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G.B.M. Mensink · J. Truthmann · M. Rabenberg · C. Heidemann · M. Haftenberger · A. Schienkiewitz · A. Richter

Department of Epidemiology and Health Monitoring, Robert Koch Institute, Berlin

# Fruit and vegetable intake in Germany

## Results of the German Health Interview and Examination Survey for Adults (DEGS1)

### Background and purpose

The composition of the food we eat has a significant influence on our health. Including a high percentage of fruit and vegetables in our daily nutrition is of advantage, because they are important sources of vitamins, minerals, trace elements, dietary fibres and phytochemicals. They usually have high water content and a very low fat content, which means that they contain only few calories per volume unit. The favourable ratio of high nutrient and low energy content with a relatively good satiety effect makes fruits and vegetables particularly valuable from a nutritional physiological perspective. In addition, a high percentage of fruit and vegetables in our daily nutrition can help to reduce consumption of animal-based foods, thereby also reducing the intake of saturated fatty acids. Furthermore, systematic reviews emphasise the importance of high fruit and vegetable consumption with regard to the prevention of various chronic diseases, such as coronary heart disease, hypertension and stroke [1, 2, 3].

According to the current recommendations of the German Nutrition Society (DGE), adults are encouraged to eat at least 400 g of vegetables and 250 g of fruit every day [4]. Parallel to this, the "5-a-day" campaign, which promotes the consumption of five portions of fruit and vegetables per day, has been running in

Germany since 2002. Up to one portion can be substituted by a glass of fruit or vegetable juice. This is roughly equal to the quantities recommended by the DGE for adults [4]. In the past, however, these recommended levels were not met by the majority of the German population [5, 6, 7]. With the "German Health Interview and Examination Survey for Adults" (DEGS), the current fruit and vegetable consumption was evaluated on the basis of representative data.

### Methods

DEGS is part of the national health monitoring system at the Robert Koch Institute (RKI). The concept and design of DEGS are described in detail elsewhere [8, 9, 10, 11, 12]. The first wave (DEGS1) was conducted from 2008 to 2011 and comprised interviews, examinations and tests [13, 14]. The target population comprises residents of Germany aged 18 to 79 years. DEGS1 has a mixed design that permits both cross-sectional and longitudinal analyses. For this purpose, a random sample from local population registries was drawn to complete the participants of the "German National Health Interview and Examination Survey 1998" (GNHIES98) who re-participated. A total of 8,152 persons participated, including 4,193 first-time participants (response rate, 42%) and 3,959 revisiting participants of GNHIES98 (response

rate, 62%). In all, 7,238 persons attended one of the 180 examination centres, and 914 were interviewed only. The net sample (n=7,988) permits representative cross-sectional and time trend analyses to be performed for the age range of 18–79 years in comparison with GNHIES98 (n=7,124) [12]. The data of the revisiting participants are suitable for longitudinal analyses.

To assess food intake, the participants received a nutrition questionnaire several days before their visit to the study centre and were asked to take the completed questionnaire to the appointment. The semi-quantitative food frequency questionnaire assesses the food consumption frequencies and amounts of a total of 53 food groups consumed over a period of 4 weeks, and is a further development of the nutrition questionnaire used in the German Health Interview and Examination Survey for Children and Adolescents (KiGGS) [5]. The main modification was the adaptation of the questions on food portions to the usual dietary habits of adults. For this, information on the frequency of food consumption from the German Nutrition Survey 1998 [15], a module of GNHIES98, and the National Nutrition Survey II (NVS II) [7] was used. Both nutrition questionnaires of KiGGS [16] and DEGS1 [17] were validated. The DEGS1 nutrition questionnaire was validated among 161 adults who completed standardised 24-

**Tab. 1** Mean (95% confidence intervals) portions of fruit, vegetables and juices consumed per day in the adult population of Germany (DEGS1), according to sex and age group (n=7,010)

