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Prevalence of persons following a vegetarian diet in Germany

Abstract

People adopt a vegetarian diet for various reasons. A largely plant-based diet not only has advantages for health, it also has positive social and environmental aspects. The aim of this analysis is to provide a description of the people in Germany who follow a predominantly vegetarian diet and to compare their food consumption with those of non-vegetarians. As part of DEGS1 (2008–2011), a validated questionnaire was used within a representative sample of 6,933 persons aged 18 to 79 to study how often and how much of 53 different food groups was consumed during a four-week period. The questionnaire also included a question about a vegetarian diet. The data were analysed descriptively and with a binary-logistical regression model. In Germany, 4.3% of the population (6.1% of women and 2.5% of men) aged 18 to 79 usually follows a vegetarian diet. The highest proportion of vegetarians is found among 18- to 29-year-olds (women 9.2% and men 5.0%) and among women aged 60 to 69 (7.3%). People with a higher level of education are more likely to usually follow a vegetarian diet. The same applies to people who live in large cities and those who conduct more than four hours of sports per week. In addition, women and men who usually follow a vegetarian diet not only consume significantly less meat compared with non-vegetarians, they also drink less energy-reduced drinks, and less beer and wine; they also drink more tea and eat more fruit and vegetables. A vegetarian lifestyle is often associated with positive socio-political impacts. It can, among others, contribute to a reduction in factory farming, which means it can help preserve the environment. A reduction in meat consumption in Germany would also be beneficial from a public health perspective, since meat consumption is currently considerably higher than the amounts recommended by the German Nutrition Society. The benefits linked to a vegetarian diet would be further strengthened, if, in addition to the relatively small group of people who completely refrain from eating meat, a larger section of the population would reduce their meat consumption.

NUTRITION · VEGETARIAN · HEALTH SURVEY · DEGS1 · GERMANY

1. Introduction

People decide to follow a vegetarian diet for various reasons. Common motives include ethical and moral concerns, which are also embedded in some religions. In this particular case, respect for every living being, a rejection of killing animals, and of causing suffering play significant roles. But vegetarianism can also be grounded on environmental reasons: a vegetarian diet can help reduce factory farming and lower methane and CO_2 polution. Furthermore, a vegetarian diet also conserves the energy and water that would otherwise have been

needed for animal farming. Vegetarianism can, therefore, promote a more compassionate manner of handling the environment [1], and a focus on plant-based products could even help provide the world's population with sufficient food. Lastly, individual considerations about improving personal health can also play a role in the decision to adopt a vegetarian diet.

There are several types of vegetarian diet including ovo-lacto-vegetarianism, lacto-vegetarianism and veganism. In addition, there are types of diet which are based on largely plant-based foods, including large amounts of fruit and vegetables, but still include certain amounts of meat (flexitarianism) or fish (pesco-vegetarianism) (Table 1) [2, 3]. The reasons for vegetarianism described above play an important role in the decision about which type of diet an individual may choose to adopt. Industry has recognised the growing trend towards vegetarianism and has expanded its range of food products to include a wide variety of vegetarian and vegan products; these are becoming increasingly common in supermarkets and discount chains in Germany. Over the last few years, it has become far easier to eat a balanced vegetarian diet in Germany, and, today, vegetarians are more than just an idealistic minority in this country.

The vegetarian diet has a long history. The first written references to vegetarianism in Europe can be found in ancient Greece around 600 BC. The first German vegetarian association was founded in 1867 [4].The first German studies focusing on the impact of a vegetarian diet on health, particularly in relation to cancer and cardiovascular diseases, were conducted in Heidelberg, Gießen, and Berlin in the 1970s and 1980s [5–7].

1.1 The impact of the vegetarian diet on health

There was an initial assumption within the fields of nutrition and health science that vegetarians might have a higher risk of nutritional deficiencies [4]. In fact, it is more difficult to gain enough of certain nutrients from a vegetarian, or especially a vegan diet, than from a mixed diet. An adequate supply of vitamin B_{12} can be particularly

Table 1
The various forms of the vegetarian diet

Name	Does not eat...
Ovo-lacto-vegetarian	...meat and fish products; this is what is usually meant by the term 'vegetarian'
Lacto-vegetarian	...meat and fish products, eggs
Ovo-vegetarian	...meat and fish products, milk and dairy products
Pesco-vegetarian	...meat products
Flexitarian (normally vegetarian)	...meat and fish products; occasionally, however, small amounts of meat and fish products are consumed
Vegan	...all animal products (meat, fish, milk, eggs, honey)
Raw food	...all animal products (meat, fish, milk, eggs, honey) and cooked or processed food
Fruitarians/frugivores	...all animal products (meat, fish, milk, eggs, honey) and cooked or processed foods, including vegetables; only eats fruit, nuts and seeds

problematic [8]. Vitamin B_{12} deficiency is associated with various neurological conditions and an increased risk of cardiovascular diseases [9]. The intake of the following nutrients can also be critical in a vegetarian diet: long-chain n-3 fatty acids, vitamin D, iron, calcium, zinc, iodine and selenium [3, 4, 10]. However, over the last few years, observations have concluded that vegetarians are not more likely to suffer from deficiencies of some of these nutrients than non-vegetarians [4, 11]. In particular, folate intake among vegetarians is usually higher than among non-vegetarians [4]. Recent studies have observed a generally healthy nutritional balance among people who follow a vegetarian diet and especially among those who follow a vegan diet. The Oxford-EPIC study showed that vegans have higher intakes of polyunsaturated fatty acids, unsaturated fatty acids and fibre. The overall better quality of fats ingested by vegans is due to their higher consumption of plant-based foods [12–14]. Nevertheless, vegans do need to ensure adequate levels of critical nutrients, especially vitamin B_{12}, by taking dietary supplements or eating fortified foods [11, 15, 16].

In Germany, 4.3% of the adults usually follow a vegetarian diet.

The potential of a vegetarian, or mostly vegetarian, diet to reduce the risk of chronic diseases such as obesity, type 2 diabetes mellitus, cardiovascular diseases and cancer is currently emphasized [17]. A review based on several studies has shown that the prescription of a vegetarian diet can help to reduce the body mass index (BMI) [18]. A recent meta-analysis showed that a vegetarian diet is associated with a lower risk of ischemic heart diseases in both genders. It also identified a significant reduction in cerebrovascular diseases and all-cause mortality, but only among men [11]. Nevertheless, the health benefits associated with a vegetarian diet have mainly been shown in studies conducted on members of the Seventh-day Adventist Church [11, 17, 19, 20]. Most of these individuals follow, for religious reasons, a vegetarian diet and they also tend to live a generally healthier lifestyle than the overall population: they are less likely to smoke; they do not drink alcohol, and are more physically active. The impact of these lifestyle factors on the correlation between diet and health could not be completely disentangled until now.

The health benefits associated with a vegetarian diet are probably not only due to the high proportion of plant-based foods consumed by vegetarians and vegans; they are also due to the exclusion of animal products from vegetarian diets. A number of studies have demonstrated an independent association between a high level of consumption of animal products, especially processed red meat, and a higher risk of all-cause mortality [16, 19, 21]. In general, the German Nutrition Society (DGE) considers a vegetarian diet appropriate to adapt permanently. However, the DGE recommends that pregnant and breastfeeding women, as well as infants, children and adolescents, should avoid a vegan diet as it can be more difficult to obtain an adequate supply of some nutrients [22]. In contrast, the US Academy of Nutrition and Dietetics (AND; formerly known as American Dietetic Association) provides a different recommendation in this respect: the AND states that well-planned vegetarian and vegan diets are appropriate for individuals during all stages of life. Moreover, the AND also points out that a vegetarian diet can actually be beneficial because it helps prevent and treat certain diseases [23].

Vegetarians consume significantly lower amounts of energy-reduced drinks, beer and wine, and significantly higher amounts of tea, fruit and vegetables than non-vegetarians.

1.2 The prevalence of the vegetarian diet in Germany

In general, meat consumption in Germany has steadily reduced since 1990 [24]. Estimates of the prevalence of vegetarianism in Germany over the last 20 years have varied between 2% and 10%. The German National Health Interview and Examination Survey 1998 (GNHIES98) showed that about 8% of women and 3% of men exclusively or predominantly follow a vegetarian diet [25]. In 2006, the German National Nutrition Survey II (NVS II) indicated that approximately 2% of the population in Germany between 14 and 80 years of age was vegetarian [26]. An online survey conducted in 2013 showed that about 4% of the population is vegetarian; flexitarians were estimated at around 12% [27]. In contrast, the German Vegetarian Union (VEBU) estimates approximately 10% of the population as vegetarian, and 1% as vegan [28]. A European comparison of selected countries observed the highest numbers of vegetarians in Germany, Britain and Italy (9%), with relatively low numbers of vegetarians in France, Switzerland, and Austria (3%) [4].

The German Health Interview and Examination Survey for Children and Adolescents (KiGGS baseline survey, 2003–2006) showed that less than 2% of boys aged 3 or over and 3% of girls in the same age group consumed no meat, poultry or sausage [29, 30]. Among 14- to 17-year-olds this was as much as 2% of boys and 6% of girls. There are more young vegetarians in medium-sized and large cities. Children and adolescents with an immigration background are also more likely to be vegetarian [31].

The German Health Interview and Examination Survey for Adults (DEGS1, 2008–2011), which was conducted by the Robert Koch Institute, also collected information about vegetarian diets. The aim of the following analysis is to provide the prevalence of vegetarians in Germany and to describe the distribution of the vegetarian diet according to a number of selected characteristics. In addition, the food consumed by vegetarians is compared with that of non-vegetarians.

2. Methods

2.1 Dietary assessment in the German Health Interview and Examination Survey for Adults (DEGS1)

DEGS1 was carried out between 2008 and 2011 and is part of the Robert Koch Institute's health monitoring system. The concept and design of DEGS1 are described in detail elsewhere [12, 32, 33]. As part of DEGS1, comprehensive questionnaires, examinations, and tests were conducted among a representative sample of 18- to 79-year-old-population. Food consumption data was gathered using a semi-quantitative food frequency questionnaire (FFQ). This FFQ is a validated instrument that records the frequency and the portion size of a total of 53 food groups consumed over a four-week period [34]. The questionnaire was a further development of the FFQ used as part of the KiGGS baseline study [35]. In DEGS1, the questionnaire was completed by the study participants who also took part in the physical examination, and is available for a total of 7,115 people. It included the question: 'How many times have you eaten (or drunk) ...?' for each of the 53 food items.

Answers on how often a particular type of food was eaten could be provided as follows: 'never', 'once a month', '2–3 times per month', '1–2 times per week', '3–4 times per week', '5–6 times per week', 'once per day', 'twice per day', '3 times per day', '4–5 times per day', and 'more times than 5 times per day'. Serving sizes could be reported for example as '½ portion (or less)', '1 portion', '2 portions', '3 portions' or '4 portions (or more)'. Depending on the type of food, there was also the option to select '¼ portion'. Additional portion descriptions in different measures were provided depending on the type of food, such as a glass, cup, bowl, plate, slice or piece. In order to provide a better estimate of portion size, most of the questions were illustrated with a picture. Data on how often and how much of a particular food was consumed were used to calculate the average food consumption. Food items were categorized into food groups for the following analysis.

A vegetarian diet is more prevalent among women (6.1%) than men (2.5%).

2.2 Collecting information on vegetarian diet

As part of the DEGS1 FFQ, the participants were also asked: 'Do you usually follow a vegetarian diet?' This question could be answered with 'Yes' or 'No'. Valid responses to this question are available for 6,933 people. In the following, the group of people who answered 'Yes' are referred to as vegetarian. Respondents who answered 'No' are considered non-vegetarian. However, the wording of the question influences the possible distribution of vegetarianism as it uses the word 'usually', the definition of vegetarian in DEGS1, thus may, also include people who occasionally eat meat or fish.

