74 | 64–86 | Median: 71 | 60–81 | Median: 71 | 60–82 | Median: 65 | 57–77 |
| (En%)              | Median: 14.7 | 25th–75th Percentile: 13.3–16.1 | Median: 15.3 | 14.0–16.8 | Median: 15.3 | 13.9–16.5 | Median: 15.5 | 14.0–17.1 | Median: 16.4 | 14.9–18.1 | Median: 16.1 | 14.6–17.8 |
| Vegetable protein (g) | Median: 38 | 25th–75th Percentile: 31–46 | Median: 34 | 28–41 | Median: 29 | 24–36 | Median: 29 | 24–35 | Median: 28 | 23–33 | Median: 25 | 21–30 |
| Animal protein (g)   | Median: 47 | 25th–75th Percentile: 39–57 | Median: 46 | 38–55 | Median: 45 | 37–52 | Median: 41 | 33–49 | Median: 42 | 35–51 | Median: 40 | 33–48 |
| Alcohol (g)         | Median: 6.6 | 25th–75th Percentile: 2.5–13.3 | Median: 8.5 | 2.8–16.8 | Median: 6.3 | 1.6–12.5 | Median: 2.5 | 0.3–6.7 | Median: 3.3 | 0.7–9.3 | Median: 1.4 | 0.0–6.4 |
| (En%)              | Median: 2 | 25th–75th Percentile: 0.7–4.1 | Median: 2.7 | 1.0–5.1 | Median: 2.1 | 0.6–4.6 | Median: 0.9 | 0.1–2.5 | Median: 1.4 | 0.2–3.7 | Median: 0.6 | 0.0–2.7 |
| Fibre (g)           | Median: 25 | 25th–75th Percentile: 21–31 | Median: 24 | 19–29 | Median: 22 | 18–26 | Median: 21 | 17–25 | Median: 21 | 18–25 | Median: 20 | 17–24 |
| (En%)              | Median: 2 | 25th–75th Percentile: 1.7–2.3 | Median: 2.1 | 1.8–2.4 | Median: 2.1 | 1.8–2.4 | Median: 2.1 | 1.8–2.4 | Median: 2.3 | 2.0–2.6 | Median: 2.3 | 2.0–2.6 |
| Retinol equivalents (µg) | Median: 1126 | 25th–75th Percentile: 853–1504 | Median: 1182 | 894–1597 | Median: 1181 | 902–1612 | Median: 941 | 724–1197 | Median: 1002 | 785–1301 | Median: 995 | 788–1295 |
| Vitamin B2 (mg)     | Median: 1.5 | 25th–75th Percentile: 1.2–1.8 | Median: 1.5 | 1.2–1.8 | Median: 1.4 | 1.2–1.6 | Median: 1.3 | 1.0–1.5 | Median: 1.3 | 1.1–1.6 | Median: 1.3 | 1.1–1.6 |
| Vitamin B6 (mg)     | Median: 1.6 | 25th–75th Percentile: 1.3–1.8 | Median: 1.4 | 1.2–1.7 | Median: 1.3 | 1.1–1.6 | Median: 1.3 | 1.1–1.6 | Median: 1.3 | 1.1–1.5 | Median: 1.2 | 1.0–1.5 |
### Table 3. Cont.

| Age Group | Men \( (n = 23,703) \) | Women \( (n = 36,279) \) |
|-----------|----------------|------------------|
| 18–50 Years \( (n = 14,890) \) | 51–70 Years \( (n = 8144) \) | >70 Years \( (n = 669) \) | 18–50 Years \( (n = 24,361) \) | 51–70 Years \( (n = 11,185) \) | >70 Years \( (n = 733) \) |
| **Median** | **25th–75th Percentile** | **Median** | **25th–75th Percentile** | **Median** | **25th–75th Percentile** | **Median** | **25th–75th Percentile** | **Median** | **25th–75th Percentile** |
| Folate (present in food by nature) \( (\mu g) \) | 254 | 209–303 | 254 | 210–303 | 247 | 210–290 | *abc | 223 | 185–265 | 241 | 202–285 | 239 | 202–282 |
| Folate equivalents \( (\mu g) \) | 260 | 213–315 | 263 | 216–322 | 253 | 216–308 | ***a | 227 | 188–273 | 247 | 206–299 | 246 | 206–302 |
| Vitamin B12 \( (\mu g) \) | 3.9 | 3.0–5.2 | 4.1 | 3.2–5.6 | 4.0 | 3.2–5.5 | ***a | 3.3 | 2.5–4.3 | 3.6 | 2.8–4.9 | 3.5 | 2.7–4.6 |
| Vitamin C \( (mg) \) | 89 | 64–120 | 95 | 68–128 | 104 | 76–134 | ***abc | 90 | 65–120 | 108 | 79–138 | 115 | 89–147 |
| Vitamin E \( (mg) \) | 14 | 11–18 | 13 | 10–17 | 12 | 9–16 | ***abc | 11 | 9–14 | 11 | 9–14 | 10 | 10–8–13 |
| Calcium \( (mg) \) | 978 | 775–1231 | 1001 | 798–1247 | 1003 | 817–1211 | ***a | 890 | 707–1100 | 974 | 788–1199 | 994 | 814–1196 |

* * Significant difference between categories of age. * * * \( p < 0.05 \), *** \( p < 0.001 \). a: significant difference between 18–50 and 51–70 years, b: significant difference between 18–50 and >70 years, c: significant difference between 51–70 and >70 years.

### Table 4. Daily energy and macronutrient intake per known SES category, obtained from the Flower FFQ \( (n = 58,971) \).