Age group in years	18–29	30–39	40–49	50–59	60–69	70–79	Total
<b>Women</b>							
Fruit and vegetables <sup>a</sup>	2.8 (2.5–3.0)	3.1 (2.8–3.4)	2.9 (2.6–3.1)	3.3 (3.0–3.6)	3.7 (3.4–4.0)	3.2 (2.8–3.5)	3.1 (3.0–3.2)
Fruit	1.4 (1.2–1.6)	1.6 (1.3–1.8)	1.5 (1.3–1.6)	1.9 (1.7–2.2)	2.3 (2.0–2.6)	2.0 (1.7–2.3)	1.8 (1.6–1.9)
Vegetables	1.0 (0.9–1.1)	1.1 (1.0–1.2)	1.1 (1.0–1.2)	1.1 (1.0–1.2)	1.1 (1.0–1.2)	0.9 (0.8–1.0)	1.0 (1.0–1.1)
Juices	0.9 (0.7–1.0)	0.8 (0.6–1.0)	0.6 (0.4–0.7)	0.5 (0.4–0.7)	0.6 (0.4–0.7)	0.4 (0.3–0.5)	0.6 (0.6–0.7)
<b>Men</b>							
Fruit and vegetables <sup>a</sup>	2.0 (1.8–2.2)	2.2 (2.0–2.4)	2.3 (2.2–2.5)	2.4 (2.1–2.6)	2.8 (2.6–3.1)	2.6 (2.4–2.8)	2.4 (2.3–2.4)
Fruit	0.8 (0.7–0.9)	1.0 (0.9–1.2)	1.2 (1.1–1.3)	1.3 (1.2–1.5)	1.7 (1.5–1.9)	1.5 (1.4–1.7)	1.2 (1.2–1.3)
Vegetables	0.7 (0.6–0.8)	0.7 (0.7–0.8)	0.8 (0.7–0.8)	0.7 (0.7–0.8)	0.8 (0.7–0.9)	0.8 (0.7–0.8)	0.8 (0.7–0.8)
Juices	1.1 (0.9–1.2)	0.9 (0.7–1.2)	0.7 (0.5–0.8)	0.7 (0.5–0.8)	0.5 (0.4–0.7)	0.5 (0.4–0.7)	0.7 (0.7–0.8)

<sup>a</sup>Fruit, vegetables and up to one glass of fruit or vegetable juice

h dietary recalls two times in addition to the nutrition questionnaire. The ranking of intake quantities per food group in the same or adjacent quartile for both methods ranged between 68% for cooked vegetables and 94% for coffee, which implies a reasonable to good validity [17].

In the DEGS1 nutrition questionnaire, the question “How often did you eat (or drink)...?” is asked for each food group (referring to the last 4 weeks). The presented analyses include the following food groups: “fruit juice (e.g. orange, apple, cherry juice)”, “vegetable juice (e.g. tomato or carrot juice)”, “fresh fruit (e.g. apple, banana)”, “cooked fruit (e.g. compote, canned fruit)”, “raw vegetables (e.g. garden lettuce, raw vegetables salads)”, “legumes (e.g. beans, peas, lentils)” and “cooked vegetables”.

The consumption frequencies can be answered with the categories “never”, “once a month”, “2–3 times a month”, “1–2 times a week”, “3–4 times a week”, “5–6 times a week”, “once a day”, “2 times a day”, “3 times a day”, “4–5 times a day” or “more often than 5 times a day”. For the portion size, a choice can be made between “1/2 portion (or less)”, “1 portion”, “2 portions”, “3 portions” or “4 portions (or more)” as well as—depending on the food—“1/4 portion”. Standard portion units are given, depending on the food group, for example: glass, cup, mug, bowl, plate, slice or piece. In addition, photos are included alongside many of the questions to illustrate the portion sizes. The average consumption expressed as portions per day was calculated from the data on frequency and quantities.

Calculations were made for the separate groups (fruit, vegetables, juices), as well as for the aggregated group. In accordance with the dietary recommendations for fruit and vegetables, up to one portion (one glass) of consumed fruit or vegetable juice was added to total fruit and vegetable intake.

Data from GNHIES98 were included to determine the change in fruit and vegetable intake over the last 10 years. In addition to the associated German Nutrition Survey 1998, food frequency questions about various food groups were included in the general health questionnaire of GNHIES98. The central question on food consumption frequency was: “How often do you consume the following foods and/or convenience products? Please consider the last 12 months”. After this, the foods were listed in a tabular format that included among others “fresh or frozen vegetables (cooked)”, “canned vegetables”, “leaf lettuce, raw vegetable salad, raw vegetables (e.g. tomatoes, carrots, sweet pepper)” and “fresh fruit”. Another question was: “How frequently do you consume the following drinks? Please consider the last 12 months”. The drinks included among others “fruit and vegetable juices”. The answer options for both question blocks were “several times a day”, “daily or almost daily”, “several times a week”, “roughly once a week”, “two to three times a month”, “once a month or less” and “(almost) never”. The answer options from DEGS1 and GNHIES98 were combined for the analyses in order to make the best possible comparison. To compare the frequencies of fruit and

juice consumption with the GNHIES98 answer category “several times a day”, the DEGS1 answer categories “2 times a day” and higher frequencies were combined. To compare vegetable consumption, the category “almost daily and more often” was constructed by combining the GNHIES98 answer categories “several times a day” and “daily or almost daily” as well as the DEGS1 answer categories “5–6 times a week” and higher frequencies.