2.3 Construction of further variables

The information provided by participants on educational qualifications was used to create educational categories in line with the 'Comparative Analysis of Social Mobility

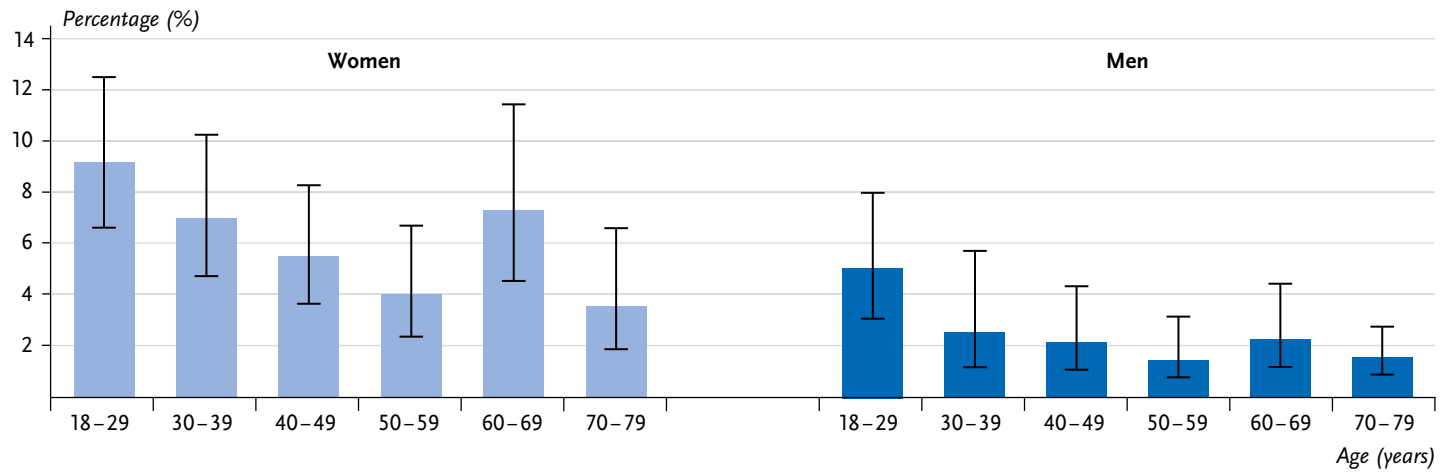

Fig. 1
The proportion of 18- to 79-year-olds who usually follow a vegetarian diet according to gender and age
Source: DEGS1 (2008–2011)

in Industrial Nations' index (CASMIN). This index takes into account the differences between vocational training and more general educational paths [36]. Additionally, socio-economic status was determined using an index based on data collected on education, training, professional status, and net household income, which was weighted according to household needs. This index enabled the respondents to be categorised into low, medium or high socio-economic status [15].

Sport activity during the last three months was assessed by asking the following question: 'How often do you do sport?' The answers were categorised into 'I don't do any sport', 'less than 1 hour a week', 'regularly, 1 to 2 hours a week', 'regularly, 2 to 4 hours a week' and 'regularly, more than four hours a week'. These categories were reclassified for purposes of the current analysis as '> 4 hours a week' and '≤ 4 hours a week'. Using the information on the participant's residency and the number of inhabitants in their local area, place of residence was categorised as 'rural (<5,000 inhabitants)', 'provincial (5,000 to <20,000 inhabitants)', 'medium-sized city (20,000 to <100,000 inhabitants)' and 'large city (≥ 100,000 inhabitants)'.

The analyses were carried out using a weighting factor to correct the deviations within the net sample from the actual German population statistics (as of 31 December 2010) regarding age, gender, region, nationality, place of residence, and education. The analyses were conducted using the complex survey procedures available in SAS 9.4, taking account of the weighting factors and the effect of the cluster design.

3. Results

3.1 Socio-demographic characteristics of vegetarians in Germany

In Germany, 4.3% of adults aged 18 to 79 usually follow a vegetarian diet. A vegetarian diet is more common among women (6.1%) than men (2.5%) (Figure 1). The proportion of vegetarians is highest among 18- to 29-year-olds among both women (9.2%) and men (5.0%). The percentages reduce with increasing age, with the exception of women aged 60 to 69 since 7.3% of women in this age group usually follow a vegetarian diet.

Table 2 shows the percentages of women and men who usually follow a vegetarian diet according to socio-economic status, education, and community size.

Table 2
The proportion of 18- to 79-year-olds who usually follow a vegetarian diet according to gender, socio-economic status, level of education and size of place of residence
Source: DEGS1 (2008–2011)

	Women	Men
	% (95% CI)	% (95% CI)
Socio-economic status	**(n=3,594)**	**(n=3,300)**
Low	8.1 (5.5–11.7)	1.9 (0.7–4.7)
Medium	4.9 (3.8–6.3)	2.6 (1.7–3.7)
High	7.8 (5.3–11.4)	2.5 (1.6–3.9)
Education	**(n=3,652)**	**(n=3,359)**
Low	5.3 (3.8–7.3)	1.5 (0.8–2.9)
Medium	6.0 (4.6–7.7)	2.5 (1.6–3.7)
High	8.8 (6.1–12.7)	4.2 (2.6–6.8)
Community size	**(n=3,673)**	**(n=3,378)**
Rural (<5,000)	4.6 (3.0–7.1)	1.3 (0.6–2.5)
Provincial (5,000 – <20,000)	6.9 (4.7–10.2)	2.2 (1.1–4.4)
Medium-sized city (20,000 –< 100,000)	4.7 (3.3–6.8)	1.9 (1.1–3.3)
Large city (≥ 100,000)	7.4 (5.4–10.1)	4.0 (2.6–6.1)

CI = confidence interval

Table 3
Multivariate associations between a vegetarian diet and selected determinants for 18- to 79-year-olds (n = 6,745)
Source: DEGS1 (2008–2011)

	OR (95% CI)
Gender	
Women	**2.9 (2.0–4.1)**
Men	Ref.
Age	
18–29 years	**2.7 (1.3–5.4)**
30–39 years	1.5 (0.8–2.9)
40–49 years	1.3 (0.6–2.6)
50–59 years	**0.9 (0.4–1.8)**
60–69 years	1.4 (0.7–3.0)
70–79 years	Ref.
Education	
Low	Ref.
Medium	1.1 (0.7–1.7)
High	**1.7 (1.0–2.9)**
Community size	
Rural (<5,000)	Ref.
Provincial (5,000–<20,000)	1.1 (0.7–1.9)
Midium-sized city (20,000–<100,000)	1.0 (0.6–1.7)
Large city (≥ 100,000)	**1.6 (1.0–2.6)**
Sport activity	
>4 hours/week	**1.7 (1.0–2.6)**
≤4 hours/week	Ref.

OR = odds ratio; CI = confidence interval; Ref. = Reference group
Bold: significant ($p < 0.05$)

A vegetarian diet is most common among 18- to 29-year-old women and men, and women aged 60 to 69.

In women, a vegetarian diet is most common among those with a low socio-economic status; in contrast, men with a low socio-economic status are less likely to be vegetarian. A breakdown by education level, however, demonstrates that a higher proportion of both women and men with higher educational levels are more likely to usually follow a vegetarian diet. The proportion of people who usually follow a vegetarian diet is at its highest among both men and women who live in large cities.

According to the results of the binary logistic regression analyses, when gender, age, education, municipality size, and sporting activity is taken into account, women, people aged 18 to 29, people with a high education level, people who take part in sports, and people who live in large cities are significantly more likely to follow a vegetarian diet than the reference group (Table 3).

3.2 Food consumption by vegetarians

In the comparison of the average consumption of aggregated food groups in grams per day for women and men according to whether they usually follow a vegetarian or a non-vegetarian diet, it is observed that vegetarians not only eat significantly less meat than non-vegetarians, but they also consume less energy-reduced drinks, beer, and wine, and significantly more tea, fruit, and vegetables (Table 4). Women who usually follow a vegetarian diet, moreover, consume significantly less spirits, eggs, and pizza, and more dairy products compared with non-vegetarians. Men who usually follow a vegetarian diet consume significantly lower amounts of coffee and potatoes, and significantly more pasta and rice compared with non-vegetarians.

4. Discussion

Data from DEGS1 suggest that 4.3% of adults aged 18 to 79 in Germany usually follow a vegetarian diet. A vegetarian diet is significantly more common among women, young adults, people with a high education level,

Table 4
Food consumption for 18- to 79-year-olds according to gender and whether they usually follow a vegetarian or non-vegetarian lifestyle
Source: DEGS1 (2008–2011)

	Women (g/day)				Men (g/day)			
	vegetarians (n=190)		non-vegetarians (n=3,483)		vegetarians (n=79)		non-vegetarians (n=3,299)	
Food groups	M	% (95% CI)	M	95% CI	M	95% CI	M	95% CI
Milk	239	(187–291)	265	(246–285)	219	(108–331)	276	(253–299)
Fizzy drinks and fruit juice	330	(198–462)	377	(336–417)	397	(106–689)	561	(514–609)
Energy-reduced drinks	**93**	(1–185)	111	(87–134)	**46**	(16–76)	118	(91–144)
Vegetable juice	14	(4–25)	7	(6–8)	14	(-5–34)	6	(5–7)
Water	1,826	(1,484–2,168)	1,779	(1,700–1,859)	1,644	(1,186–2,102)	1,386	(1,319–1,452)
Tea	**590**	(439–740)	364	(332–395)	**530**	(270–791)	209	(186–232)
Coffee	430	(320–540)	478	(451–505)	**358**	(249–468)	501	(473–529)
Beer	**23**	(13–34)	38	(33–44)	**63**	(30–96)	256	(225–286)
Wine	**20**	(14–26)	30	(28–33)	**24**	(14–33)	34	(29–38)
Spirits	**3**	(1–5)	9	(9–12)	12	(3–21)	13	(11–15)
Cereals	6	(4–8)	5	(4–5)	12	(6–18)	6	(5–7)
Bread	136	(118–154)	137	(132–142)	169	(126–212)	183	(176–191)
Spreadable fats	7	(6–9)	9	(8–9)	10	(7–12)	11	(11–12)
Dairy products	**155**	(131–180)	123	(118–128)	159	(35–283)	112	(106–118)
Sweet spreads	11	(9–13)	10	(10–11)	25	(-5–56)	11	(10–12)
Eggs	**10**	(8–12)	14	(14–15)	32	(10–55)	19	(18–21)
Meat and sausages	**27**	(18–37)	88	(85–91)	**70**	(30–110)	138	(132–144)
Fish	13	(8–18)	17	(16–18)	30	(12–48)	19	(17–20)
Fruit	**451**	(349–554)	250	(236–265)	**267**	(189–344)	182	(173–191)
Vegetables	**206**	(177–235)	154	(147–160)	**174**	(140–208)	111	(106–116)
Pasta and rice	47	(41–54)	45	(44–47)	**83**	(60–106)	52	(49–55)
Potatoes	88	(67–108)	90	(86–94)	**79**	(58–101)	104	(98–110)
Pizza	**12**	(9–14)	15	(14–16)	38	(22–53)	24	(23–26)
Cake	24	(19–29)	28	(26–30)	40	(27–54)	33	(31–35)
Confectionery	33	(27–40)	38	(35–40)	35	(22–48)	40	(36–44)
Savoury snacks	2	(1–3)	4	(2–6)	6	(1–10)	4	(4–5)
Nuts	3	(2–4)	2	(2–2)	6	(1–12)	2	(2–2)

CI = confidence interval; M = mean
Bold: significant ($p < 0.05$)

people who live in large cities, and among people who take part in sport for more than four hours per week.

The fact that many young women in particular are vegetarian has been observed in previous studies [25, 26]. Nevertheless, the relatively high proportion of vegetarian women among the 60- to 69-year-old age group is remarkable. A number of reasons could have a combined influence on this situation: one possible explanation could be that women in this age group no longer have to make as many compromises about their diet as they did when they had to give greater consideration to the preferences of other family members. In addition, their children may have convinced them to adopt a vegetarian diet. Health consciousness is also particularly high among this age group: an analysis of the data collected by the German Health Update (GEDA) shows that women over 60 are significantly more likely to care strongly or very strongly about their health than younger women [37]. Furthermore, they are more likely than men to adopt a vegetarian diet for health reasons following the diagnosis of a disease [38]. Finally, a cohort effect could also play a role to some extent: during the 1960s and 1970s, when these women were adolescents or young adults, Western Europe experienced a growing interest in the Far East and especially in Indian spirituality, meditation and, in connection also, vegetarianism [39].