| SES Group | Men \( (n = 23,296) \) | Women \( (n = 35,675) \) |
|-----------|----------------|------------------|
| Low SES \( (n = 6590) \) | Moderate SES \( (n = 8563) \) | High SES \( (n = 8143) \) | Low SES \( (n = 10,500) \) | Moderate SES \( (n = 14,314) \) | High SES \( (n = 10,861) \) |
| **Median** | **25th–75th Percentile** | **Median** | **25th–75th Percentile** | **Median** | **25th–75th Percentile** | **Median** | **25th–75th Percentile** | **Median** | **25th–75th Percentile** |
| Energy \( (kcal) \) | 2355 | 1957–2834 | 2432 | 2013–2892 | 2319 | 1949–2725 | ***abc | 1801 | 1512–2135 | 1868 | 1564–2199 | 1868 | 1576–2188 |
| Total carbohydrates \( (g) \) | 253 | 207–309 | 264 | 214–317 | 249 | 206–299 | ***abc | 195 | 161–235 | 206 | 170–245 | 206 | 170–244 |
| \( (\text{En}%) \) | 45.1 | 41.2–49.0 | 45.5 | 41.8–49.3 | 45.4 | 41.8–49.1 | ***ab | 45 | 41.1–48.9 | 45.8 | 42.1–49.5 | 45.9 | 42.4–49.6 |
| Mono- and disaccharides \( (g) \) | 109 | 82–141 | 111 | 85–143 | 104 | 81–132 | ***abc | 87 | 68–111 | 90 | 71–114 | 88 | 70–110 |
| Polysaccharides \( (g) \) | 141 | 114–174 | 148 | 120–180 | 143 | 118–173 | ***ac | 106 | 87–128 | 113 | 93–135 | 115 | 94–137 |
| Total fat \( (g) \) | 96 | 75–122 | 98 | 77–124 | 93 | 74–114 | ***abc | 72 | 56–90 | 74 | 58–93 | 73 | 58–90 |
| \( (\text{En}%) \) | 36.9 | 32.3–42.2 | 36.9 | 32.5–41.8 | 36.5 | 32.6–40.8 | ***bc | 35.6 | 31.2–40.3 | 35.9 | 31.9–40.3 | 35.5 | 31.7–39.5 |
| Saturated fatty acids \( (g) \) | 33 | 26–41 | 33 | 26–42 | 32 | 26–40 | ***abc | 25 | 20–32 | 26 | 21–33 | 26 | 21–32 |
| Monounsaturated fatty acids \( (g) \) | 33 | 26–43 | 35 | 27–44 | 33 | 26–41 | ***abc | 25 | 19–31 | 26 | 20–33 | 25 | 20–32 |
Table 4. Cont.

|                         | Men (n = 23,296)          | Women (n = 35,675)         |
|-------------------------|---------------------------|---------------------------|
|                         | Low SES (n = 6590)        | Moderate SES (n = 8563)   | High SES (n = 8143)   | Low SES (n = 10,500)        | Moderate SES (n = 14,314)   | High SES (n = 10,861)       |
|                         | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile |
| Polysaturated fatty acids (g) | 21 15–28                  | 21 15–27                  | 19 14–25                  | 15 11–19                  | 15 11–19                  | 14 11–18                   |
| Eicosapentaenoic acid (EPA) (g) | 0.04 0.01–0.08            | 0.04 0.01–0.08            | 0.06 0.02–0.10            | 0.04 0.01–0.08            | 0.04 0.01–0.08            | 0.05 0.02–0.10             |
| Docosahexaenoic acid (DHA) (g) | 0.06 0.02–0.11            | 0.05 0.02–0.11            | 0.08 0.03–0.15            | 0.05 0.01–0.11            | 0.05 0.01–0.11            | 0.08 0.02–0.14             |
| Total protein (g)       | 82 69–97                  | 85 72–100                 | 84 72–97                  | 69 59–80                  | 71 60–81                  | 72 62–82                   |
| (En%)                   | 14.6 13.3–16.1            | 14.7 13.4–16.2            | 15.3 14.0–16.7            | 15.8 14.2–17.5            | 15.6 14.1–17.3            | 16 14.5–17.6               |
| Vegetable protein (g)   | 35 28–43                  | 37 30–45                  | 37 30–44                  | 27 23–33                  | 29 24–34                  | 30 25–36                   |
| Animal protein (g)      | 46 38–56                  | 47 39–57                  | 47 38–55                  | 41 33–49                  | 41 34–49                  | 41 33–49                   |
| Alcohol (g)             | 6.7 2.5–15.4              | 6.7 2.5–15.0              | 6.8 2.7–15.5              | 2 0.0–6.9                 | 2.5 0.3–6.7               | 3.4 0.9–8.3                |
| (En%)                   | 2.2 0.7–4.4               | 2.1 0.8–4.3               | 2.4 0.9–4.5               | 0.8 0.0–2.8               | 0.9 0.1–2.6               | 1.3 0.4–3.2                |
| Fibre (g)               | 24 19–29                  | 25 20–30                  | 25 21–30                  | 20 17–24                  | 21 17–25                  | 22 18–26                   |
| (En%)                   | 2 1.7–2.3                 | 2 1.7–2.3                 | 2.1 1.8–2.4               | 2 1.8–2.5                 | 2.1 1.8–2.5               | 2.3 2.0–2.6                |
| Retinol equivalents (µg) | 1194 889–1633             | 1147 865–1544             | 1118 856–1465             | 961 737–1264              | 945 734–1207              | 980 764–1234               |
| Vitamin B12 (mg)        | 1.5 1.2–1.8               | 1.5 1.2–1.8               | 1.5 1.2–1.8               | 1.3 1.1–1.6               | 1.3 1.0–1.6               | 1.3 1.1–1.6                |
| Vitamin B6 (mg)         | 1.5 1.2–1.8               | 1.3 1.3–1.8               | 1.5 1.3–1.8               | 1.3 1.1–1.5               | 1.3 1.1–1.5               | 1.4 1.2–1.6                |
| Folate (present in food by nature) (µg) | 250 203–299               | 252 209–303               | 258 215–305               | 222 184–265               | 224 186–265               | 241 203–286                |
| Folate equivalents (µg)  | 256 208–312               | 259 213–316               | 267 221–321               | 227 187–276               | 228 189–274               | 247 207–297                |
| Vitamin B12 (µg)        | 4.0 3.0–5.4               | 4.0 3.0–5.3               | 4.1 3.1–5.5               | 3.4 2.6–4.5               | 3.3 2.6–4.4               | 3.5 2.7–4.7                |
| Vitamin C (mg)          | 88 62–120                 | 90 65–122                 | 96 71–127                 | 96 68–127                 | 92 66–123                 | 101 74–131                 |
| Vitamin E (mg)          | 13 10–17                  | 14 11–18                  | 13 10–17                  | 11 9–14                   | 11 9–14                   | 11 9–14                    |
| Calcium (mg)            | 977 775–1232              | 987 785–1241              | 993 792–1233              | 925 735–1137              | 908 722–1121              | 929 743–1142               |

* Significant difference between categories of SES. *p < 0.05, **p < 0.01, ***p < 0.001. a: significant difference between low and moderate SES, b: significant difference between low and high SES, c: significant difference between moderate and high SES.
Table 5. Daily energy and macronutrient intake per known BMI category, obtained from the Flower FFQ ($n = 59,981$).