Socioeconomic status was determined using an index that includes information on school education and vocational training, professional status and net household income (weighted by household needs) and which enables a classification into low-, middle- and high-status groups [18].

The cross-sectional analyses included persons aged 18–79 years who participated in the examination part (n=7,116), since only this group also completed the DEGS1 nutrition questionnaire. A total of 7,080 nutrition questionnaires were completed. After plausibility checks, 70 participants were excluded because their questionnaires showed either very high (n=9) or very low (n=53) amounts of intake or were incomplete (more than 20 missing values; n=8). Accordingly, 7,010 participants were included in the analysis. The trend analyses included the 18- to 79-year-old participants in GNHIES98 (n=7,124) and DEGS1 (n=7,010).

The cross-sectional and trend analyses were conducted with a weighting factor that corrects deviations in the sample from the population structure (as of 31 December 2010) with regard to age, sex,

region and nationality, as well as community type and education [12]. A separate weighting factor was prepared for the examination part. Calculation of the weighting factor also considered the re-participation probability of the GNHIES98 participants, based on a logistic regression model. A non-response analysis and a comparison of selected indicators with data from census statistics indicated a high level of representativity of the net sample for the resident population of Germany aged 18–79 years [12]. To take into account the weighting as well as the correlation of the participants within a community, the confidence intervals were determined with the survey procedures for complex samples of SAS 9.3. Differences were regarded as statistically significant if the respective 95% confidence intervals did not overlap. Results are presented by sex and age groups (18–29, 30–39, 40–49, 50–59, 60–69 and 70–79 years) and by socioeconomic status.

## Results

The mean number of portions consumed per day of total fruit and vegetables (including up to one glass of juice) and separately for fruit, vegetables and fruit and vegetable juices, according to sex and age groups, are shown in **Tab. 1**. Overall, with an average of 3.1 portions, women consume significantly more fruit and vegetables than men, who have an average of 2.4 portions. This is attributable in particular to a significantly higher consumption of fruit and a slightly but still significantly higher consumption of vegetables. Fruit consumption becomes higher with advancing age among both women and men up to the 60–69-year age group. Vegetable intake, on the other hand, is almost constant over all age groups, whereas juice consumption decreases slightly with advancing age.

**Tab. 2** shows the percentage of persons consuming certain quantities of total fruit and vegetables (including up to one glass of juice) according to sex and age groups. The percentage of persons who meet the “5-a-day” recommendation is of particular interest, and more than twice as many women (15.1%) as

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G.B.M. Mensink · J. Truthmann · M. Rabenberg · C. Heidemann · M. Haftenberger · A. Schienkiewitz · A. Richter

## Fruit and vegetable intake in Germany. Results of the German Health Interview and Examination Survey for Adults (DEGS1)

### Abstract

To date, the recommendations of the German Nutrition Society on fruit and vegetable intake have not been met by the majority of the population. In the first wave of the “German Health Interview and Examination Survey for Adults” (DEGS1), which was conducted from 2008 to 2011, food consumption was determined with a validated food frequency questionnaire in a representative random sample of the 18–79-year-old resident population of Germany (n=7,116). The number of portions of fruit and vegetables consumed on average every day and the number of persons meeting the recommended five portions of fruit and vegetables per day were calculated. On average, women consume 3.1 and men 2.4 portions of fruit and vegetables per day. Moreover, 15% of women and 7%

of men reach the recommended quantity of five portions per day. Fruit intake increases in both men and women up to the age of 60–69 years. About 39% of women and 25% of men consume at least three portions of fruit and vegetables per day. The proportion of men and women who consume at least three portions per day tends to increase with rising socioeconomic status. Although the intake of fruit has increased slightly compared to previous surveys, the percentage of persons who consume five portions of fruit and vegetables per day is still very low.

### Keywords

Health survey · Adults · Fruit · Vegetables · Food frequency

## Obst- und Gemüsekonsum in Deutschland. Ergebnisse der Studie zur Gesundheit Erwachsener in Deutschland (DEGS1)

### Zusammenfassung

Bisher wurden die Empfehlungen der Deutschen Gesellschaft für Ernährung zum Obst- und Gemüseverzehr von einem Großteil der Bevölkerung nicht erreicht. In der von 2008 bis 2011 durchgeführten ersten Welle der „Studie zur Gesundheit Erwachsener in Deutschland“ (DEGS1) wurde in einer repräsentativen Stichprobe der 18- bis 79-jährigen Wohnbevölkerung (n=7.116) der Lebensmittelverzehr mit einem validierten Verzehrhäufigkeitsfragebogen ermittelt. Es wurde berechnet, wie viele Portionen Obst und Gemüse durchschnittlich pro Tag konsumiert werden und wie viele Personen die Empfehlungen von 5 Portionen Obst und Gemüse pro Tag erreichen. Im Mittel konsumieren Frauen 3,1 und Männer 2,4 Portionen Obst und Gemüse pro Tag. 15% der Frauen