The proportion of people following usually a vegetarian diet rises with increasing levels of education.

The conclusion that a vegetarian diet is more common among individuals with a higher socio-economic status and people with a higher education level is also confirmed by other studies [40]. Within the DEGS1 results, it is remarkable that women with a low socio-economic status are significantly more likely to adopt a vegetarian diet than women with a mid-level socio-economic status. This can be explained by the fact that many young people have a low socio-economic status because they are still in training or at university and, thus, either have little or no income. This is also one of the reasons why the link to educational level was examined. A similar effect was not identified in this regard; instead, it is possible to draw a clear gradient with education, with a higher prevalence of vegetarianism among people with higher levels of education.

People who take part in sport more than four hours per week are more likely to follow a vegetarian diet than those who are less active. In addition, vegetarians were significantly more likely to state that they paid a lot of attention to achieve enough physical activity (results not shown). In fact, when vegetarians are compared with non-vegetarians, the statistically significant differences between the food choices those groups make, demonstrate a generally more health-conscious form of food consumption among vegetarians. These findings indicate that vegetarians live an overall healthier lifestyle than non-vegetarians. This has been observed in previous studies, including those conducted among the members of the Seventh-day Adventist Church mentioned above. However, irrespective of religion-based lifestyles, people who follow a vegetarian diet are generally less likely to smoke; they also drink less alcohol, and are more physically active [11].

However, the analysis of the vegetarian diet using data from DEGS1 has a number of limitations. Due to the low prevalence of vegetarianism and the complex study design, it is pointless to use other determinants

to differentiate between the various forms of vegetarianism. The descriptive results largely demonstrate overlapping confidence intervals (Figure 1 and Table 2). Statistically significant associations become apparent in the multivariate analysis. Moreover, it is hardly possible to evaluate the additional information which could be used to differentiate between the various forms of vegetarianism. DEGS1 asked the supplementary question: 'Which of the following foods do you not eat?', with the option to select 'meat, poultry, and sausage', 'fish', 'milk and dairy products', and 'eggs'. However, approximately half of the respondents who reported to follow usually a vegetarian diet skipped this question, and the subgroups are too small for specific evaluation.

Compared with other studies on vegetarianism, DEGS1 observed a slightly lower proportion of vegetarians among the population than suggested by the results of the German National Health Interview and Examination Survey 1998 (GNHIES98). This could be due to the different ways in which the studies formulated their questions about vegetarianism. GNHIES98 classified people who had been vegetarian in the past as currently vegetarian. In contrast, DEGS1 only took a participant's diet at the time of the study into account. The fluctuating proportion of vegetarians and vegans among the German population could also be connected to the fact that meat scandals may have caused people to give up meat temporarily; this may have occurred in 2000, when beef consumption collapsed after the first German case of BSE was reported.

In recent years, other studies have identified a similar proportion of vegetarians and vegans in Germany as DEGS1 [25, 27]. The proportion of vegetarians and vegans has probably increased further in recent years. Nevertheless, the results of these studies varied considerably between 2% and 10% (see introduction) [26, 28]. This is partly due to the various definitions used by the studies and the way in which the vegetarian diet is measured. Some studies use reported food intake to define participants as vegetarian [41]. This procedure is particularly problematic because of the increasingly large number of vegetarian and vegan meat substitutes available. Thus, if a participant answered 'Yes' to a question about whether they eat sausages, they could be referring to vegetarian sausages; on the other hand, a simple question such as 'Are you vegetarian?' would not do justice to the variety of vegetarian diets. Therefore, it is probably more meaningful to ask direct questions about participants' diet in future studies to enable an analysis of the different forms of a plant-based diet. Moreover, DEGS1 used the term 'usually' in the question about vegetarian diet. This widens the range of people it classifies as vegetarian, and may reduce the comparability with other study results. In contrast, the National Consumption Study II (NVS) estimated that 2% of the population are vegetarian, which is a significantly lower prevalence, but this study also operated with a much stricter definition of the term. Moreover, the NVS II also gathered detailed information about the type of vegetarian diet its participants were following (vegan, lacto-vegetarian, ovo-vegetarian, ovo-lacto-vegetarian, and ovo-lacto-vegetarian with fish, as well as a raw fruit and vegetable diet). No questions, however, were asked about a flexitarian diet. In contrast, the definition used

Infobox

The German Nutrition Society (DGE) recommends a diversified diet which properly combines nutrient-rich and low-energy foods. Many of its guidelines can actually be achieved more easily through a plant-based diet; i.e.:

- At least 30 grams of dietary fibre daily.
- 5 servings of fruits and vegetables a day, preferably fresh.
- No more than 300–600 g of meat and meat products per week.

See: 10 guidelines for a wholesome diet by the DGE:
https://www.dge.de/index.php?id=322

in DEGS1 does take into account the fact that there are now many 'flexitarians' in Germany, and this could also explain the higher prevalence of the vegetarian diet in DEGS1.

Currently, only a relatively small number of people in Germany entirely omit the consumption of meat and fish. A greater contribution to achieving widely shared socio-political aims, such as protecting the environment or reducing levels of factory farming, could be achieved if a larger section of the population were to gradually reduce its consumption of animal products without necessarily giving up entirely the consumption of animal products. This trend would be desirable from a public health perspective, since average meat consumption in Germany is considerably higher than the level recommended by the DGE (see infobox). Moreover, a shift towards a vegetarian diet is expected to provide benefits to the health of the population [25, 42, 43].

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Breastfeeding monitoring in Germany – What contribution can the data from KiGGS provide?

Abstract

A continuous breastfeeding monitoring is essential as it enables reports on changes in breastfeeding behaviour. The German Health Interview and Examination Survey for Children and Adolescents (KiGGS), which is conducted by the Robert Koch Institute, periodically collects data about the health of children and young people living in Germany, including data on breastfeeding. Moreover, KiGGS is mentioned within the approach developed by the National Breastfeeding Committee as a possible source of data for breastfeeding monitoring.

The data from KiGGS can be used to develop retrospective indicators on breastfeeding for particular birth cohorts. The data demonstrate that the prevalence of children who were ever breastfed tended to rise between the 2001/2002 and 2007/2008 cohorts; however, no significant changes were identified for the 2001–2008 cohorts with respect to breastfeeding duration. Breastfeeding monitoring relies on reports about current trends in the field; due to the periodicity with which the KiGGS study waves are conducted, data on current birth cohorts cannot be provided. Therefore, data on breastfeeding needs to be collected throughout Germany in relation to direct environmental and other factors. This data should be collected during health screenings and regular check-ups so that it can be used as a further measure in breastfeeding monitoring

BREASTFEEDING BEHAVIOUR · BREASTFEEDING PROMOTION · BREASTFEEDING MONITORING IN GERMANY · HEALTH SURVEY · TEMPORAL TRENDS

1. Introduction

Breastfeeding is linked to many short-term and long-term benefits for the health and capacities of breastfed children; it helps ensure that they grow up healthily and contributes to the prevention of various diseases. In the short-term, fewer gastrointestinal and respiratory infections are observed among breastfed children [1]. Furthermore, the results of a recent meta-analysis suggest that breastfeeding is associated with a long-term reduction in the risk of becoming overweight and of obesity, as well as with a slightly higher intelligence quotient [2]. Breastfeeding also strengthens the bond between mother and child.

The World Health Organisation (WHO), along with other international organisations, actively supports the promotion of breastfeeding. According to the Global Strategy for Infant and Young Child Feeding, during the first six months infants should be exclusively breastfed to achieve optimal growth, development and

health [3]. At the European level, the Global Strategy was used to establish an action plan entitled Protection, Promotion and Support of Breastfeeding in Europe [4]. This action plan provides guidelines for the development and implementation of measures aimed at promoting breastfeeding in Europe. A call for standardisation in breastfeeding monitoring constitutes an essential component of the action plan. The plan defines breastfeeding monitoring as the systematic collection of current, comprehensive and accurate data on breastfeeding rates and breastfeeding behaviour at the national and regional level. The German National Breastfeeding Committee has prepared a plan to monitor breastfeeding in Germany [5]. The aim is to adopt an integrative approach that will enable various data sources to be analysed together, while providing complementary results. This should help provide a complete and up-to-date picture of breastfeeding and the conditions in which breastfeeding takes place. Moreover, it could also help establish targeted planning measures that promote breastfeeding and study their effectiveness.

Breastfeeding monitoring involves the systematic collection of current, comprehensive and accurate data on breastfeeding rates and behaviour at the national and regional level with the aim of optimally promoting breastfeeding.

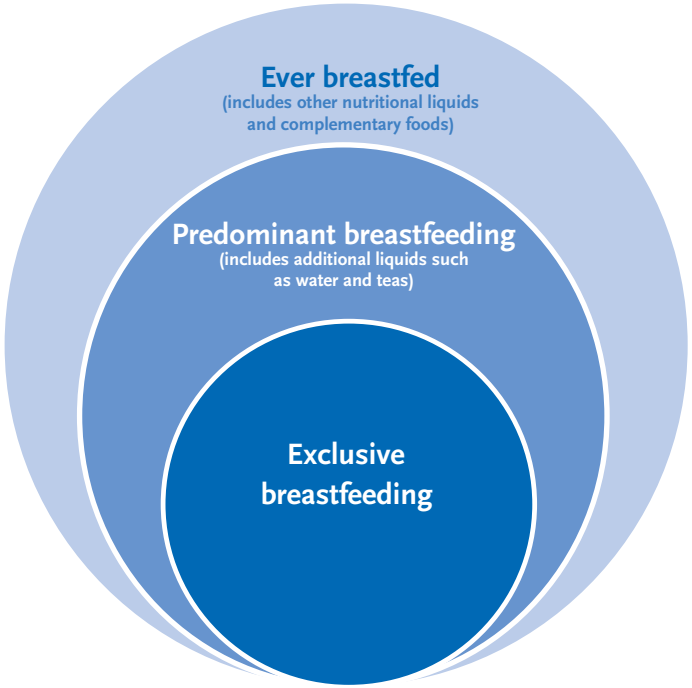


Fig. 1
Definitions of breastfeeding
Source: Own diagram based on [12, 13]

The German Health Interview and Examination Survey for Children and Adolescents (KiGGS), which is conducted by the Robert Koch Institute, is listed as a data source for integrated breastfeeding monitoring within the approach developed by the National Breastfeeding Committee. Results on breastfeeding from the KiGGS study have already been published and enable overall assessments of breastfeeding rates in Germany over longer periods (birth cohorts 1996–2002 and 2002–2012) [6, 7]. Consequently, a detailed analysis of the data in the KiGGS Baseline Survey and KiGGS Wave 1 is important as it would provide extremely useful data for breastfeeding monitoring. Furthermore, it would also enable reports to be made about developments in breastfeeding rates by cohort, and about breastfeeding duration (whether a child was breastfed for two, four, six months, or longer). In addition, it would also enable the study of whether a child was ever, exclusively or predominantly breastfed (Figure 1). This analysis also aims to understand the contribution that the KiGGS data could make to breastfeeding monitoring at the national level in Germany.

2. Methods

KiGGS is a combined cross-sectional and cohort study (for more details about the methodology used see [8–10]). As part of the KiGGS Baseline Survey (2003–2006), a total of 17,641 children and adolescents were studied at 167 sample points (response rate: 66.6%). The follow-up survey, KiGGS Wave 1 (2009–2012), involved a cross-sectional sample of 4,455 newly invited participants aged 0–6 years and 7,913 re-invited participants aged 7–17 years (response rate: 38.8% for newly invited participants; 72.8% for re-invited). In the KiGGS Baseline Survey data on breastfeeding behaviour was gathered from all parents with children and adolescents aged 0 to 17, while in KiGGS Wave 1 from parents of children aged 0 to 10. This means, the data on breastfeeding was gathered retrospectively from different periods (for more details about the collection of breastfeeding data see [7, 11]). If data was gathered in both waves and there was a discrepancy in the answers, the data from the baseline survey was considered to be the correct one (lower recall bias). If discrepancy in the data was observed in cases where the information came from different respondents, the information given from the mother was considered to be the correct one.