|                      | Men ($n = 23,703$) | Women ($n = 36,278$) |
|----------------------|--------------------|---------------------|
|                      | Normal Weight ($n = 8875$) | Overweight ($n = 11,690$) | Obesity ($n = 3138$) | Normal Weight ($n = 18,608$) | Overweight ($n = 12,198$) | Obesity ($n = 5472$) |
| Energy (kcal)        | Median 2473 2081–2910 2324 1937–2275 2218 1823–2693 | ***abc | Median 1898 1602–2219 1806 1591–2139 1766 1641–2100 | ***abc |
|                      | 25th–75th Percentile 1882–2693 1528–2040 1495–2007 | |
| Total carbohydrates (g) | Median 272 226–326 249 204–300 232 188–283 | ***abc | Median 210 175–248 196 161–234 192 155–233 | ***abc |
|                      | (En%) 46.3 42.8–50.1 45 41.3–48.7 43.8 39.5–47.8 | ***abc | (En%) 46.2 42.6–49.9 45.2 41.3–48.8 44.8 40.8–48.5 | ***bc |
| Mono- and disaccharides (g) | Median 116 90–146 105 81–135 94 71–124 | ***abc | Median 92 73–116 86 67–109 83 64–106 | ***abc |
|                      | Polysaccharides (g) | Median 153 126–184 141 114–170 134 108–165 | ***abc | Median 115 95–137 108 88–130 107 86–130 | ***abc |
|                      | Total fat (g) | Median 98 79–122 94 74–118 92 71–116 | ***abc | Median 75 59–93 71 57–90 70 55–88 | ***abc |
|                      | (En%) 36.5 32.3–41.1 36.8 32.5–41.6 37 32.7–42.2 | ***abc | (En%) 35.7 31.7–40.1 35.7 31.6–40.0 35.4 31.4–40.0 | |
| Saturated fatty acids (g) | Median 34 27–42 32 26–40 31 24–40 | ***abc | Median 27 21–33 25 20–32 25 19–31 | ***abc |
| Monounsaturated fatty acids (g) | Median 35 28–43 33 26–42 32 25–42 | ***abc | Median 26 20–33 25 20–31 25 19–31 | ***abc |
| Polyunsaturated fatty acids (g) | Median 20 16–27 20 15–26 19 14–26 | ***abc | Median 15 11–19 14 11–19 14 10–18 | ***abc |
| Eicosapentaenoic acid (EPA) (g) | Median 0.04 0.01–0.09 0.05 0.02–0.09 0.05 0.02–0.09 | ***abc | Median 0.04 0.01–0.09 0.04 0.01–0.09 0.04 0.01–0.09 | ***bc |
| Docosahexaenoic acid (DHA) (g) | Median 0.06 0.02–0.12 0.06 0.02–0.13 0.07 0.02–0.13 | ***abc | Median 0.06 0.02–0.012 0.06 0.02–0.13 0.06 0.02–0.11 | ***bc |
| Total protein (g) | Median 86 73–99 83 71–97 82 69–97 | ***abc | Median 71 60–82 70 60–81 70 59–81 | * |
| (En%) 14.6 13.3–16.0 15 13.7–16.5 15 13.9–17.0 | ***abc | (En%) 14.5 14.0–17.1 16 14.5–17.7 16 14.6–18.0 | ***abc |
| Vegetable protein (g) | Median 39 32–47 36 29–43 34 27–42 | ***abc | Median 30 25–35 28 23–34 27 22–33 | ***abc |
| Animal protein (g) | Median 46 38–55 47 39–56 48 39–58 | ***abc | Median 40 33–48 42 34–50 42 35–50 | ***ab |
| Alcohol (g) | Median 6.7 2.6–13.3 6.9 2.6–15.9 6.7 1.9–15.8 | ***abc | Median 2.9 0.7–7.1 2.6 0.3–7.1 1.3 0.0–5.2 | ***abc |
| (En%) 2.1 0.7–4.1 2.4 0.9–4.7 2.2 0.6–4.8 | ***abc | (En%) 1.1 0.3–2.9 1 0.1–3.0 0.5 0.0–1.9 | ***abc |
| Fibre (g) | Median 26 21–31 24 20–29 23 19–28 | ***abc | Median 21 18–26 21 17–25 20 16–24 | ***abc |
| (En%) 2 1.7–2.3 2 1.7–2.3 2 1.7–2.3 | ***abc | (En%) 2.2 1.9–2.5 2.2 1.9–2.5 2 1.9–2.5 | |
| Retinol equivalents (µg) | Median 1151 879–1519 1142 865–1548 1155 844–1589 | - | Median 955 745–1221 963 745–1233 964 740–1273 | *b |
| Vitamin B2 (mg) | Median 1.5 1.2–1.8 1.5 1.2–1.8 1.4 1.2–1.8 | ***bc | Median 1.3 1.0–1.6 1.3 1.1–1.6 1.3 1.0–1.6 | *a |
| Vitamin B6 (mg) | Median 1.5 1.3–1.8 1.5 1.2–1.8 1.4 1.2–1.7 | ***abc | Median 1.3 1.1–1.5 1.3 1.1–1.5 1.3 1.1–1.5 | ***abc |
Table 5. Cont.

|                      | Normal Weight (n = 8875) | Overweight (n = 11,690) | Obesity (n = 3,138) | Normal Weight (n = 18,608) | Overweight (n = 12,198) | Obesity (n = 5,472) |
|----------------------|--------------------------|-------------------------|---------------------|---------------------------|-------------------------|---------------------|
|                      | Median                   | 25th–75th Percentile    | Median              | 25th–75th Percentile      | Median                  | 25th–75th Percentile |
| Folate (present in food by nature) (µg) | 261                      | 217–313                 | 250                 | 207–298                   | 243                     | 200–293             | 231                  | 192–275              | 227                     | 189–270               | 223                  | 183–265               | ***abc                |
| Folate equivalents (µg) | 269                      | 222–327                 | 258                 | 212–312                   | 248                     | 204–303             | 236                  | 195–285              | 233                     | 193–280               | 227                  | 86–273               | ***abc                |
| Vitamin B12 (µg)     | 3.9                      | 3.0–5.1                 | 4.1                 | 3.1–5.4                   | 4.2                     | 3.1–5.8            | 3.4                  | 2.6–4.4              | 3.4                     | 2.7–4.6              | 3.5                  | 2.7–4.7              | ***ab                 |
| Vitamin C (mg)       | 93                       | 67–125                  | 91                  | 66–122                    | 88                      | 63–120            | 96                   | 70–127               | 97                      | 70–127               | 94                   | 66–124              | ***bc                 |
| Vitamin E (mg)       | 14                       | 11–17                   | 13                  | 10–17                     | 13                      | 10–17             | 11                   | 9–14                 | 11                      | 9–14                 | 11                   | 8–14                | ***ab                 |
| Calcium (mg)         | 998                      | 797–1250                | 986                 | 786–1232                  | 957                     | 746–1205          | 920                  | 728–1135             | 924                     | 739–1140             | 907                  | 726–1120            | **c                   |