und 7% der Männer erreichen die empfohlenen 5 Portionen pro Tag. Der Obstverzehr nimmt bei Frauen wie Männern bis zum Alter von 60 bis 69 Jahren zu. Mindestens 3 Portionen Obst und Gemüse pro Tag konsumieren 39% der Frauen und 25% der Männer. Der Anteil der Männer und Frauen, die täglich mindestens 3 Portionen verzehren, nimmt mit steigendem Sozialstatus tendenziell zu. Obwohl die Verzehrhäufigkeit von Obst gegenüber früheren Erhebungen leicht angestiegen ist, ist der Anteil der Personen, der 5 Portionen Obst und Gemüse am Tag konsumiert, immer noch sehr gering.

### Schlüsselwörter

Gesundheitssurvey · Erwachsene · Obst · Gemüse · Verzehrhäufigkeit

men (7.0%) achieved this. Nevertheless, 39.0% of women and 24.7% of men manage to eat at least three portions of fruit and vegetables per day. Comparing age groups, the lowest prevalence of women who consume at least five portions a day is seen among the 40- to 49-year-olds. The percentage of men who consume at least five portions increases with age up to the 60–69 years age group. Among

both sexes, the percentage of persons who consume at least three portions a day is highest among the 60- to 69-year-olds. About half of the women and more than half of the men consume between one and less than three portions per day. The percentage of those who eat less than one portion per day decreases with age.

**Tab. 3** shows the percentage of persons who reach a certain amount of por-

**Tab. 2** Proportion of persons (percentage and 95% confidence intervals) in categories of portions of fruit, vegetables and juices<sup>a</sup> consumed per day in the adult population of Germany (DEGS1), according to sex and age group (n=7,010)

Age group in years	18–29	30–39	40–49	50–59	60–69	70–79	Total
<b>Women</b>							
Less than one portion	18.5 (14.8–22.8)	10.9 (8.0–14.8)	13.4 (10.3–17.2)	12.1 (9.0–15.9)	6.0 (4.4–8.2)	7.7 (5.3–11.2)	11.9 (10.5–13.4)
One to less than three portions	48.3 (43.2–53.4)	52.9 (46.7–58.9)	52.4 (47.8–56.9)	45.5 (40.7–50.4)	44.9 (40.2–49.6)	51.2 (45.7–56.7)	49.2 (47.0–51.4)
Three to less than five portions	19.5 (15.8–23.7)	21.4 (16.7–26.9)	23.2 (19.8–27.1)	24.6 (21.3–28.4)	30.5 (25.8–35.5)	25.3 (20.8–30.3)	23.9 (22.2–25.6)
Five portions or more	13.8 (10.6–17.8)	14.8 (10.9–19.8)	11.0 (8.8–13.7)	17.8 (14.2–22.2)	18.6 (15.2–22.7)	15.8 (11.9–20.7)	15.1 (13.6–16.7)
<b>Men</b>							
Less than one portion	25.3 (21.1–30.0)	23.2 (18.6–28.5)	16.8 (13.5–20.7)	21.6 (17.4–26.3)	12.4 (9.6–15.9)	13.1 (9.9–17.3)	19.3 (17.7–21.0)
One to less than three portions	55.6 (51.0–60.1)	54.9 (48.5–61.1)	60.5 (55.7–65.1)	52.4 (47.5–57.3)	55.2 (49.9–60.3)	56.5 (51.0–61.7)	56.0 (53.7–58.3)
Three to less than five portions	14.1 (10.9–18.1)	16.3 (12.2–21.3)	16.8 (13.8–20.3)	19.3 (15.8–23.5)	20.8 (16.6–25.7)	20.8 (16.8–25.6)	17.7 (16.1–19.4)
Five portions or more	5.0 (3.1–8.0)	5.7 (3.4–9.4)	5.9 (4.1–8.5)	6.7 (4.8–9.3)	11.6 (8.5–15.7)	9.5 (7.0–12.8)	7.0 (6.1–8.1)

<sup>a</sup>Fruit, vegetables and up to one glass of fruit or vegetable juice

**Tab. 3** Proportion of persons (percentage and 95% confidence intervals) in categories of portions of fruit, vegetables and juices<sup>a</sup> consumed per day in the adult population of Germany (DEGS1), according to sex and socioeconomic status group (n=7,010)