Based on the information provided by parents, data from the KiGGS Baseline Survey and KiGGS Wave 1 for the birth cohorts 2001–2008 were used to ascertain the proportion of children who were breastfed until they were two, four or six months old (or older), and whether a child was ever, predominantly, or exclusively breastfed. The data was also used to calculate the average duration of breastfeeding. Children who are exclusively breastfed do not receive any other liquids or complementary foods in addition to breast milk; in contrast, additional liquids such as water or tea may be provided to predominantly breastfed children (this category also includes children who were exclusively breastfed). Children who were ever breastfed will also have been fed other nutritious liquids (in particular infant formula) and supplementary foods (therefore, this category also includes children who were exclusively or predominantly breastfed) [12, 13] (Figure 1).

Two cohorts were combined for the analyses: 2001/2002, 2003/2004, 2005/2006 and 2007/2008. Since the 2006 Parental Allowances and Parental Leave Act applies to all children born after 1 January 2007, [14] it was also interesting to see whether breastfeeding rates or duration differed between the birth cohorts 2007–2008 from those of previous cohorts. As a significant proportion of the 2009–2012 cohort was still breastfed at the time of the survey (the KiGGS Wave 1 survey period), and it was not clear for how long these children would be breastfed, these cohorts were not taken into account as part of the current analysis.

The duration of exclusively breastfeeding was also stratified according to age and educational status of the mother, number of siblings, smoking during pregnancy, (pre)maturity and place of residence. Educational status was categorised in accordance with the international form of classification set out as part of the Comparative Analyses of Social Mobility in Industrial Nations (CASMIN) [15, 16]. Since no differences between girls and boys were found in terms of breastfeeding rates, [7] a gender-based analysis was not conducted.

The KiGGS data demonstrate that the proportion of children who have been ever breastfed tended to increase between the 2001/2002 and 2007/2008 cohorts. However, there was no significant change in breastfeeding duration.

3. Results

The KiGGS data demonstrate an increase in the prevalence of breastfeeding in Germany: whereas 77.0% of children from the 2001/2002 cohorts were ever breastfed, this rate increased to 82.5% among the 2007/2008 cohorts. At the age of six months, about half of the infants were still being breastfed in all cohorts. After this point, however, breastfeeding rates decreased significantly (Table 1).

Two-thirds (66.4%) of the children from the 2007/2008 cohorts were exclusively breastfed, even if it was for a short time. The rate was 63.4% for the 2001/2002 cohorts. The present analyses of KiGGS data show that the prevalence of exclusive breastfeeding between birth and a child's second month of life only decreased slightly (by about five to eight percentage points). However, the prevalence of exclusive breastfeeding decreased particularly between the second and fourth month, with an average difference of 22 percentage points (Table 1). The average duration of exclusive breastfeeding was about four months (Figure 2).

A significant decline in predominant breastfeeding was also identified for children between two and four

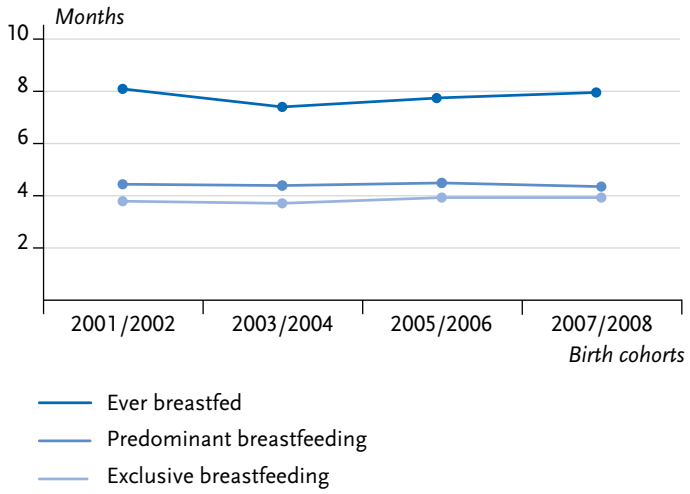
The number of infants who are exclusively or predominantly breastfed significantly falls when children reach two to four months.

		Cohort 2001/2002	Cohort 2003/2004	Cohort 2005/2006	Cohort 2007/2008
	n	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Exclusive breastfeeding					
Ever	3,281	63.4 (58.6–68.0)	63.1 (58.7–67.3)	68.0 (63.2–72.4)	66.4 (62.0–70.5)
2 months	2,911	55.5 (50.6–60.2)	56.4 (51.9–60.8)	61.5 (56.7–66.1)	58.9 (54.8–62.9)
4 months	1,817	33.2 (29.4–37.2)	31.5 (28.0–35.2)	39.1 (34.9–43.4)	38.4 (34.5–42.5)
6 months	590	10.2 (8.1–12.9)	9.2 (7.2–11.7)	12.4 (10.2–15.1)	11.9 (9.8–14.5)
>6 months	202	4.1 (2.6–6.5)	3.8 (2.6–5.6)	3.7 (2.5–5.5)	4.4 (3.1–6.2)
Predominant breastfeeding					
Ever	3,747	70.4 (65.8–74.6)	70.7 (66.1–74.9)	71.8 (67.1–76.0)	72.0 (67.6–76.1)
2 months	3,493	65.9 (61.3–70.5)	66.7 (62.1–70.9)	68.1 (63.3–72.6)	64.6 (60.4–68.5)
4 months	2,552	44.5 (40.5–48.5)	47.3 (42.8–51.9)	49.2 (44.8–53.6)	48.9 (44.8–53.0)
6 months	1,026	20.5 (17.2–24.2)	17.3 (14.5–20.5)	20.3 (17.3–23.6)	18.5 (15.7–21.6)
>6 months	426	9.2 (7.0–11.9)	8.0 (6.2–10.4)	8.7 (6.6–11.2)	8.0 (6.1–10.4)
Ever breastfed					
Ever	4,324	77.0 (72.6–81.0)	80.3 (76.1–84.0)	81.5 (77.3–85.1)	82.5 (78.6–85.8)
2 months	4,092	74.0 (69.5–78.1)	73.5 (68.9–77.6)	75.1 (70.5–79.2)	77.3 (73.2–80.9)
4 months	3,429	58.6 (54.2–62.9)	59.6 (55.2–63.9)	62.2 (57.5–66.7)	65.6 (61.3–69.6)
6 months	2,909	49.2 (45.0–53.3)	49.3 (44.9–53.7)	53.3 (48.7–58.0)	54.4 (50.0–58.7)
12 months	979	17.2 (14.4–20.4)	14.9 (12.3–17.9)	17.9 (15.0–21.3)	21.7 (18.4–25.4)
>12 months	589	11.8 (9.4–14.8)	7.8 (6.3–9.7)	11.0 (8.7–13.8)	12.4 (10.2–14.9)

CI = confidence interval

Table 1
The prevalence of breastfeeding: exclusive and predominant breastfeeding, and ever breastfed in a child's life, according to cohort
Source: KiGGS Baseline Study (2003–2006); KiGGS Wave 1 (2009–2012)

Fig. 2
Average duration of ever breastfed, predominant and exclusive breastfeeding, by cohort (based on all the children who were ever breastfed, n = 4,324))
Source: KiGGS Baseline Study (2003–2006); KiGGS Wave 1 (2009–2012))



A significant decline can be observed in breastfeeding rates after a child becomes six months old for all categories of breastfeeding.

months. At two months, 64.6% of children born in 2007/2008 were predominantly breastfed; even at four months, the rate was only 48.9% (Table 1). Rates of exclusive and predominant breastfeeding and the average duration of breastfeeding remained almost constant for the 2001–2008 cohorts (Figure 2).

Regarding determinants of breastfeeding, the children of mothers with lower levels of education were exclusively breastfed for a significantly shorter period than children of mothers with medium to higher levels of education (Table 2). In addition, children of mothers who smoked during pregnancy, as well as infants who were born prematurely, were breastfed for a significantly shorter period. There is also a positive correlation between the mother's age and the duration of breastfeeding among all cohorts: the duration of exclusive breastfeeding increases with the age of the mother. There was no difference with regards to place of residence (in eastern or western Germany).

4. Discussion

A comparison of the KiGGS results with other studies demonstrates that KiGGS shows a slightly lower rate of ever breastfed than the rates reported from regional studies [17]. However, the rate identified by KiGGS is similar to the nationwide online survey conducted by Libuda et al. (2014). This study showed that 78% of the children from birth cohorts 2007–2010 were ever breastfed [18]. The differences between the findings of regional studies can be explained by the different methodological approaches they used (for example, a prospective study design or the exclusion of prematurely born children). In addition, recall bias also plays a role in retrospective studies, and breastfeeding that lasted for a very short period may be assessed differently in retrospect. Therefore, direct comparisons with other studies are limited.

The rates of predominant breastfeeding at the age of two months from the KiGGS 2007/2008 cohorts (64.6%) are relatively close to the results of Jöllenbeck et al. (2012) for 2008/2009 (65%). However, these data are from a study with regional limitations [19]. The rates of predominant breastfeeding at the age of four months among the 2007/2008 cohorts (48.9% and 50%) also are confirmed by both studies.

The relatively slight decline in the rate of breastfeeding between birth and two months among the KiGGS data was not confirmed by other (prospective) studies. According to these studies, despite an initially high rate of breastfeeding, the strongest decrease in (predominant) breastfeeding occurs during the first two months of a child's life [17]. This might be related to

Table 2
The duration of exclusive breastfeeding according to subgroups
Source: KiGGS Baseline Study (2003–2006); KiGGS Wave 1 (2009–2012)

		Cohort 2001/2002	Cohort 2003/2004	Cohort 2005/2006	Cohort 2007/2008
	n	M in months (95% CI)	M in months (95% CI)	M in months (95% CI)	M in months (95% CI)
Age of mother					
≤ 24 years	531	3.47 (2.61–4.32)	2.81 (2.38–3.25)	3.61 (2.94–4.27)	3.41 (2.80–4.02)
25–29 years	1,409	3.53 (3.13–3.94)	3.48 (3.13–3.83)	3.74 (3.36–4.12)	3.54 (3.18–3.89)
30–34 years	1,855	3.85 (3.59–4.10)	4.20 (3.88–4.51)	3.97 (3.63–4.31)	4.11 (3.89–4.34)
≥35 years	1,300	4.27 (3.95–4.59)	3.95 (3.66–4.23)	4.24 (3.94–4.55)	4.32 (4.00–4.63)
Educational status of the mother					
Low	476	3.40 (2.72–4.08)	3.27 (2.70–3.83)	3.61 (3.16–4.06)	3.32 (2.69–3.95)
Medium	3,362	3.73 (3.51–3.94)	3.76 (3.58–3.95)	3.94 (3.68–4.19)	3.97 (3.77–4.17)
Higher	1,254	4.44 (4.13–4.75)	4.11 (3.76–4.45)	4.33 (4.08–4.58)	4.31 (4.08–4.53)
Number of siblings					
0	2,169	3.90 (3.55–4.25)	3.63 (3.34–3.93)	3.99 (3.72–4.25)	3.87 (3.62–4.12)
1	1,850	3.43 (3.15–3.72)	3.86 (3.61–4.12)	3.94 (3.60–4.28)	3.83 (3.54–4.11)
2 or more	861	4.28 (3.93–4.64)	3.70 (3.11–4.29)	3.98 (3.61–4.35)	4.32 (3.88–4.75)
Twins/Multiple births	182	4.03 (2.80–5.26)	3.83 (3.02–4.64)	3.10 (1.90–4.30)	3.78 (2.69–4.87)
Smoking in pregnancy					
Yes	470	3.57 (2.88–4.27)	2.96 (2.19–3.73)	3.39 (2.52–4.26)	2.67 (2.06–3.27)
No	4,604	3.83 (3.58–4.04)	3.78 (3.58–3.97)	3.99 (3.78–4.19)	4.02 (3.85–4.19)
(Pre)maturity					
Premature birth	408	4.01 (3.46–4.57)	3.60 (3.01–4.18)	3.17 (2.44–3.90)	3.11 (2.44–3.78)
Mature or definitely post-term-birth	4,658	3.78 (3.57–3.99)	3.75 (3.56–3.95)	3.99 (3.79–4.19)	4.01 (3.83–4.19)
Region					
West	3,395	3.91 (3.69–4.14)	3.82 (3.62–4.02)	3.98 (3.78–4.23)	3.98 (3.78–4.19)
East (incl. Berlin)	1,700	3.35 (3.00–3.70)	3.41 (2.97–3.84)	3.68 (3.44–3.92)	3.79 (3.48–4.09)

M = mean, CI = confidence interval

Alongside other potential data sources, the data from KiGGS can provide a contribution to breastfeeding monitoring at the national level.

the fact that prospective studies also include breastfeeding that occurs only in the first few days after birth; there may be a decline of about 10 percentage points in the first week of a child's life [19]. It is also possible that short breastfeeding periods such as these are forgotten or even go unmentioned in retrospective studies. Therefore, in retrospective studies a recall bias cannot be excluded. However, studies about the ability to remember with respect to breastfeeding have shown that questions about whether breastfeeding took place at all and on breastfeeding duration do produce valid answers [20, 21]. Nevertheless, there was a recall bias regarding the precise moment of starting complementary feeding [20].