* Significant difference between categories of BMI. *p < 0.05, **p < 0.01, ***p < 0.001. a: significant difference between normal weight and overweight, b: significant difference between normal weight and obesity, c: significant difference between overweight and obesity.
Table 6. Daily food intake, categorised into food groups, obtained from the Flower FFQ (n = 59,982).

|                        | Men (n = 23,703) | Women (n = 36,279) |
|------------------------|------------------|--------------------|
|                        | Median           | 25th–75th Percentile | Median           | 25th–75th Percentile |
| Alcoholic beverages (g)| 107              | 36–215             | 29              | 4–85               |
| Artificially sweetened beverages (g) | 9            | 0–80               | 13              | 0–80               |
| Bread (g)              | 163              | 120–208            | 116             | 83–148             |
| Breakfast cereals (g)  | 0                | 0–6               | 0               | 0–8                |
| Cake and cookies (g)   | 30               | 18–48             | 30              | 18–46              |
| Cheese (g)             | 26               | 14–43             | 23              | 13–40              |
| Coffee (g)             | 465              | 348–697           | 348             | 161–465            |
| Dairy (g)              | 291              | 180–427           | 282             | 170–413            |
| Eggs (g)               | 9                | 7–18              | 7               | 4–18               |
| Fat, oils and sauces (g)| 57          | 37–81             | 40              | 26–58              |
| Fish (g)               | 13               | 4–22              | 12              | 3–20               |
| Fruits (g)             | 105              | 44–203            | 133             | 68–205             |
| Fruit juice (g)        | 21               | 0–96              | 21              | 0–54               |
| Legumes (g)            | 7                | 0–16              | 4               | 0–11               |
| Meat (g)               | 86               | 64–109            | 70              | 46–93              |
| Nuts and seeds (g)     | 10               | 5–21              | 7               | 3–14               |
| Pasta (g)              | 19               | 12–32             | 19              | 12–26              |
| Potatoes (g)           | 95               | 53–138            | 71              | 40–104             |
| Probiotics and drinks lowering cholesterol and blood pressure (g)| 0            | 0–0               | 0               | 0–0               |
| Ready-made products (g)| 31               | 6–51              | 18              | 1–36               |
| Rice (g)               | 20               | 8–32              | 16              | 6–25               |
| Savoury snacks (g)     | 32               | 16–51             | 22              | 11–39              |
| Soft drinks (g)        | 34               | 0–116             | 9               | 0–62               |
| Soup (g)               | 36               | 22–89             | 36              | 22–72              |
| Soy products (g)       | 0                | 0–0               | 0               | 0–0               |
| Sweets (g)             | 34               | 17–57             | 25              | 12–42              |
| Tea (g)                | 116              | 11–232            | 232             | 89–465             |
| Vegan products other than soy (g)| 0            | 0–0               | 0               | 0–0               |
| Vegetables (g)         | 131              | 89–184            | 148             | 106–205            |
| Water (g)              | 279              | 107–482           | 418             | 161–557            |

* Significant difference between men and women. ** p < 0.01, *** p < 0.001.
Table 7. Daily food intake, categorised into food groups, per age category, obtained from the Flower FFQ ($n = 59,982$).

|                          | Men ($n = 23,703$) |                         | Women ($n = 36,279$) |                         |
|--------------------------|--------------------|-------------------------|----------------------|-------------------------|
|                          | 18–50 Years ($n = 14,890$) | 51–70 Years ($n = 8144$) | >70 Years ($n = 669$) | 18–50 Years ($n = 24,361$) | 51–70 Years ($n = 11,185$) | >70 Years ($n = 733$) |
|                          | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile |
| Alcoholic beverages (g) | 107 36–223 | 110 38–217 | 64 17–139 | 107 36–223 | 110 38–217 | 64 17–139 |
| Artificially sweetened beverages (g) | 13 0–95 | 5 0–54 | 0 0–27 | 18 0–96 | 5 0–43 | 0 0–21 |
| Bread (g)               | 169 129–214 | 149 111–198 | 132 100–166 | 119 84–151 | 114 82–145 | 108 78–137 |
| Breakfast cereals (g)   | 0 0–6 | 0 0–6 | 0 0–6 | 0 0–6 | 0 0–6 | 0 0–6 |
| Cake and cookies (g)    | 30 17–47 | 30 18–48 | 35 23–50 | 30 18–46 | 30 17–47 | 35 23–50 |
| Cheese (g)              | 24 12–41 | 29 17–46 | 30 18–47 | 21 11–37 | 28 17–43 | 29 18–42 |
| Coffee (g)              | 465 322–697 | 465 348–697 | 465 348–523 | 348 45–465 | 465 241–581 | 348 232–465 |
| Dairy (g)               | 290 177–430 | 292 183–421 | 307 204–422 | 276 164–400 | 293 183–422 | 309 236–440 |
| Eggs (g)                | 9 7–18 | 14 7–18 | 18 7–18 | 7 4–18 | 9 7–18 | 18 7–18 |
| Fat, oils and sauces (g) | 59 40–84 | 53 34–77 | 47 30–70 | 42 27–61 | 36 23–53 | 33 21–49 |
| Fish (g)                | 11 3–20 | 16 8–25 | 15 9–22 | 11 1–19 | 15 6–24 | 13 5–20 |
| Fruits (g)              | 89 40–192 | 130 69–211 | 197 101–231 | 104 48–199 | 193 85–216 | 205 141–292 |
| Fruit juice (g)         | 27 0–107 | 21 0–54 | 13 0–54 | 21 0–96 | 13 0–54 | 11 0–54 |
| Legumes (g)             | 7 0–16 | 9 0–18 | 9 0–16 | 4 0–11 | 7 0–16 | 7 0–16 |
| Meat (g)                | 90 66–112 | 80 61–103 | 71 48–93 | 72 49–95 | 67 41–89 | 62 36–75 |
| Nuts and seeds (g)      | 11 5–21 | 10 4–21 | 6 3–14 | 7 3–14 | 7 3–15 | 4 1–10 |
| Pasta (g)               | 24 13–39 | 19 8–26 | 12 3–18 | 19 12–32 | 13 8–19 | 8 3–13 |
| Potatoes (g)            | 97 55–140 | 90 50–135 | 90 40–135 | 72 42–105 | 65 34–104 | 69 27–103 |
| Probiotics and drinks lowering cholesterol and blood pressure (g) | 0 0–0 | 0 0–0 | 0 0–0 | 0 0–0 | 0 0–0 | 0 0–0 |
| Ready-made products (g) | 33 13–53 | 14 0–33 | 1 0–26 | 31 12–43 | 13 0–32 | 0 0–15 |
| Rice (g)                | 20 10–34 | 16 6–26 | 10 0–20 | 16 6–26 | 15 4–24 | 10 0–16 |
| Savoury snacks (g)      | 39 22–59 | 20 9–37 | 8 2–17 | 28 15–44 | 14 5–25 | 6 1–14 |
| Soft drinks (g)         | 62 11–156 | 10 0–52 | 0 0–31 | 21 0–94 | 0 0–18 | 0 0–13 |
Table 7. Cont.