Fruit, vegetables and juice per day	Less than one portion	One to less than three portions	Three to less than five portions	Five portions or more
<b>Women</b>				
Low	17.5 (14.3–21.3)	49.3 (44.2–54.4)	19.5 (15.8–23.8)	13.6 (10.7–17.2)
Middle	11.6 (9.8–13.6)	50.8 (48.0–53.6)	23.2 (21.2–25.4)	14.3 (12.6–16.3)
High	6.6 (4.8–9.0)	43.6 (39.1–48.1)	31.6 (27.3–36.2)	18.2 (15.0–21.9)
<b>Men</b>				
Low	29.2 (24.5–34.4)	50.3 (44.4–56.2)	14.9 (11.5–19.3)	5.6 (3.7–8.3)
Middle	18.3 (16.2–20.5)	57.8 (54.8–60.8)	17.1 (15.1–19.3)	6.8 (5.6–8.3)
High	14.0 (11.4–17.2)	55.8 (51.3–60.2)	21.2 (18.0–24.9)	8.9 (6.9–11.5)

<sup>a</sup>Fruit, vegetables and up to one glass of fruit or vegetable juice

tions of total fruit and vegetables (including up to one glass of juice) per day according to sex and socioeconomic status groups. The percentage of persons who consume three to less than five and five or more portions per day tends to increase (but not significantly) with rising socioeconomic status in both sexes, while the percentage that consumes less than one portion per day decreases significantly.

■ **Tab. 4** presents the percentage of women and men who consume fresh fruit and/or fruit juice (GNHIES98: “fruit and vegetable juices”) several times a day calculated from GNHIES98 and DEGS1. The percentages of women and men who consume raw vegetables (GNHIES98: “leaf lettuce, raw vegetable salad, raw vegetables”) or cooked vegeta-

bles [GNHIES98: “fresh or frozen vegetables (cooked)”) almost daily or more often are also presented. The percentage of women who eat fruit several times a day has increased significantly from 18.5% in GNHIES98 to 26.2% in DEGS1. The percentage of men who eat fruit several times a day is significantly lower than it is among women. Again, the percentage in DEGS1 is higher (13.9%) than in GNHIES98 (9.8%). While DEGS1 shows an increase with advancing age in the percentage of persons who eat fruit several times a day, this is not the case in GNHIES98. The percentage of persons who drink juice several times a day has increased among women and even more substantially among men since the GNHIES98 survey. Overall, the percentages are roughly the same among men

and women in DEGS1. Whereas the percentage of those who drink juice several times a day decreases with advancing age in GNHIES98, no clear age difference can be seen in DEGS1. The percentage of persons who eat raw vegetables almost daily or several times a day is higher among women than among men. A clear and significant decline between GNHIES98 and DEGS1 can be seen for both men and women. A clear increase or decrease with age cannot be observed in either survey. The percentage of those who consume cooked vegetables almost daily or several times a day is higher among women than among men. This percentage has decreased between GNHIES98 and DEGS1, slightly among women and substantially among men, and the difference is significant for both sexes as a whole and also in some age groups. This decline applies to all age groups with the exception of 18- to 29-year-old women.

## Discussion

On average, women consume 3.1 and men 2.4 portions of fruit and vegetables per day, and 15% of women and 7% of men meet the recommended five portions per day. As much as 39% of women and 25% of men, however, consume at least three portions of fruit and vegetables per day. Women in all age groups consume fruit and vegetables more fre-

**Tab. 4** Proportion of persons (percentage and 95% confidence intervals) in categories of frequency of consumption of fresh fruit, (fruit) juices, raw and cooked vegetables in GNHIES98 (n=7,124) and DEGS1 (n=7,010), according to age group