Infobox: Breastfeeding recommendations

Recommendations by the WHO

"As a global public health recommendation, infants should be breastfed exclusively for the first six months of life to achieve optimal growth, development and health" [4].

Recommendations by the National Breastfeeding Committee at the Federal Institute for Risk Assessment

"Breast milk is the best food for nearly all infants. Exclusive breastfeeding during the first six months provides an adequate diet for the majority of infants.
The point at which an infant will need supplementary foods in addition to breastfeeding depends on the child's well-being and his or her ability to eat. Supplementary foods should be provided no later than at seven months, and no earlier than at five months. The introduction of solid food does not mean that a child should be weaned off breast milk immediately, but instead that the amount of breast milk provided to the child and the frequency of breastfeeding can be reduced. It is up to the mother and the child to jointly decide when it is time to stop breastfeeding" [28].

The current study of KiGGS data showed that external factors such as legislation on parental leave and parental benefits had no discernible influence on breastfeeding behaviour. Nevertheless, in the interest of structural prevention, it would be important to see whether higher breastfeeding rates will be observed in the following years; even though it would not be possible to derive a causal relationship from the data in this case.

The fact that mothers with lower levels of education exclusively breastfeed for a shorter period than mothers with medium or higher education has also been shown by various other national and international studies [22–24]; the same applies to smoking in pregnancy and to premature birth [25]. The positive correlation between maternal age and the duration of exclusive breastfeeding is also demonstrated by other studies [26, 27].

5. Conclusions for breastfeeding monitoring

The KiGGS study has the long-term goal of monitoring and reporting on the health of children and in Germany. As breastfeeding is just one aspect of the KiGGS study, information about factors that encourage or impede breastfeeding cannot be recorded in detail due to the study's scope. However, the data from KiGGS can be used to retrospectively develop indicators for ever, predominant and exclusive breastfeeding, for cohorts for which conclusive data is available. Due to the periodicity of KiGGS waves (about every five years), it is impossible to regularly report on the breastfeeding behaviour of current cohorts. However, breastfeeding monitoring requires current data. Therefore, data on breastfeeding needs to be gathered throughout Germany in relation to direct environmental factors and factors influencing breastfeeding in the context of health screenings for children and regular check-ups. This data could then be used as a further measure that could help develop an overall and up-to-date picture of breastfeeding and the conditions in which it occurs. In turn, and this is foreseen as part of the approach developed on integrative breastfeeding monitoring by the National Breastfeeding Committee [5], this could form a basis with which to plan and review the effectiveness of targeted interventions aimed at increasing breastfeeding rates in Germany.

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Folate status in Germany

Abstract

Folate is important for cell division and thus for growth and physical development. Serum folate concentrations can be used to assess a population's folate status. In Germany, the median serum folate level of adults aged 18 to 79 is 7.5 ng/ml (women: 7.9 ng/ml, and men: 7.2 ng/ml). Approximately 86% of the adult population in Germany has adequate folate levels. Higher folate concentrations are observed among older age groups and individuals with a higher socio-economic status. However, the World Health Organization recommends that women of reproductive age should, at the population level, have significantly higher folate levels in order to reduce the risk for neural tube defects. However, the majority of women in this age group do not achieve these concentrations.

NUTRITION · FOLATE · HEALTH SURVEY · DEGS1 · GERMANY

Approximately 86% of the adult population in Germany have adequate folate levels.

Introduction

Folate refers to the naturally occurring form of this water-soluble B vitamin. Many types of fruit and vegetables (such as green leafy vegetables, cucumbers and tomatoes) as well as potatoes, meat, and bread and pastries made from wholegrain flour are good sources of folate. However, a significant amount of folate can be lost during food preparation, e.g. through exposure to heat [1]. The synthetic form of folate – folic acid – is used in dietary supplements and fortified foods. The two forms are chemically distinguishable: folic acid is more stable when exposed to light, heat and oxygen, and has a higher level of bioavailability than folate [1, 2]. Folate is required for a number of important body functions including cell growth, division and differentiation. An adequate supply of folate, therefore, is particularly important during pregnancy as it can significantly reduce the risk for embryonic malformations (neural tube defects), foetal growth retardation, premature birth, miscarriage and low birth weight [3]. There is also discussion about a possible contribution of folate in the prevention of cardiovascular diseases, neurodegenerative diseases and cancer. However, there is insufficient evidence to support a preventive impact of folate supply beyond general requirements [1].

A population's folate status may be estimated in different ways: firstly, information on folate intake via foods that people consume can be collected (using data gathered through consumption surveys); secondly, serum and erythrocyte folate concentrations can be measured. Whereas erythrocyte folate is a good indicator of an individual's long-term folate status, serum folate levels provide information about an individual's current folate status. Although serum folate concentrations are subject to individual and daily variations, they are still considered an appropriate biomarker for assessing the population's folate status [1, 6]. In the following, results are presented of serum folate analyses collected in the 'German Health Interview and Examination Survey for

Adults' (DEGS1), which was conducted by the Robert Koch Institute between 2008 and 2011 [4, 5].

Indicator

As part of DEGS1, serum folate concentrations were analysed for 7,045 individuals (3,669 women and 3,376 men) aged 18 to 79 years using a chemiluminescent microparticle immunoassay (CMIA, Architect system, Abbott Wiesbaden). A serum folate concentration ≥ 4.4 ng/ml is assumed to be adequate for adults. In contrast, concentrations < 3 ng/ml indicate clinical folate deficiency [1, 6]. In the following, the serum folate concentrations are presented in relation to gender, age and socio-economic status.

Reflection of the results

The median serum folate level measured in DEGS1 was 7.5 ng/ml overall, with 7.9 ng/ml for women and 7.2 ng/ml for men (Table 1). This means that the median value for women and men is significantly higher than the reference level of ≥ 4.4 ng/ml (representing an adequate folate status for adults). Similarly, the German National Health Interview and Examination Survey 1998 (GNHIES98), which was conducted between 1997 and 1999 by the Robert Koch Institute, recorded a median serum folate concentration among its 18- to 40-year-old female participants of 7.6 ng/ml [7]. Therefore, on average, women's folate levels seem to have remained relatively unchanged since the late 1990s (GNHIES98 did not evaluate men's serum folate levels).

DEGS1 demonstrated a positive correlation between serum folate concentrations and age among women and men: in 18- to 29-year-olds, the median serum folate concentration was 6.9 ng/ml for women and 6.3 ng/ml for men, while in the 70- to 79-year-old age group, the concentration was 8.7 and 8.2 ng/ml for women and men, respectively (Table 1). DEGS1 also showed a correlation between serum folate levels and socio-economic status, particularly among women (and less

Folate status improves with increasing age.

Table 1
Serum folate among 18- to 79-year-olds according to gender, age and socio-economic status
Source: DEGS1 (2008–2011)

	n	Median	Serum folate	
		ng/ml	< 3 ng/ml	≥ 4.4 ng/ml
Women (total)	**3,669**	**7.9**	**2.5%**	**88.2%**
Age				
18 – 29 years	539	6.9	3.3%	82.9%
30 – 39 years	429	7.4	2.6%	85.6%
40 – 49 years	691	7.6	2.5%	87.7%
50 – 59 years	752	8.3	2.1%	90.4%
60 – 69 years	712	9.0	2.1%	94.5%
70 – 79 years	546	8.7	2.3%	89.3%
Socio-economic status				
Low	595	7.3	4.3%	81.6%
Medium	2,280	7.9	2.4%	88.9%
High	771	8.5	1.1%	94.2%
Men (total)	**3,376**	**7.2**	**4.1%**	**84.1%**
Age				
18 – 29 years	515	6.3	5.8%	79.1%
30 – 39 years	406	6.7	4.4%	80.3%
40 – 49 years	597	7.1	5.1%	81.3%
50 – 59 years	640	7.5	4.8%	86.2%
60 – 69 years	668	7.9	1.7%	91.1%
70 – 79 years	550	8.2	0.6%	91.0%
Socio-economic status				
Low	518	6.7	7.2%	78.8%
Medium	1,934	7.3	3.7%	84.0%
High	900	7.4	2.7%	89.6%

strongly among men) (Table 1). These findings can probably be explained by the fact that older age groups and people with a higher socio-economic status are more likely to eat more fruit and vegetables [8].

Approximately 86% of the adult population (around 88% of women and 84% of men) has adequate serum folate concentrations of ≥4.4 ng/ml (Table 1). The percentage increases with age. Approximately 12% of women and 16% of men have serum folate values <4.4 ng/ml, indicating an inadequate folate status. The prevalence of people with an inadequate folate status is significantly higher among 18- to 29-year-olds (about 17% of women and about 21% of men) than in the 70- to 79-year-old age group (about 11% of women and about 9% of men). A total of 3.3% of adults (2.5% of women and 4.1% of men) have serum folate levels below 3 ng/ml, indicating clinical folate deficiency (Table 1). Again, the percentage of people with clinical folate deficiency is higher among younger aged groups (18- to 29-year-olds: 3.3% of women and 5.8% of men; 70- to 79-year-olds: 2.3% of women and 0.6% of men).

Most women of reproductive age do not meet the World Health Organization's recommended population level for red blood cell folate to reduce the risk for neural tube defects.

In summary, serum folate concentrations compared with the reference value demonstrates that approximately 86% of the adult population in Germany have an adequate folate status. However, it is important to consider that the reference value applied is intended for the folate status of the general population. For women of reproductive age, however, a higher reference value has been suggested in order to reduce the risk for embryonic neural tube defects. Consequently, WHO recommends that, on a population level, women of reproductive age should have an erythrocyte folate concentration of at least 400 ng/ml [9]. If this recommendation is applied to the biomarker of erythrocyte folate, which has also been measured in DEGS1, 95% of the women would not have adequate levels of folate [10]. A similar situation was already identified in GNHIES98 among women of reproductive age [7]. The present results thus emphasize the importance of the recommendation for periconceptional folic acid supplementation [1], which is followed insufficiently in Germany. It has, however, to be considered that neural tube defects are caused by numerous factors. It is therefore impossible to predict the individual risk of neural tube defects based solely on the WHO-reference value for folate levels in erythrocytes. Folate measurements as presented here, thus, merely serve to provide as an estimate of the folate status of the female population of reproductive age.

In addition to biomarkers, the folate supply can be estimated by use of food intake data gathered via consumption surveys. The German Nutrition Society (DGE) recommends an adult intake of 300 µg folate equivalents per day (equivalents take into account the different bioavailability of folate and folic acid). This rises to 450 µg/day when breastfeeding and to 550 µg/day during pregnancy. Clearly, an adequate consumption of folate-containing foods is required to prevent folate deficiency. Alongside a folate-rich diet, however, the DGE recommends that women who wish to have a child should take a daily supplement containing 400 µg folic acid in order to reduce the risk of neural tube defects. They should start supplementation at least 4 weeks before pregnancy and maintain it during the first trimester of pregnancy [1]. The National Food Consumption Survey II, which was carried

out between 2005 and 2006 by the Max Rubner-Institut, observed that women and men aged between 14 and 80 had a median folate intake of 184 µg/day and 207 µg/day, respectively [11]. Thus, the majority of the adult population failed to meet the reference values for folate intake. Nevertheless, it is important to note that the reference values are intended to assure that at least 97.5% of the population has adequate folate concentrations [1]. Therefore, intake reference values also contain safety margins for people with increased folate needs. Therefore, an assessment of the overall folate supply can also be based on the estimated average requirement (EAR), which indicates the average daily level of intake estimated to meet the needs of 50% of individuals. A study that compared various EU countries, using an EAR of 150 µg/day, revealed that the folate intake of the population in Germany is comparatively adequate [12].