|                   | Men ($n = 23,703$) |       | Women ($n = 36,279$) |       |
|-------------------|--------------------|-------|----------------------|-------|
|                   | 18–50 Years ($n = 14,890$) | 51–70 Years ($n = 8144$) | >70 Years ($n = 669$) | 18–50 Years ($n = 24,361$) | 51–70 Years ($n = 11,185$) | >70 Years ($n = 733$) |
|                   | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile |
| Soup (g)          | 36 22–72           | 36 22–89 | 36 22–89             | -     | 36 22–45           | 36 22–72 | 36 22–72    | ***ab |
| Soy products (g)  | 0 0–0              | 0 0–0   | 0 0–0                | ***a  | 0 0–0              | 0 0–0    | 0 0–0       | ***ac |
| Sweets (g)        | 37 19–60           | 30 4–50 | 31 16–48             | ***ab | 27 14–45           | 20 10–35 | 21 10–34    | ***ab |
| Tea (g)           | 89 11–232          | 116 18–241 | 232 116–465         | ***abc| 232 89–465        | 232 116–465 | 348 161–465 | ***abc |
| Vegan products other than soy (g) | 0 0–0             | 0 0–0 | 0 0–0                | *     | 0 0–0             | 0 0–0    | 0 0–0       | c    |
| Vegetables (g)    | 128 87–181         | 136 93–190 | 135 93–180          | ***a  | 143 100–199       | 162 118–217 | 152 109–200 | ***abc |
| Water (g)         | 279 107–557        | 279 107–418 | 279 139–418      | ***ab | 386 139–579       | 418 193–557 | 418 161–557 | ***abc |

* Significant difference between categories of age. * $p < 0.05$, ** $p < 0.001$. a: significant difference between 18–50 and 51–70 years, b: significant difference between 18–50 and >70 years, c: significant difference between 51–70 and >70 years.

Table 8. Daily food intake, categorised into food groups, per known SES category, obtained from the Flower FFQ ($n = 58.971$).

|                   | Men ($n = 23,296$) |       | Women ($n = 35,675$) |       |
|-------------------|--------------------|-------|----------------------|-------|
|                   | Low SES ($n = 6590$) | Moderate SES ($n = 8563$) | High SES ($n = 8143$) | Low SES ($n = 10,500$) | Moderate SES ($n = 14,314$) | High SES ($n = 10,861$) |
|                   | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile |
| Alcoholic beverages (g) | 107 33–229 | 107 36–227 | 107 39–208 | - | 21 0–76 | 27 4–71 | 27 4–71 | ***abc |
| Artificially sweetened beverages (g) | 7 0–80 | 11 0–92 | 11 0–72 | - | 11 0–72 | 13 0–95 | 13 0–95 | ***ac |
| Bread (g)         | 165 123–213       | 166 124–211 | 153 113–201       | ***bc | 118 85–148 | 117 83–149 | 117 83–149 | - |
| Breakfast cereals (g) | 0 0–3            | 0 0–6   | 0 0–10             | ***abc| 0 0–5    | 0 0–6   | 0 0–6   | ***abc |
| Cake and cookies (g) | 31 18–48         | 31 18–48 | 30 17–47           | ***bc | 31 18–47 | 31 18–47 | 31 18–47 | ***bc |
| Cheese (g)        | 26 14–44          | 25 13–42 | 23 14–43           | **ac  | 23 13–40  | 22 12–39 | 22 12–39 | ***ac |
| Coffee (g)        | 465 348–697       | 465 348–397 | 465 348–697       | b    | 465 232–581 | 348 116–465 | 348 116–465 | ***abc |
| Dairy (g)         | 288 177–423       | 294 185–431 | 291 178–426       | ***ac | 288 178–418 | 284 172–417 | 284 172–417 | ***bc |
| Eggs (g)          | 14 7–18           | 9 7–18  | 9 7–18             | ***abc| 7 4–18   | 7 4–18  | 7 4–18  | ***ab |
Table 8. Cont.