Age group in years		18–29	30–39	40–49	50–59	60–69	70–79	Total
<b>Fresh fruit several times per day</b>								
Wom-en	GNHIES98	17.3 (14.1–21.1)	15.8 (12.9–19.3)	19.3 (16.2–22.8)	23.4 (19.6–27.6)	16.9 (12.8–22.1)	16.6 (12.1–22.2)	18.5 (16.7–20.3)
	DEGS1	20.5 (15.8–26.2)	24.1 (19.5–29.5)	22.1 (18.6–26.0)	27.5 (24.1–31.2)	33.4 (28.7–38.4)	32.9 (27.4–38.9)	26.2 (24.2–28.3)
Men	GNHIES98	7.9 (5.5–11.1)	8.3 (6.3–10.8)	11.7 (8.8–15.5)	11.1 (8.6–14.2)	9.0 (6.2–12.8)	9.8 (6.0–15.6)	9.8 (8.5–11.2)
	DEGS1	6.4 (4.3–9.4)	11.2 (7.8–15.8)	13.5 (10.6–17.1)	15.7 (12.7–19.3)	20.5 (16.5–25.2)	20.1 (16.6–24.2)	13.9 (12.6–15.4)
<b>Juices several times per day</b>								
Wom-en	GNHIES98	14.6 (11.6–18.4)	8.4 (6.6–10.7)	7.9 (6.0–10.4)	6.5 (4.8–8.6)	4.7 (3.2–7.0)	4.2 (2.3–7.4)	7.9 (7.0–9.0)
	DEGS1	12.9 (10.3–16.1)	21.9 (17.0–27.8)	12.9 (10.2–16.2)	10.5 (8.1–13.6)	12.8 (9.7–16.7)	9.0 (6.4–12.6)	13.2 (11.7–14.9)
Men	GNHIES98	6.8 (5.0–9.2)	5.4 (3.8–7.6)	4.2 (2.8–6.3)	4.2 (2.7–6.6)	3.7 (2.2–6.1)	2.8 (1.3–5.6)	4.6 (3.9–5.5)
	DEGS1	14.7 (11.7–18.4)	16.2 (12.1–21.2)	13.4 (10.4–17.2)	10.9 (8.2–14.3)	10.9 (7.9–14.7)	13.2 (9.3–18.5)	13.2 (11.8–14.9)
<b>Raw vegetables almost every day or more often</b>								
Wom-en	GNHIES98	36.5 (32.8–40.4)	38.2 (33.6–43.0)	45.6 (41.3–50.1)	47.7 (42.9–52.6)	39.7 (34.0–45.8)	35.4 (28.6–42.9)	41.0 (38.7–43.4)
	DEGS1	28.7 (24.3–33.4)	25.5 (20.7–30.9)	29.1 (25.0–33.6)	29.5 (25.5–33.8)	29.3 (24.7–34.3)	23.6 (19.5–28.4)	27.8 (25.8–30.0)
Men	GNHIES98	25.6 (21.8–29.9)	25.4 (21.6–29.5)	28.1 (24.0–32.5)	32.7 (28.6–37.1)	35.2 (31.0–39.7)	28.8 (21.7–37.1)	29.1 (26.9–31.4)
	DEGS1	15.2 (11.9–19.2)	17.9 (13.4–23.6)	18.4 (14.2–23.6)	17.1 (13.7–21.1)	20.0 (15.8–24.9)	18.7 (14.8–23.3)	17.7 (15.7–19.9)
<b>Cooked vegetables almost every day or more often</b>								
Wom-en	GNHIES98	12.2 (9.3–15.8)	16.0 (12.9–19.6)	19.7 (16.3–23.7)	20.1 (16.7–24.0)	25.2 (20.6–30.4)	27.8 (21.6–35.0)	19.8 (17.8–21.9)
	DEGS1	15.0 (11.5–19.4)	14.4 (10.6–19.3)	15.0 (11.8–19.1)	16.3 (13.2–19.9)	18.2 (14.5–22.6)	17.3 (13.2–22.4)	15.9 (14.3–17.7)
Men	GNHIES98	12.1 (9.4–15.6)	13.0 (10.3–16.3)	11.6 (9.1–14.8)	13.6 (10.6–17.2)	18.6 (14.2–24.0)	16.8 (12.0–23.0)	13.9 (11.9–16.0)
	DEGS1	7.2 (4.9–10.4)	7.4 (4.8–11.0)	6.6 (4.4–9.8)	6.1 (4.3–8.7)	8.8 (5.7–13.4)	8.6 (6.4–11.5)	7.3 (6.2–8.5)

quently than men. This result is in line with previous studies, which indicate that women are eating more health-consciously than men [19, 20]. The observation that fruit and vegetable intake increases with age up to about 60–69 years, although energy requirements diminish with age, is interesting and may indicate a growing health consciousness with increasing age. The rise in fruit and vegetable consumption in recent years appears to have taken place in the older age groups in particular. Consumption of fruit and vegetable juices, on the other hand, is highest in the younger age groups.

The consumption frequencies from DEGS1 were compared with the data from GNHIES98 on a relatively rough level. Owing to methodological differences, a more detailed comparison of the two consumption estimates is not possible. Questions on consumption frequency were integrated into the general health questionnaire in GNHIES98, whereas a separate nutrition questionnaire was used in DEGS1. The reference period covered the “last 12 months” in GNHIES98 and the “last 4 weeks” in DEGS1. Portion amounts were not assessed in