Individuals with a higher socio-economic status generally have higher folate levels.

Note

This fact sheet is based on the chapter on folate published in the German Nutrition Society's 13th German Nutrition Report [10]. This report also provides a more detailed presentation of erythrocyte folate results.

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Sodium intake in Germany

Abstract

For many years, a high sodium intake has been discussed as a potential risk factor in the development of hypertension and, consequently, cardiovascular diseases. As part of the German Health Interview and Examination Survey for Adults (DEGS1), which was conducted between 2008 and 2011, sodium excretion in casual urine samples was used as a biomarker to measure sodium intake. DEGS1 observed that the median daily sodium intake of women (3.4 g) as well as men (4.0 g) exceeds the levels recommended by German and international organisations. Among other factors, men's higher sodium intake could be explained by their higher energy intake. In addition, DEGS1 demonstrates an association between women's sodium intake and age; however, no equivalent correlation was identified for men. Furthermore, although high socio-economic status is associated with lower sodium intake in men, no comparable correlation was observed among women.

NUTRITION · SODIUM · HEALTH SURVEY · DEGS1 · GERMANY

Based on German and international recommendations, sodium intake of large parts of the German population is too high.

Introduction

Sodium is an essential nutrient with important functions in the body [1]. It is a component of table salt, which is added to foods during processing, preparation, and immediately before eating. As such, processed foods, and especially bread, prepared meat products, and dairy products such as cheese, are the primary sources of sodium [2, 3].

A high sodium intake is associated with a risk of high blood pressure (hypertension) and is thereby indirectly related to the development of cardiovascular disease [4–10]. However, not all people respond with elevated blood pressure to high salt intake (salt sensitivity) [11, 12]. Further negative effects of a high sodium intake have also been discussed: these include a possible higher risk of stomach cancer and osteoporosis [13].

In order to compensate for daily losses of sodium, a minimum intake of 0.55 g per day for adults and young people is recommended [1]. The German Nutrition Society (DGE) has defined a guidance level of up to 6 g per day for table salt [14]. This is comparable to a teaspoon of salt and corresponds to a daily sodium intake of about 2.4 g.

A representative and regular assessment of the population's sodium intake in Germany is an important means of assessing and developing practical approaches for the future.

Indicator

The amount of sodium that is excreted throughout the day is assumed to roughly correspond to a person's daily sodium intake; as such, the amount of sodium measured in the urine constitutes a suitable biomarker to measure sodium intake. Casual urine samples were collected as part of the German Health Interview and Exam-

ination Survey for Adults (DEGS1), which was conducted by the Robert Koch Institute between 2008 and 2011 [15]. The measured sodium concentrations were converted to estimates of daily sodium excretion based on creatinine concentrations [15]. The results on sodium intake are analysed according to gender, age, and socio-economic status.

Reflection of the results

The German adult population has a median sodium intake of 3.7 g per day. The median intake of women (3.4 g) is lower than men (4.0 g) (Table 1). This means that 50% of the adult population in Germany has a daily sodium intake that is higher than this level. Sodium intake of 25% of women is 5.0 g per day or more; 25% of men have a sodium intake of 5.7 g per day or more (Table 1, 75th percentile); 5% of women consume more than 8.1 g of sodium per day; and 5% of men consume more than 8.8 g of sodium per day (Table 1, 95th percentile). The mean estimated daily sodium intake (3.8 g for women and 4.5 g for men) is higher than the corresponding median values. Men's higher sodium intake could be explained by their higher energy intake. In terms of units of energy, men and women in Germany have a similar sodium intake [16].

Women's sodium intake does increase until the 40-to-59 age group and decreases slightly in the older age groups. No such age-related trends have been observed among men.

Men tend to have a higher sodium intake than women; this is linked to men's higher dietary energy intake.

Table 1
Estimated sodium intake (percentile) for 18- to 79-year-olds according to gender and age (n=3,626 women, n=3,333 men)
Source: DEGS1 (2008–2011)

	P5 g/day	P10 g/day	P25 g/day	Median g/day	P75 g/day	P90 g/day	P95 g/day
Women (all)	**1.1**	**1.5**	**2.3**	**3.4**	**5.0**	**6.7**	**8.1**
Age							
18–29 years	1.0	1.3	2.0	2.9	4.2	5.9	7.0
30–39 years	1.3	1.5	2.3	3.3	4.7	6.4	7.8
40–49 years	1.3	1.6	2.6	3.8	5.2	7.1	8.5
50–59 years	1.1	1.5	2.4	3.7	5.4	7.0	8.0
60–69 years	1.1	1.5	2.1	3.4	4.8	6.7	7.9
70–79 years	0.9	1.3	2.1	3.1	5.0	6.6	8.6
Men (all)	**1.2**	**1.7**	**2.7**	**4.0**	**5.7**	**7.6**	**8.8**
Age							
18–29 years	1.5	1.8	2.6	3.9	6.0	7.9	8.7
30–39 years	1.1	1.8	2.9	4.2	6.1	8.2	9.2
40–49 years	1.0	1.5	2.6	3.8	5.3	6.9	8.6
50–59 years	1.3	1.9	2.7	4.1	5.9	7.8	9.0
60–69 years	1.3	1.7	2.7	4.1	5.7	7.6	9.6
70–79 years	1.2	1.7	2.6	3.9	5.5	7.6	8.6
Total	**1.2**	**1.6**	**2.4**	**3.7**	**5.3**	**7.2**	**8.6**

P = percentile

Table 2
Estimated sodium intake (median) among 18- to 79-year-olds according to gender and socio-economic status (n=3,602 women, n=3,309 men)
Source: DEGS1 (2008–2011)

	Women g/day	Men g/day
Socio-economic status		
Low	3.4	4.0
Medium	3.5	4.1
High	3.4	3.7

Women's sodium intake is lower among younger and among the highest age groups.

There is no association between women's socio-economic status and sodium intake (Table 2). In contrast, men with a high socio-economic status consume slightly less sodium than men with a mid to low socio-economic status (Table 2).

Estimates of sodium intake in Germany based on sodium excretions in urine are consistently higher than those gained from dietary surveys [2, 3, 11, 17, 18]. Differences in methodology probably account for the discrepancies between the results. The German National Nutrition Survey II determined sodium intake using dietary history interviews (software: DISHES) and two 24-hour recalls [3, 17]. The study found women's median daily sodium intake to be 2.4 g and 1.9 g depending on the specific method and men's median sodium intake at 3.2 g and 2.8 g. The German National Health Interview and Examination Survey 1998 (GNHIES98), which also used DISHES to estimate sodium intake, estimated the daily median sodium intake to be 2.2 g for women and 3.0 g for men [2, 11].

The estimated international average daily sodium intake varies between 2.6 g and 4.8 g and the mean value (calculated using all of the included studies) is 3.7 g [19]. Compared with international levels, the mean daily sodium intake in Germany – 4.1 g – (estimated using sodium excretion) is in the mid to high range.

Compared with recommendations made by national and international organisations, large parts of the German population consume too much sodium: 73% of women and 80% of men in Germany exceed the guidance level defined by the German Nutrition Society [14] of up to 6 g of table salt per day (equivalent to 2.4 g of sodium). Furthermore, 80% of women and 86% of men in Germany exceed the World Health Organization's (WHO) [20] recommendation of a sodium intake of less than 2 g per day.

Since the daily sodium intake in many EU member states is higher than recommended levels, the WHO's Action plan for implementation of the European Strategy for the Prevention and Control of Noncommunicable Diseases 2012–2016 declared the reduction of sodium intake to be one of its five priority areas for intervention [21].

Note

This fact sheet is based on information that appeared in the chapter "Sodium" published in the German Nutrition Society's 13th Nutritional Report [22].

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Vitamin D status of adults in Germany

Abstract

Vitamin D plays an important role in the body as part of bone metabolism. Blood serum concentrations demonstrate that 30.2% of adults (29.7% of women and 30.8% of men) have a deficient vitamin D status. In total, 38.4% of adults (38.6% of women, 38.3% of men) have an adequate status. Although there is little variation among men between the various age groups, the proportion of women with deficient vitamin D status increases with age, while the proportion of women with an adequate status decreases. Furthermore, adults with a low socio-economic status are significantly more likely to have a deficient vitamin D status than adults with a higher socio-economic status. Vitamin D status is subject to strong seasonal fluctuations. In order to ensure adequate concentrations of serum vitamin D, it is recommended to expose the face, hands and arms to the sun two to three times a week between March and October without using sun protection; however, sunburn should be strictly avoided.

NUTRITION · VITAMIN D · HEALTH SURVEY · DEGS1 · GERMANY

30.2% of adults have a deficient vitamin D status and 38.4% of adults have an adequate vitamin D status.

Introduction

Vitamin D is a fat-soluble vitamin that acts in the body like a hormone. An important role in the body is its participation in bone metabolism including promoting absorption of calcium from the small intestine, and strengthening the bones [1]. Severe and prolonged vitamin D deficiency, therefore, can cause bone weakening and skeletal deformations. This may result in rickets in infants and children and osteomalacia in adults.

In older age, vitamin D deficiency can contribute to the development of osteoporosis. In recent years, observational studies have also identified associations between low vitamin D concentrations and various chronic diseases such as type 2 diabetes mellitus, cardiovascular disease and different types of cancer [2–4]. However, evidence of a causal relationship is lacking [5, 6].

The vitamin D status depends on the intake of vitamin D through the diet and the production of vitamin D in the skin when it is exposed to UV-B radiation (vitamin D synthesis) [7, 8]. Since only a small number of foods, such as fatty fish or mushrooms, contain sufficient quantities of vitamin D, the body has to synthesise the vast majority – an estimated share of 80% to 90% – of its vitamin D supply [1]. However, the levels of solar radiation needed to produce enough vitamin D are only available throughout the year at latitudes below 35°. At higher latitudes, the intensity and duration of solar radiation decreases, making vitamin D synthesis dependent on the season in these regions [9–11]. This also applies to Germany, which lies between latitudes 47° and 55°. In Germany, subcutaneous synthesis of vitamin D can take place between March and October [11]. During this time, the

body synthesises vitamin D and stores it in fat and muscle tissue and can be used during the winter months. However, various lifestyle factors inhibit the development of an adequate vitamin D reserve (such as staying indoors or a strong sun protection-behaviour). Therefore, low vitamin D levels are relatively common, particularly during the dark winter months.

People who rarely go outside and those who usually cover their skin when they do so (because of reliance on nursing care or for religious or cultural reasons), those who have darker skin, as well as older people have a higher risk of vitamin D deficiency [12]. The same applies to people with chronic gastrointestinal, liver or kidney disease, and to people who take medicines that negatively affect vitamin D metabolism (such as antiepileptic and cytostatic drugs).

The proportion of women with a deficient vitamin D status increases with age; the proportion of women with an adequate status decreases with age.

Indicator

The German Health Interview and Examination Survey for Adults (DEGS1) [13, 14], which was conducted by the Robert Koch Institute between 2008 and 2011, assessed the vitamin D status of 6,995 participants aged 18 to 79 years by measuring serum 25-hydroxyvitamin D (25(OH)D) [15].

The Institute of Medicine, USA, has evaluated the possible impact of vitamin D status on bone health [16]. An adequate level of vitamin D was assumed at a 25(OH)D serum concentration of >50 nmol/l. Serum concentrations between 30 and <50 nmol/l indicate a suboptimal level of vitamin D and are associated with possible negative consequences for bone health. 25(OH)D serum concentrations of <30 nmol/l indicate a deficient level of vitamin D which is associated with an increased risk of diseases such as osteomalacia and osteoporosis [11]. In the following, vitamin D status is presented using this classification and according to gender, age, socio-economic status and season.