|                          | Men (n = 23,296) |               |               | Women (n = 35,675) |               |               |
|--------------------------|------------------|---------------|---------------|-------------------|---------------|---------------|
|                          | Low SES (n = 6590) | Moderate SES (n = 8563) | High SES (n = 8143) | Low SES (n = 10,500) | Moderate SES (n = 14,314) | High SES (n = 10,861) |
|                          | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile | Median 25th–75th Percentile |
| Fat, oils and sauces (g) | 58 38–84         | 59 39–84       | 53 35–76       | ***bc             | 39 25–58       | 41 27–59       | 41 27–59       | ***ac           |
| Fish (g)                 | 11 3–20          | 12 4–21        | 16 6–25        | ***bc             | 11 2–19        | 11 2–19        | 11 2–19        | ***bc           |
| Fruits (g)               | 101 41–202       | 100 42–201     | 111 52–205     | ***bc             | 137 65–207     | 110 52–202     | 110 52–202     | ***abc          |
| Fruit juice (g)          | 13 0–54          | 27 0–107       | 27 5–107       | ***abc            | 13 0–54        | 21 0–64        | 21 0–64        | ***abc          |
| Legumes (g)              | 7 0–18           | 7 0–16         | 7 0–16         | ***ab             | 4 0–16         | 4 0–11         | 4 0–11         | ***abc          |
| Meat (g)                 | 86 64–110        | 89 66–111      | 83 62–105      | ***abc            | 70 46–92       | 72 50–95       | 72 50–95       | ***abc          |
| Nuts and seeds (g)       | 9 3–19           | 10 4–21        | 12 5–22        | ***abc            | 6 2–14         | 7 3–14         | 7 3–14         | ***abc          |
| Pasta (g)                | 19 11–32         | 19 13–32       | 20 13–45       | ***abc            | 13 8–20        | 19 12–26       | 19 12–26       | ***abc          |
| Potatoes (g)             | 100 55–149       | 97 58–147      | 86 48–122      | ***bc             | 73 45–106      | 72 45–105      | 72 45–105      | ***bc           |
| Probiotics and drinks lowering cholesterol and blood pressure (g) | 0 0–0          | 0 0–0          | 0 0–0          | ***abc            | 0 0–0          | 0 0–0          | 0 0–0          | ***abc          |
| Ready-made products (g)  | 14 0–36          | 32 12–52       | 33 12–52       | ***abc            | 13 0–32        | 26 6–36        | 26 6–36        | ***abc          |
| Rice (g)                 | 15 2–26          | 20 8–31        | 21 11–39       | ***abc            | 15 4–21        | 16 6–25        | 16 6–25        | ***abc          |
| Savoury snacks (g)       | 26 12–46         | 34 19–54       | 33 17–52       | ***abc            | 18 8–33        | 25 13–42       | 25 13–42       | ***abc          |
| Soft drinks (g)          | 35 0–126         | 42 3–136       | 26 0–94        | ***abc            | 0 0–47         | 13 0–90        | 13 0–90        | ***abc          |
| Soup (g)                 | 36 22–72         | 36 22–72       | 36 22–89       | -                 | 36 22–72       | 36 22–67       | 36 22–67       | -               |
| Soy products (g)         | 0 0–0            | 0 0–0          | 0 0–0          | ***abc            | 0 0–0          | 0 0–0          | 0 0–0          | ***abc          |
| Sweets (g)               | 34 17–58         | 36 18–59       | 33 17–54       | ***abc            | 23 11–40       | 26 13–43       | 26 13–43       | ***abc          |
| Tea (g)                  | 89 0–232         | 89 11–232      | 134 36–348     | ***abc            | 232 80–348     | 232 89–465     | 232 89–465     | ***abc          |
| Vegan products other than soy (g) | 0 0–0         | 0 0–0          | 0 0–0          | ***abc            | 0 0–0          | 0 0–0          | 0 0–0          | ***abc          |
| Vegetables (g)           | 122 81–171       | 126 86–178     | 146 102–200    | ***abc            | 137 96–188     | 143 101–197    | 143 101–197    | ***abc          |
| Water (g)                | 279 107–557      | 279 107–557    | 279 107–418    | -                 | 418 193–697    | 418 161–579    | 418 161–579    | ***abc          |

* Significant difference between categories of SES. *p < 0.05, **p < 0.01, ***p < 0.001. a: significant difference between low and moderate SES, b: significant difference between low and high SES, c: significant difference between moderate and high SES.
Table 9. Daily food intake, categorised into food groups, per known BMI category, obtained from the Flower FFQ ($n = 59,981$).

|                   | Men ($n = 23,703$) | Women ($n = 36,278$) |
|-------------------|--------------------|-----------------------|
|                   | Normal Weight ($n = 8875$) | Overweight ($n = 11,690$) | Obesity ($n = 3138$) | Normal Weight ($n = 18,608$) | Overweight ($n = 12,198$) | Obesity ($n = 5472$) |
|                   | Median | 25th–75th Percentile | Median | 25th–75th Percentile | Median | 25th–75th Percentile | Median | 25th–75th Percentile | Median | 25th–75th Percentile | Median | 25th–75th Percentile |
| Alcoholic beverages (g) | 105 | 36–214 | 109 | 38–223 | 99 | 27–217 | ***abc | 35 | 7–90 | 29 | 4–87 | ***abc | 13 | 0–56 | ***abc |
| Artifically sweetened beverages (g) | 0 | 0–54 | 13 | 0–92 | 29 | 0–143 | ***abc | 7 | 0–54 | 13 | 0–93 | 29 | 0–139 | ***abc |
| Bread (g) | 171 | 132–216 | 154 | 114–204 | 149 | 109–200 | ***abc | 119 | 86–151 | 113 | 81–145 | 116 | 82–147 | ***ab |
| Breakfast cereals (g) | 0 | 0–10 | 0 | 0–5 | 0 | 0–1 | ***abc | 1 | 0–9 | 0 | 0–6 | 0 | 0–4 | ***abc |
| Cake and cookies (g) | 32 | 19–50 | 30 | 17–47 | 27 | 15–43 | ***abc | 31 | 18–47 | 30 | 17–46 | 29 | 16–44 | ***ab |
| Cheese (g) | 25 | 13–42 | 26 | 14–43 | 26 | 14–43 | **ab | 23 | 13–40 | 23 | 13–40 | 22 | 13–39 | *c |
| Coffee (g) | 465 | 241–581 | 465 | 348–697 | 465 | 348–697 | ***ab | 348 | 116–465 | 348 | 232–581 | 348 | 161–581 | ***ab |
| Dairy (g) | 295 | 186–431 | 292 | 182–427 | 276 | 162–407 | ***bc | 281 | 166–409 | 285 | 175–418 | 282 | 168–413 | ***a |
| Eggs (g) | 9 | 7–18 | 14 | 7–18 | 14 | 7–18 | ***abc | 7 | 4–18 | 7 | 4–18 | 9 | 4–18 | ***ab |
| Fat, oils and sauces (g) | 59 | 40–84 | 56 | 37–80 | 53 | 34–77 | ***abc | 42 | 27–60 | 39 | 25–57 | 37 | 24–54 | ***abc |
| Fish (g) | 12 | 4–21 | 13 | 4–22 | 14 | 4–23 | ***ab | 12 | 3–20 | 12 | 4–21 | 12 | 3–20 | **c |
| Fruits (g) | 106 | 46–203 | 105 | 45–204 | 97 | 39–201 | ***bc | 130 | 69–205 | 137 | 70–206 | 115 | 47–204 | ***bc |
| Fruit juice (g) | 27 | 0–107 | 21 | 0–96 | 21 | 0–96 | ***abc | 21 | 0–96 | 21 | 0–54 | 13 | 0–54 | ***abc |
| Legumes (g) | 7 | 0–16 | 7 | 0–16 | 7 | 0–16 | - | 4 | 0–11 | 4 | 0–11 | 4 | 0–11 | ***bc |
| Meat (g) | 83 | 61–106 | 86 | 65–108 | 92 | 68–115 | ***abc | 68 | 41–92 | 72 | 49–94 | 75 | 55–97 | ***abc |
| Nuts and seeds (g) | 11 | 5–22 | 11 | 5–21 | 8 | 3–18 | ***abc | 7 | 3–15 | 7 | 3–14 | 6 | 2–12 | ***abc |
| Pasta (g) | 20 | 13–39 | 19 | 12–32 | 19 | 11–28 | ***abc | 19 | 12–32 | 16 | 8–26 | 13 | 8–20 | ***abc |
| Potatoes (g) | 97 | 55–143 | 95 | 53–136 | 90 | 47–132 | ***abc | 71 | 40–104 | 72 | 40–104 | 68 | 39–104 | - |
| Probiotics and drinks lowering cholesterol and blood pressure (g) | 0 | 0–0 | 0 | 0–0 | 0 | 0–0 | ***abc | 0 | 0–0 | 0 | 0–0 | 0 | 0–0 | ***ab |
| Ready-made products (g) | 32 | 12–52 | 31 | 2–50 | 30 | 1–50 | ***ab | 23 | 6–36 | 16 | 1–35 | 18 | 1–36 | ***ab |
| Rice (g) | 20 | 9–34 | 17 | 6–31 | 16 | 4–27 | ***abc | 16 | 8–26 | 15 | 5–24 | 15 | 4–24 | ***abc |
| Savoury snacks (g) | 33 | 17–53 | 30 | 15–50 | 29 | 15–50 | ***abc | 23 | 12–40 | 21 | 10–38 | 21 | 10–38 | ***ab |
Table 9. Cont.