GNHIES98 [21]. In addition, there were small differences in the answer categories for the frequency questions between the two surveys, and some food groups were defined differently. This also applies to juices and vegetables. In GNHIES98, “leaf lettuce, raw vegetable salad, raw vegetables” and “fruit and vegetable juices” were assessed with one question. In our opinion, the first grouping can reasonably be compared with the question on raw vegetables from DEGS1. However, in DEGS1 separate questions were asked on the intake of fruit and vegetable juice. Owing to the lack of information on portions in GNHIES98, the consumption frequency of vegetable juice cannot simply be added to that of fruit juice because, for example, a combination of “several times a week” for each of these foods can mean that juices are consumed every day, but not necessarily so. The consumption frequency of vegetable juices was very low in DEGS1 and is therefore neglectable for the comparison of these food groups. The questions on the consumption of cooked vegetables also differed: “cooked fresh or deep frozen vegetables” (one question) and “canned vegetables” were assessed with

separate questions in GNHIES98, whereas “cooked vegetables” without any further differentiation and “legumes” were assessed separately in DEGS1. However, the figures for legumes in DEGS1 as well as canned vegetables in GNHIES98 were so low that this difference is of no consequence. The information on fresh fruit, on the other hand, was assessed more or less similarly in both surveys.

Despite the above-mentioned methodological differences, it was observed that the percentage of men and women who consume fruit several times a day has increased. This observation is confirmed by the increasing consumption figures for fruit derived from food balance sheets [22]. The increase between GNHIES98 and DEGS1 is only significant, however, in men and women in the age groups 60–69 and 70–79 years and in women aged 30–39 years. Perhaps persons in these age groups in particular are susceptible to preventive measures. Another remarkable development is the increase in the percentage of men and women who drink juice several times a day. On the contrary, there is a slight reduction in the percentage of men and women who consume raw veg-

etables almost every day and the percentage of men who eat cooked vegetables every day. An influence of the EHEC (enterohaemorrhagic *Escherichia coli*) crisis in 2011 [23] may be conceivable, but preliminary analyses showed no substantial reduction in consumption frequency during the corresponding months.

Other nationwide representative surveys including fruit and vegetable consumption have been conducted in recent years. In the “German Health Update 2010 (GEDA 2010)”, which is part of the national health monitoring at the Robert Koch Institute, approximately 22,000 persons were interviewed by telephone [24]. The survey period (September 2009 to July 2010) lies within the DEGS1 survey period. The percentage of persons who consumed five portions of fruit and vegetables per day was slightly lower in GEDA 2010 than in DEGS1 (women 12% vs. 15%, men 5% vs. 7%). The difference is probably attributable to the communication approach and the interview method. A slightly more detailed assessment of foods was possible with the self-administered questionnaire in DEGS1, whereas the assessment by telephone in GEDA 2010 consisted merely of three simple questions on fruit and vegetable intake. An increase in the consumed portions of fruit and vegetables per day with advancing age was observed in both surveys, however. While the differences in prevalence between age groups among women were small, the difference among men was particularly pronounced from the age of 60 years (DEGS1: 60–69 years 12%, 70–79 years 10%; GEDA 2010: 60–69 years 5%, 70–79 years 4%).

In the NVS II, representative consumption data, including fruit, vegetables and juices, were collected throughout Germany from 2005 to 2006 [7]. However, there are also restrictions in comparability between the NVS II and DEGS1, since the NVS II used more quantitative assessment instruments and therefore the results could be presented as gram amounts. Despite this, increased fruit consumption with advancing age was also observed in the NVS II, with the highest intake amounts being observed among 65- to 80-year-old men and 51- to 64-year-old women [7]. The NVS II

also recorded a higher consumption of fruit and vegetables in individuals with a higher socioeconomic status. Whereas almost no difference was observed in the number of vegetable portions per day between age groups in DEGS1, the consumed amounts of vegetables increased with advancing age in the NVS II. This is probably attributable to the more detailed assessment of several kinds of vegetables.

Within all surveys used to evaluate fruit and vegetable consumption, there are methodological differences in the assessment instruments, the sampling procedures and the communication approaches (telephone, self-administered or face-to-face interviews). This complicates the comparison and interpretation of the results. In addition, there are differences in the reference periods, which have probably strained the memory skills of the participants to different degrees, and seasonal fluctuations were also accounted for in different ways.

## Conclusion

**Fruit intake has increased slightly compared to previous surveys. The percentage of persons who reach the recommended five portions of fruit and vegetables per day is still very low.**

## Corresponding address

### G.B.M. Mensink

Department of Epidemiology and Health Monitoring, Robert Koch Institute  
General-Pape-Str. 62–66, 12101 Berlin  
Germany  
g.mensink@rki.de