Reflection of the results

In total, 30.2% of adults (29.7% of women and 30.8% of men) between the age of 18 and 79 years have 25(OH)D serum concentrations <30 nmol/l and thus a deficient vitamin D status. Only 38.4% of adults (38.6% of women and 38.3% of men) have an adequate status with 25(OH)D serum concentrations ≥50 nmol/l (Tables 1 and 2).

The results stratified for age show that the proportion of women with an adequate vitamin D status significantly decreases with age, whereas the proportion of women with a deficient status increases slightly (Tables 1 and 2). Among men, the age-trend is less clear. Although the percentage of men with a deficient vitamin D status slightly decreases with age, the proportion of men with an adequate status remains almost constant throughout. The gender-specific differences across the age strata are not entirely explainable. Possible causes which have been discussed include women's higher percentage of body fat and a stronger tendency to seek protection from the sun [17].

The data provided by DEGS1 also demonstrate that women and men with a low socio-economic status significantly more often have a deficient vitamin D status than women and men with a high socio-economic status (Tables 1 and 2). There are also significantly more

Table 1
25(OH)D serum concentrations for 18- to 79-year-old women as classified by the Institute of Medicine according to age and socio-economic status (n=3,635)
Source: DEGS1 (2008–2011)

	25(OH)D <30 nmol/l (deficient)		25(OH)D 30–<50 nmol/l (suboptimal)		25(OH)D ≥50 nmol/l (adequate)	
	Women	Total	Women	Total	Women	Total
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Age						
18–29 years	25.1 (20.7–30.0)	28.4 (24.4–32.8)	28.4 (24.0–33.3)	28.8 (25.4–32.4)	46.5 (40.8–52.2)	42.8 (38.2–47.7)
30–44 years	31.8 (26.5–37.6)	32.8 (28.2–37.8)	25.9 (22.3–29.7)	27.2 (24.2–30.4)	42.4 (36.5–48.4)	40.0 (35.0–45.2)
45–64 years	28.8 (25.1–32.7)	29.6 (26.1–33.3)	34.5 (31.5–37.6)	32.8 (30.4–35.2)	36.8 (32.9–40.8)	37.7 (33.9–41.6)
65–79 years	32.9 (28.3–37.9)	30.0 (26.2–34.2)	36.9 (32.8–41.3)	36.5 (33.2–39.9)	30.1 (25.5–35.2)	33.5 (29.2–38.0)
Socio-economic status						
Low	37.6 (31.6–43.9)	38.6 (33.5–43.9)	37.1 (32.4–42.1)	33.5 (29.7–37.4)	25.3 (21.0–30.2)	28.0 (23.6–32.9)
Medium	28.7 (25.3–32.4)	29.0 (25.4–32.7)	30.5 (28.1–33.1)	30.8 (28.6–33.1)	40.7 (36.5–45.2)	40.2 (36.1–44.5)
High	22.8 (18.6–27.6)	24.8 (21.0–29.2)	30.6 (26.8–34.7)	31.3 (28.5–34.2)	46.6 (41.3–51.9)	43.8 (39.3–48.5)
Total	**29.7 (26.5–33.1)**	**30.2 (26.9–33.8)**	**31.8 (29.7–33.9)**	**31.3 (29.4–33.3)**	**38.6 (35.0–42.3)**	**38.4 (34.7–42.3)**

CI = confidence interval

Table 2
25(OH)D serum concentrations as classified by the Institute of Medicine for 18- to 79-year-old men according to age and socio-economic status (n=3,360)
Source: DEGS1 (2008–2011)

	25(OH)D <30 nmol/l (deficient)		25(OH)D 30–<50 nmol/l (suboptimal)		25(OH)D ≥50 nmol/l (adequate)	
	Men	Total	Men	Total	Men	Total
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Age						
18–29 years	31.6 (26.1–37.6)	28.4 (24.4–32.8)	29.1 (24.6–34.1)	28.8 (25.4–32.4)	39.3 (33.3–45.7)	42.8 (38.2–47.7)
30–44 years	33.8 (28.0–40.2)	32.8 (28.2–37.8)	28.5 (24.0–33.4)	27.2 (24.2–30.4)	37.7 (31.6–44.2)	40.0 (35.0–45.2)
45–64 years	30.4 (25.9–35.3)	29.6 (26.1–33.3)	31.1 (27.8–34.6)	32.8 (30.4–35.2)	38.5 (33.6–43.6)	37.7 (33.9–41.6)
65–79 years	26.6 (21.8–32.2)	30.0 (26.2–34.2)	36.0 (31.5–40.7)	36.5 (33.2–39.9)	37.4 (32.0–43.1)	33.5 (29.2–38.0)
Socio-economic status						
Low	39.6 (33.0–46.7)	38.6 (33.5–43.9)	29.6 (24.1–35.7)	33.5 (29.7–37.4)	30.8 (24.3–38.2)	28.0 (23.6–32.9)
Medium	29.2 (24.8–34.0)	29.0 (25.4–32.7)	31.1 (28.2–34.2)	30.8 (28.6–33.1)	39.7 (34.9–44.7)	40.2 (36.1–44.5)
High	26.5 (21.6–32.0)	24.8 (21.0–29.2)	31.9 (28.0–36.0)	31.3 (28.5–34.2)	41.6 (36.0–47.6)	43.8 (39.3–48.5)
Total	**30.8 (26.8–35.2)**	**30.2 (26.9–33.8)**	**30.9 (28.4–33.6)**	**31.3 (29.4–33.3)**	**38.3 (33.8–42.9)**	**38.4 (34.7–42.3)**

CI = confidence interval

women in the middle and high groups for socio-economic status with an adequate vitamin D status than women in the lower socio-economic group. Such differences are not observed among men and the reason for this is partly unclear. However, it is likely that differences between people's behaviour during their leisure time – especially with respect to outdoor activities – significantly contribute to these observations. It is also conceivable that other risk factors associated with vitamin D deficiency are less common among individuals with a high socio-economic status.

There are only small age-related differences among men.

Figure 1 shows that vitamin D status is subject to strong seasonal fluctuations. During summer, 8.3% of adults have a deficient vitamin D status; during autumn, this is the case for 19.3% of adults. In spring, 38.4% of adults and in winter time, 52.0% of adults have a deficient status. The proportion of adults with an adequate vitamin D status varies similarly strong between the seasons,

Adults with a low socio-economic status are significantly more likely to have a deficient vitamin D status.

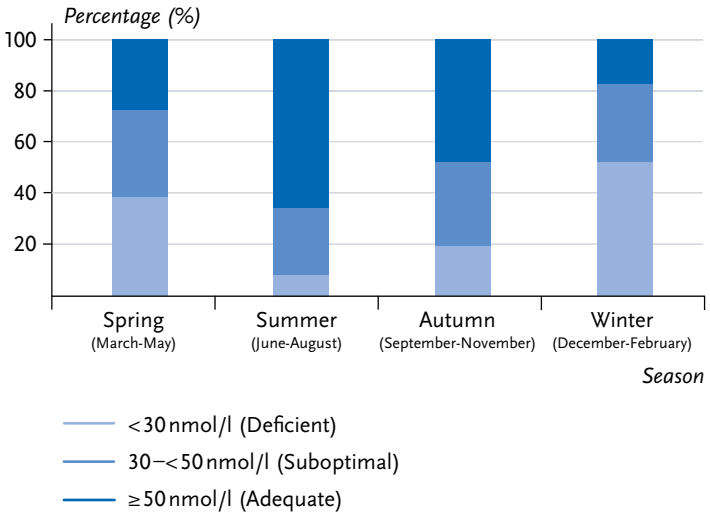

Fig. 1
25(OH)D serum concentrations as classifiedby the Institute of Medicine according to season (n=6,995)
Source: DEGS1 (2008–2011)

ranging from 27.3% in spring, to approximately 65.8% in summer, 47.9% in autumn and 17.6% in winter. In addition to the seasons, other factors are known to influence the body's synthesis of vitamin D. These include the length of time spent in the sun, the use of sunscreen, clothes or other items that cover the body, preferences for shade when outside as well as age and skin pigmentation [11].

The DEGS1 data on adult vitamin D status can be compared with results from the German National Health Interview and Examination Survey 1998 (GNHIES98). GNHIES98 was conducted by the Robert Koch Institute between 1997 and 1999; 25(OH)D serum concentrations of 4,030 participants aged between 18 and 79 years were analysed. A comparison of data from GNHIES98 and DEGS1 shows that the women and men who took part in GNHIES98 had somewhat higher serum 25(OH)D concentrations than those who participated in DEGS1: 23.6% of women and 23.7% of men had a deficient vitamin D status in the GNHIES98 study, with 43.2% of women and 42.7% of men showing an adequate status.

Comparisons of serum 25(OH)D concentrations at the national and international level are influenced and complicated by several factors [11]. These include the different methods used by laboratories to determine 25(OH)D, which can lead to different results [11, 17–20]. In order to make studies on vitamin D status in Europe comparable, 25(OH)D serum concentrations were taken from 14 representative studies (n=55,844), including DEGS1, and calibrated against a reference method using a standardised protocol [11, 21–23]. This was done within the framework of a project funded by the EU (ODIN

– Food-based solutions for optimal vitamin D nutrition and health through the life cycle). After standardisation, 44.0% of the participants of DEGS1 (44.3% of women and 43.7% of men) were found to have an adequate vitamin D status, whereas 15.2% (14.7% of women and 15.7% of men) had a deficient vitamin D status [11, 24]. An overall pooled estimate, which was based on all the participating studies, resulted in a vitamin D deficiency prevalence of 11.7% [11]. Consequently, the average serum 25(OH)D concentrations for the population in Germany are lower than the average calculated for all of the participating countries [11]. The highest average serum 25(OH)D concentrations were observed in Finland, presumably due to the increased fortification of foods with vitamin D in this country.

Vitamin D status is subject to strong seasonal fluctuations.

In summary, our analyses demonstrate a suboptimal vitamin D status among adults in Germany. In order to counter vitamin D deficiency, especially in the darker months, current recommendations suggest exposing the face, hands and arms to the sun two to three times a week between March and October for some time without the use of sunscreen [25]. In order to enable an adequate level of vitamin D synthesis, the skin needs to be exposed to the sun for about half of the amount of time that would normally lead to sunburn. Since skin redness and sunburn should be strictly avoided, protection is required if the skin is exposed to the sun for longer periods [25].

The German Nutrition Society recommends vitamin D supplementation for adults, only in certain circumstances: in cases of evident vitamin D deficiency; and in cases where an improved vitamin D status cannot be achieved via endogenous synthesis or diet [26]. This is particularly the case with the risk groups for vitamin D deficiency as mentioned in the introduction [12].

Note

This fact sheet is based on the chapter on vitamin D published in the 13th Nutrition Report of the German Nutrition Society (DGE) [11].

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Cooking frequency in Germany

Abstract

The growing range of ready-to-cook and ready-to-eat foods (convenience foods) and opportunities to eat outside of the home is tending to reduce the number of fresh meals that people prepare themselves. However, people continue to place great importance on preparing their own meals from fresh foods, as this provides them with greater influence over the quality and composition of the food they eat. The German Health Interview and Examination Survey for Adults (DEGS1, 2008–2011) observed that 50.8% of adults aged between 18 and 79 (61.4% of all women and 40.2% of all men) prepare their meals daily or almost daily from fresh food. Moreover, women report less often that they never cook (2.9%) than men (16.1%) and older participants report far more often to cook daily or almost daily than younger participants. Finally, among both genders is a low level of employment associated with an increased cooking frequency.

NUTRITION · COOKING HABITS · HEALTH SURVEY · DEGS1 · GERMANY

A total of 50.8% of adults prepare their meals from fresh food every day or almost every day.

Introduction

A balanced diet is important to maintain and improve health. Numerous studies show that diet plays a significant role in the development of many 'diseases of affluence' such as obesity and diabetes [1]. Cooking habits may have a significant impact on people's diets [2]. Therefore, an understanding of cooking habits in Germany could help develop approaches that would improve healthy nutrition promotion. Changes in society, to people's living conditions and developments in the food sector are bringing people to eat more often convenience products and foods outside of their home [3, 4]. In today's society, people expect food to be constantly available and easily accessible [5]. However, such products significantly reduce the influence that consumers have over the quality and composition of the foods they eat [6]. Moreover, many highly processed convenience foods have a relatively low protein contents and high levels of carbohydrates and fats [7].