|                      | Men (n = 23,703) |          | Overweight (n = 11,690) |          | Obesity (n = 3138) |          | Women (n = 36,278) |          | Overweight (n = 12,198) |          | Obesity (n = 5472) |          |
|----------------------|------------------|----------|--------------------------|----------|-------------------|----------|-------------------|----------|--------------------------|----------|-------------------|----------|
|                      | Normal Weight (n = 8875) |         | Overweight (n = 11,690) |          | Obesity (n = 3138) |          | Normal Weight (n = 18,608) |         | Overweight (n = 12,198) |          | Obesity (n = 5472) |          |
| Soft drinks (g)      | 42 5–134         | 28 0–104 | 26 0–126 ***ab          | 13 0–67  | 5 0–52            | 0 0–57 ***ab |
| Soup (g)             | 36 22–89         | 36 22–89 | 36 22–72 -             | 36 22–45 | 36 22–72          | 36 22–72 ***ab |
| Soy products (g)     | 0 0–0            | 0 0–0   | 0 0–0 ***abc           | 0 0–0    | 0 0–0             | 0 0–0 ***abc |
| Sweets (g)           | 41 23–65         | 32 16–54 | 23 10–43 ***abc         | 28 14–45 | 22 11–39          | 20 9–36 ***abc |
| Tea (g)              | 116 18–322       | 116 11–232 | 80 0–232 ***abc       | 241 116–465 | 232 89–465 | 232 80–465 ***abc |
| Vegan products other than soy (g) | 0 0–0 | 0 0–0 | 0 0–0 ***abc | 0 0–0 | 0 0–0 | 0 0–0 ***abc |
| Vegetables (g)       | 134 93–189       | 129 87–181 | 129 86–180 ***ab      | 148 106–205 | 149 106–205 | 147 102–203 *b |
| Water (g)            | 279 107–418      | 279 107–482 | 289 139–557 ***abc    | 289 139–557 | 418 193–697 | 418 193–697 ***abc |

* Significant difference between categories of BMI. * p < 0.05, ** p < 0.01, *** p < 0.001. a: significant difference between normal weight and overweight, b: significant difference between normal weight and obesity, c: significant difference between overweight and obesity.
4. Discussion

In this article, we describe dietary intake among participants of the Lifelines cohort study at baseline. Median energy intake, as well as the intake of macronutrients, was higher in men than in women and decreased with increasing categories of age and BMI. No striking differences in energy and macronutrient intake were observed for different categories of SES. In regard to the intake levels stratified for age, SES and BMI, an exception to the above concerns alcohol intake. Alcohol intake was highest in the middle age category, not in the lowest age category, in both men and women. Among different SES and BMI categories, differences were observed in women: alcohol intake was lowest in the low SES category and highest in the lowest BMI category. Regarding micronutrients, the intake was higher in men than in women, except for vitamin C. Among different age categories, different intake of micronutrients was observed, but no clear trend was observed: for some micronutrients the intake was higher among higher age categories compared to lower age categories, whereas for other micronutrients the opposite was observed. No striking differences in micronutrient intake were observed among different categories of SES and BMI. Intake of most food groups differed between men and women, as well as between different categories of age, SES and BMI.

4.1. Generalisability

The study population comprised mainly inhabitants of the northern three provinces of the Netherlands. The population in the north of the Netherlands has a homogeneous composition and low migration rates relative to other parts of the Netherlands and is therefore highly suitable for a long-lasting follow-up study such as the Lifelines cohort study [9]. To obtain an impression of the generalisability of the data, we compared the results of the Lifelines population in the current article with results from the Dutch National Food Consumption Survey (DNFCS) [20], which is compiled from a representative sample ($n = 2106$; 1055 men, 1051 women) of the general Dutch population. Data on dietary intake in the DNFCS are presented by age categories, which are different from the age categories in the current article. Here, we describe data for the age category 18–50 years in the present population and for the category 31–50 years in the DNFCS, but comparisons are applicable to other age categories as well. Compared to the DNFCS, the present population had a slightly lower median intake of energy (2476 vs. 2647 kcal for men; 1892 vs. 1956 kcal for women). The intake of En% from carbohydrates and fat were slightly higher (for carbohydrates 46 vs. 43 En% for men and 46 vs. 45 En% for women; for fats 37 vs. 35 En% for men and 37 vs. 34 En% for women), whereas the intake of En% from protein was similar (15 En% for men and 16 En% for women), and the intake of En% from alcohol was lower (2.0 vs. 3.8 En% for men and 0.9 vs. 1.2 En% for women).