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## References

- Boeing H, Bechthold A, Bub A et al (2012) Critical review: vegetables and fruit in the prevention of chronic diseases. *Eur J Nutr* 51:637–663
- World Cancer Research Fund/American Institute for Cancer Research (2007) Food, nutrition, physical activity, and the prevention of cancer: a global perspective. AICR, Washington
- World Health Organization (2003) Diet, nutrition and the prevention of chronic diseases. Report of a joint WHO/FAO expert consultation. WHO, Geneva
- Deutsche Gesellschaft für Ernährung (2012) Jetzt mit 5 am Tag in die Saison starten. DGE aktuell – Presseinformation. Deutsche Gesellschaft für Ernährung e. V., Bonn, <http://www.dge.de>
- Mensink GBM, Burger M (2004) What do you eat? Food frequency questionnaire for children and adolescents (in German). *Bundesgesundheitsbl Gesundheitsforsch Gesundheitschutz* 47:219–226
- Rabenberg M, Mensink GBM (2011) Fruit and vegetable consumption today. *GBE kompakt* 2(6). Robert Koch-Institut, Berlin
- Max Rubner Institut (2008) Nationale Verzehrsstudie II – Ergebnisbericht, Teil 2. Max Rubner Institut – Bundesforschungsinstitut für Ernährung und Lebensmittel, Karlsruhe
- Kurth BM, Lange C, Kamtsiuris P, Hölling H (2009) Health Monitoring at the Robert Koch-Institute. Status and perspectives (in German). *Bundesgesundheitsbl Gesundheitsforsch Gesundheitschutz* 52:557–570
- Kurth BM (2012) Das RKI-Gesundheitsmonitoring – was es enthält und wie es genutzt werden kann. *Public Health Forum* 20(76):4.e1–4.e3
- Göbwald A, Lange M, Kamtsiuris P, Kurth BM (2012) DEGS: German health interview and examination survey for adults. A nationwide cross-sectional and longitudinal study within the framework of health monitoring conducted by the Robert Koch-Institute (in German). *Bundesgesundheitsbl Gesundheitsforsch Gesundheitschutz* 55:775–780
- Scheidt-Nave C, Kamtsiuris P, Göbwald A et al (2012) German health interview and examination survey for adults (DEGS) – design, objectives and implementation of the first data collection wave. *BMC Public Health* 12:730
- Kamtsiuris P, Lange M, Hoffmann R et al (2013) The first wave of the German health interview and examination survey for adults (DEGS1). Sampling design, response, sample weights, and representativeness. *Bundesgesundheitsbl Gesundheitsforsch Gesundheitschutz* 56:620–630
- Robert Koch-Institut (Hrsg) (2009) DEGS: Studie zur Gesundheit Erwachsener in Deutschland – Projektbeschreibung. Beiträge zur Gesundheitsberichterstattung des Bundes. RKI, Berlin
- Göbwald A, Lange M, Dölle R, Hölling H (2013) The first wave of the German health interview and examination survey for adults (DEGS1). Participant recruitment, fieldwork, and quality management. *Bundesgesundheitsbl Gesundheitsforsch Gesundheitschutz* 56:611–619
- Mensink G, Burger M, Beitz R et al (2002) Was essen wir heute? Ernährungsverhalten in Deutschland. Robert Koch-Institut, Berlin
- Truthmann J, Mensink GBM, Richter A (2011) Relative validation of the KiGGS food frequency questionnaire among adolescents in Germany. *Nutr J* 10:133

- 
17. Haftenberger M, Heuer T, Kube F et al (2010) Relative validity of a food frequency questionnaire for national health and nutrition monitoring. *Nutr J* 9:36
  18. Lampert T, Kroll L, Müters S, Stolzenberg H (2013) Measurement of socioeconomic status in the German health interview and examination survey for adults (DEGS1). *Bundesgesundheitsbl Gesundheitsforsch Gesundheitsschutz* 56:631–636
  19. Heidemann C, Scheidt-Nave C, Richter A, Mensink GBM (2011) Dietary patterns are associated with cardiometabolic risk factors in a representative study population of German adults. *Br J Nutr* 106:1253–1262
  20. Mróz LW, Chapman GE, Oliffe JL, Bottorff JL (2011) Men, food, and prostate cancer: gender influences on men's diets. *Am J Mens Health* 5:177–187
  21. Mensink GBM, Beitz R (2004) Food and nutrient intake in East and West Germany, 8 years after the reunification – the German Nutrition Survey 1998. *Eur J Clin Nutr* 58:1000–1010
  22. Heseke H, Gedrich K, Wagner K, Karg G (2008) Trendanalysen zum Lebensmittelverbrauch auf der Basis der Agrarstatistik. *Ernährungsbericht 2008*. Deutsche Gesellschaft für Ernährung e. V., Bonn, S 20–36
  23. Buchholz U, Bernard H, Werber D et al (2011) German outbreak of *Escherichia coli* O104:H4 associated with sprouts. *N Engl J Med* 365:1763–1770
  24. Robert Koch-Institut (2012) Daten und Fakten: Ergebnisse der Studie "Gesundheit in Deutschland aktuell 2010". Beiträge zur Gesundheitsberichterstattung des Bundes. RKI, Berlin