The preparation of (warm) meals not only helps people understand more about the composition of foods, but also about the ingredients and the implications these have on their health. People who cook more often tend to engage more with issues related to food and preparing them. Consequently, studies demonstrate a positive correlation between a person's knowledge about food and the quality of their diet: the more someone knows about healthy eating, the more often they eat nutritionally preferable foods such as fruit and vegetables [8–10]. Nevertheless, putting dietary recommendations into practice strongly depends on a person's living conditions and their economic situation.

Indicator

The German Health Interview and Examination Survey for Adults (DEGS1), which was conducted by the Robert Koch Institute between 2008 and 2011, gathered data on the frequency of cooking in people aged 18 to 79 [11]. The study participants were asked to complete a self-administered food frequency questionnaire that included the following question: 'How many times per week do you prepare a hot meal (lunch or supper) yourself using basic ingredients/fresh foods?' The possible answers were grouped into three categories: 'every day/almost every day', '1 to 4 times a week', and 'never'. A total of 6,956 participants provided information about how often they cook, and this data was statistically analysed. The following describes cooking frequencies according to gender, age, education and employment status.

The information on educational status was categorised using the CASMIN index (Comparative Analysis of Social Mobility in Industrial Nations). This index reflects the various levels present within the education system and takes into account the differences between vocational training and general educational pathways [12]. The participants' employment status at the time of the survey was grouped into four categories: 'full-time employment or training', 'part-time or marginal employment', 'unemployed or rarely in employment', and 'retired/pensioner'.

Reflection of the results

According to DEGS1, 50.8% of adults in Germany prepare their warm meals every day or almost every day from fresh, basic ingredients (Table 1). The proportion of women who report this is significantly higher (61.4%) than the proportion of men (40.2%). In contrast, men report significantly more often that they never cook (16.1%) than women (2.9%). Still, 35.6% of women and 43.7% of men prepare their meals at least 1 to 4 times a week. Similar differences in cooking behaviour between men and women were observed in a study conducted

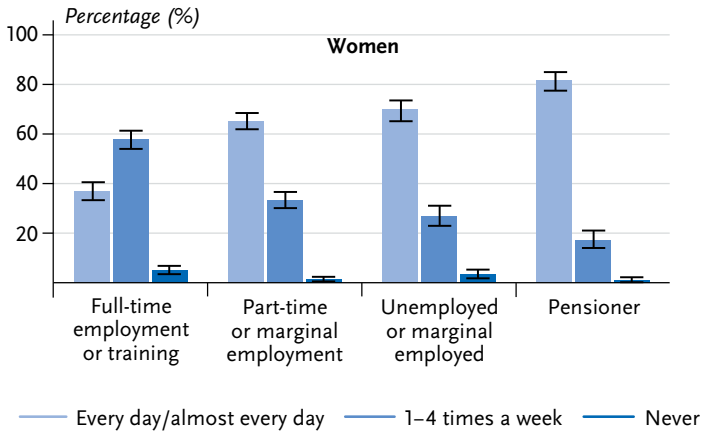
The proportion of women who cook every day or almost every day (61.4%) is much higher than the proportion of men who do so (40.2%).

					Age
	18–29 years	30–44 years	45–64 years	65–79 years	Total
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Women	**n=535**	**n=743**	**n=1,455**	**n=903**	**n=3,636**
Every day/almost every day	39.9 (34.6–45.5)	57.8 (53.5–61.9)	63.0 (59.8–66.1)	81.9 (77.7–85.5)	61.4 (59.1–63.8)
1–4 times a week	53.0 (47.7–58.1)	39.7 (35.8–43.7)	35.0 (32.0–38.2)	16.7 (13.2–20.8)	35.6 (33.4–37.9)
Never	7.1 (4.6–10.9)	2.6 (1.4–4.5)	1.9 (1.2–3.1)	1.4 (0.8–2.6)	2.9 (2.2–3.8)
Men	**n=512**	**n=663**	**n=1,255**	**n=890**	**n=3,320**
Every day/almost every day	31.0 (26.1–36.5)	34.7 (29.6–40.2)	39.0 (35.4–42.7)	60.6 (55.5–65.4)	40.2 (37.8–42.7)
1–4 times a week	52.5 (47.4–57.6)	51.2 (46.2–56.2)	44.2 (40.4–48.0)	22.3 (18.6–26.5)	43.7 (41.7–45.7)
Never	16.4 (13.1–20.4)	14.1 (10.7–18.3)	16.8 (14.6–19.3)	17.1 (13.9–21.0)	16.1 (14.3–18.0)

CI=confidence interval

Table 1
Cooking frequency among 18- to 79-year-olds according to gender and age
Source: DEGS1 (2008–2011)

Fig. 1
Preparation of meals by 18- to 79-year-old women according to employment status (n=3,600)
Source: DEGS1 (2008–2011)



on behalf of the Federal Ministry of Food and Agriculture [13]. One reason for these gender-specific differences might be that women place greater emphasis on a healthy diet, and are more likely to be responsible for caring for the family [13, 14].

Alongside gender-specific differences, DEGS1 also demonstrates age-related differences in terms of cooking frequency. Participants in the oldest age group (65–79 years) cook the most often, with 81.9% of women and 60.6% of men in this age group cooking every day or almost every day. This confirms the widespread hypothesis that dietary and cooking behaviour differs considerably between the generations [15, 16]. The age-specific differences in cooking habits could be explained by the fact that older people tend to adhere to more traditional practices and probably also are more health conscious and consequently care more about their diet [10]. Moreover, most people in this age group no longer have to work, which means that they have more time to cook their own food. In contrast, today's younger generation has grown up in a period offering a vast availability of diverse industrially processed convenience foods, and catering services [3, 17]. DEGS1 demonstrates that young women and men consume fast food particularly often compared with older people [18].

Older women and men are proportionately more likely to cook every day or almost every day than younger people.

A low level of employment is also linked to a higher frequency of cooking (Figures 1 and 2). People who are unemployed, in marginal employment and pensioners cook significantly more often every day or almost every day than those who are in full-time employment. This could be because the majority of people in full-time employment have less time available during the day to cook for themselves. This could be reflected in a propensity to eat outside of the home far more often and in a preference for cooking on weekends [5]. Among all age groups, there is a tendency, for both women and men with a low education level to cook more often every day or almost every day then those with a medium or higher level of education. However, these differences are not statistically significant (Table 2).

Fig. 2
Preparation of meals by 18- to 79-year-old men according to employment status (n=3,303)
Source: DEGS1 (2008–2011)

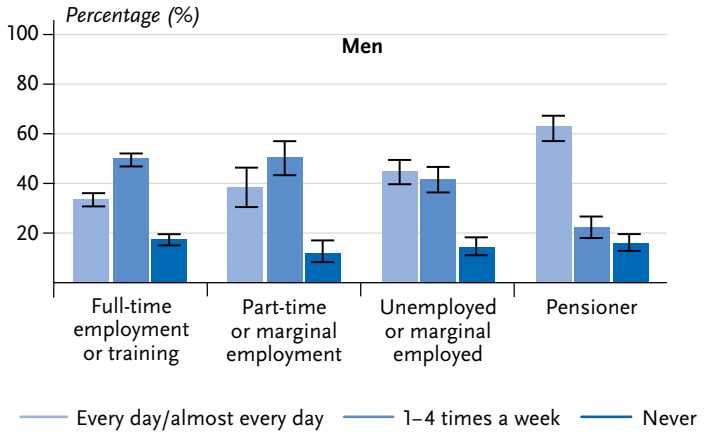


Table 2
Cooking frequency among 18- to 79-year-olds according to gender, age and educational level (n=3,614 women, n=3,302 men)
Source: DEGS1 (2008–2011)

		Educational level		
		Low	Medium	High
		% (95% CI)	% (95% CI)	% (95% CI)
Women		**n=1,175**	**n=1,878**	**n=561**
Age				
18–29 years	Every day/almost every day	47.8 (34.3–61.6)	38.8 (31.9–46.1)	38.3 (23.4–55.8)
	1–4 times a week	41.5 (28.0–56.4)	54.9 (48.0–61.7)	54.1 (39.2–68.4)
	Never	10.7 (5.1–21.2)	6.3 (4.1–9.6)	7.6 (2.1–23.6)
30–44 years	Every day/almost every day	69.7 (60.8–77.3)	55.4 (49.2–61.5)	53.4 (43.8–62.8)
	1–4 times a week	28.2 (20.6–37.4)	42.7 (36.9–48.7)	43.6 (35.1–52.4)
	Never	2.1 (0.6–7.2)	1.9 (0.9–3.8)	3.0 (0.8–10.4)
45–64 years	Every day/almost every day	69.7 (64.3–74.6)	59.1 (54.9–63.1)	58.5 (50.5–66.1)
	1–4 times a week	28.3 (23.6–33.6)	38.9 (34.9–43.0)	40.6 (33.1–48.6)
	Never	2.0 (1.0–4.0)	2.1 (1.0–4.3)	0.9 (0.3–2.4)
65–79 years	Every day/almost every day	83.1 (78.4–87.0)	80.8 (73.2–86.6)	76.6 (62.0–86.8)
	1–4 times a week	15.1 (11.5–19.6)	18.3 (12.6–26.0)	23.4 (13.2–38.0)
	Never	1.7 (0.9–3.5)	0.9 (0.2–3.5)	–
Men		**n=1,067**	**n=1,485**	**n=750**
Age				
18–29 years	Every day/almost every day	33.5 (23.2–45.6)	32.3 (26.5–38.7)	16.5 (8.2–30.5)
	1–4 times a week	43.0 (31.8–55.0)	51.9 (45.8–58.1)	74.9 (59.7–85.7)
	Never	23.5 (15.1–34.6)	15.7 (11.7–20.8)	8.6 (2.9–22.8)
30–44 years	Every day/almost every day	38.4 (27.5–50.6)	34.2 (28.2–40.7)	30.9 (22.6–40.7)
	1–4 times a week	45.4 (34.9–56.4)	53.9 (47.4–60.2)	51.0 (41.1–60.7)
	Never	16.1 (9.7–25.7)	11.9 (8.4–16.7)	18.1 (12.5–25.5)
45–64 years	Every day/almost every day	41.1 (35.2–47.3)	37.7 (32.6–43.1)	37.9 (31.2–45.1)
	1–4 times a week	41.9 (35.9–48.2)	45.3 (39.8–50.9)	45.8 (39.3–52.5)
	Never	17.0 (13.2–21.5)	17.0 (13.9–20.7)	16.3 (11.6–22.4)
70–79 years	Every day/almost every day	60.9 (54.4–67.0)	61.3 (51.1–70.5)	58.9 (49.5–67.7)
	1–4 times a week	20.9 (16.1–26.8)	25.1 (16.9–35.5)	23.7 (17.0–32.1)
	Never	18.2 (13.9–23.3)	13.7 (8.5–21.3)	17.3 (10.9–26.4)

CI = confidence interval

A higher proportion of pensioners and people who are only in marginal employment cook every day or almost every day than those in full-time employment.

Further targeted studies are needed to accurately assess cooking habits and their impact on dietary behaviour and health. The basic ingredients used and the way in which a meal is prepared may be more important for health than mere cooking frequency [19]. Nevertheless, consumers who do cook have more influence over the type of food they eat and may find it easier to implement health recommendations, such as reducing salt levels. Moreover, people who regularly cook their own meals are more knowledgeable when it comes to handling food and often have better cooking skills. Another study observed that cooking abilities, particularly among people with lower socio-economic statuses, played a significant role in enabling these individuals to maintain a healthy diet [2]. Measures aimed at increasing cooking frequency, therefore, could presumably play a role in improving the population's dietary habits.

Note

This fact sheet is based on the chapter "Cooking frequency in association with food consumption among adults in Germany" that appeared in the German Nutrition Society's 13th Nutrition Report [14].

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