A comparison regarding intake of food groups between the present population and the DNFCS is more difficult to make, because within the DNFCS, food items were categorised into 17 food groups, and for the current article, food items were categorised into 30 food groups. Moreover, data on dietary intake in the DNFCS were collected using duplicate 24 h dietary recalls, which provide detailed information on dietary intake at two specific days, whereas in the Lifelines cohort study, dietary intake in the past month was assessed using an FFQ, which provides primarily information on food consumption patterns over time.

Because of this difference in dietary assessment method, we also compared our results to nutrient intake data obtained with a general FFQ, namely, data in the National Dietary Assessment Reference Database (NDARD) for the Dutch population ($n = 1647$; 857 men, 790 women), which was set up to serve as a reference database for new dietary assessment methods [21]. Data on energy and macronutrient intake in the NDARD are in the same range as in the present population and the DNFCS. It should be noted that NDARD participants lived in a relatively small part of the Netherlands around the city of Wageningen and had a higher SES compared to the general Dutch population, the DNFCS and Lifelines participants.
It is important to note that a majority of Lifeline participants who completed the heart FFQ at the first assessment did not complete all three petal FFQs at subsequent assessments. Comparison of participants who completed the total Flower FFQ and who did not complete it showed that completers were a little older, had a higher SES, smoked less and were less physically active compared to non-completers. Participants who completed the total Flower FFQ may live healthier or may be more conscious about their health and are therefore more likely to complete all the questionnaires, which means that some selection bias occurred. However, in the present study population, a large variation in age, SES, smoking behaviour and physical activity still exists. Together with the high degree of comparability with data from the DNFCs and the NDARD, we conclude that data on dietary intake of the Lifelines population in the current article are generalisable to the general Dutch population.

4.2. Opportunities of Lifelines Data and Importance of Stratification

The large sample size of the Lifelines cohort and its heterogeneity in participant characteristics provide the opportunity to perform well-powered stratified analyses in studies on associations between dietary intake and the development of chronic diseases and healthy aging. To study these associations, stratification is important to control for confounding factors and effect modifiers, such as sex, age, SES and BMI [22,23]. In this article, we presented dietary intake for men and women separately, as well as for different categories of age, SES and BMI. Regarding energy and macronutrient intake, we observed a decrease in intake with both increasing age categories and increasing BMI categories, whereas no striking differences were observed between different categories of SES. The observation within different categories of BMI seems paradoxical; however, it is well known that a higher BMI is associated with misreporting, which could be explained by the tendency of participants to providing socially desirable answers [24]. Another explanation may be that participants with a higher BMI followed a calorie-restricted diet more often than participants with a lower BMI. In men, the percentages of participants that followed such a diet were 0.6, 2.0 and 5.0 for the normal weight, overweight and obese categories, respectively. In women, these respective percentages were 2.7, 7.5 and 11.5. Regarding intake of food groups, differences were observed between different categories of age, SES and BMI. This underlines the importance of stratification in research on dietary intake.

4.3. Strengths and Limitations

All self-reporting methods are prone to several types of error such as recall bias or the tendency to provide socially desirable answers [25]. An FFQ is not the best method to evaluate absolute nutrient intake and adequacy of nutrient intake. A specific limitation of an FFQ is that single foods are grouped into groups of food items, wherein the variation of reported intake may be underestimated. This results in a smaller distribution of nutrient intake, and consequently an underestimation of the prevalence rate of (in)adequate intake. Therefore, calculating and interpreting such prevalence rates should be done with caution. However, an FFQ is a reliable method to rank participants to their intake levels [26,27], which is also true for the specific Flower FFQ [10]. In epidemiologic studies on associations of dietary intake with diseases or health status, such as the Lifelines cohort study, ranking of participants according to their intake levels is usually more relevant than absolute levels of intake. Moreover, FFQs are the cheapest and most feasible method to assess food consumption patterns over a long time, which is another reason for their usefulness is epidemiologic studies. For the participants, however, an FFQ may be time-consuming and therefore considered burdensome to complete. This may result in the return of incomplete questionnaires and less valid answers at the end compared to the beginning of the questionnaire. As the Flower FFQ consists of four questionnaires that are administered at different time points, experienced burden and risk of bias may be lower for this FFQ than for a general FFQ. To illustrate, comparison of the time used to complete a regular FFQ and the Flower FFQ showed that completion of a regular FFQ took on average 43 min, and
completion of the heart FFQ and the first, second and third petal took on average 24, 9, 8 and 9 min, respectively, adding up to a total of 50 min [10]. For the Lifelines cohort study, the different questionnaires were administered at different time points within a period of five years. Although stable food consumption patterns over time are assumed [11], changes in food consumption patterns may have occurred within these five years.

5. Conclusions

In conclusion, data on dietary intake obtained from the Flower FFQ among participants of the unique Lifelines cohort study are quite extensive and generalisable to the general Dutch population. As such, highly valuable dietary intake data are available in the Lifelines database to study associations between dietary intake and the development of chronic diseases and healthy aging.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/nu14010048/s1, Table S1: Classification of 212 food items into 30 food groups.

Author Contributions: E.M.B.-B., C.W.M.P. and J.H.M.d.V. developed the Flower FFQ for the Lifelines cohort study; A.M.B. analysed the data and all authors interpreted the results; A.M.B. wrote the manuscript and E.M.B.-B., C.W.M.P., J.H.M.d.V. and E.J.M.F. critically reviewed it. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The Lifelines cohort study is conducted according to the principles of the Declaration of Helsinki and in accordance with the research code of the University Medical Center Groningen (UMCG). The Lifelines cohort study is approved by the medical ethical committee of the UMCG, The Netherlands.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data availability Statement: Data may be obtained from a third party and are not publicly available. Researchers can apply to use the Lifelines data used in this study. More information about how to request Lifelines data and the conditions of use can be found on their website (https://www.lifelines.nl/researcher/how-to-apply) (accessed on 1 November 2021).

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Conflicts of Interest: The authors declare no conflict of interest.

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